

# HOW FORMAL STRUCTURE OF ELECTRONIC KNOWLEDGE SHARING NETWORKS INFLUENCES PARTICIPATION BEHAVIOR IN A GLOBAL ENTERPRISE

*Completed Research Paper*

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## **Abstract**

*The literature on organizational electronic knowledge sharing networks depicts the networks as self-organizing and self-sustaining, comprised of volunteers. Rarely does the literature examine them embedded in formal structures of the organization. Yet, in global enterprises, there is a real challenge to ensure that experts continue to dedicate time to participate in the networks despite of many demands on their time and despite of being distant and geographically isolated from the other network members. To maintain sustained participation, the firms no longer rely solely on the voluntary nature of the sharing activity, but rather integrate the networks in the formal structures of the organization. Grounding our study in motivation theories, we examine how the formal structure impacts participation and how does the geographical distance from other members and the geographical diversity of the network moderate this relationship? By analyzing posted inquiries and contributed responses in over 100 different knowledge sharing networks in a global company, we show that embedding network in the formal structure is a double edged sword. On one hand, formal structure increases participation of members within the structure. On the other hand, formal structure seems to have little impact on those not part of the formal structure. One key implication is that organizations need to give special consideration to the size of the formal and informal aspects of the electronic knowledge sharing networks.*

## Introduction

Electronic knowledge sharing networks are enabled by information and communication technology and promote organizational knowledge sharing across disparate units, functions and locations that otherwise would be unlikely to share knowledge because of the geographical distance and dispersion of the knowledge workers in the global organization (Alavi and Leidner 2001; Goodman and Darr 1998; He and Wei 2009). Electronic networks facilitate peer-to-peer based sharing as well as codification of employees' private knowledge that can be searched and referenced over time for the firm's sustained performance.

Participation in such networks, however, poses demands on the employees who need to take time and effort out of their work routines. To sustain participation over time, organizations such as Fluor, Pfizer, and ConocoPhillips have integrated their networks with the formal organizations (organizational hierarchy and authority) essentially making the networks part of what the knowledge workers are expected to do as part of their daily jobs (e.g., Gray and Ranta 2010; McDermott and Archibald 2010). The networks have "specific goals, explicit accountability, and clear executive oversight" (McDermott and Archibald 2010, p. 84). When networks are part of the formal organization, employees are more likely to consider participation in the network as a responsibility or an obligation (Foss 2007; Foss et al 2009). The formal structures not only instill responsibility, but also provide managerial supervision. As such, an employee is more likely to share knowledge if his or her line manager is also part of the knowledge sharing network. Besides providing responsibility and managerial supervision, the formal structures can also help to ensure that knowledge sharing is aligned with the goals of the company (Roberts et al 2006).

Despite this corporate reality of the wide-spread use of formal structures in knowledge sharing networks, we have little understanding of the question: *how does the formal structure influence participation in electronic knowledge sharing networks?* One reason for our lack of understanding is that much of the existing academic literature on electronic knowledge sharing networks describes such networks as informal and autonomous, and free of formal control (Wasko et al 2004). The networks are comprised of "volunteers" who participate based on their own choice, and with no limits except access to and the proficiency with the technology. Knowledge sharing in electronic knowledge networks is conceptualized as pro-social and extra-role behavior (Olivera et al 2008; Wasko and Faraj 2005; Wasko et al 2004). The view of knowledge sharing as an autonomous activity of an employee prevails in the larger knowledge sharing literature (Brown and Duguid 2000; Gagne 2009; Gray and Meister 2004; Tagliaventi and Mattarelli 2006; Wang and Noe 2010; Wenger, 1998).

By the formal structure of the network, we refer to those individuals who are part of the governance team or directly report to the members of the network governance team, or who report indirectly because their supervisor reports to the governance team. McDermott and Archibald (2010, p. 86) illustrate such a governance team, "At ConocoPhillips, networks report to functional teams, which are responsible for stewarding improvements in specific areas, such as oil and gas production. The functional teams, typically staffed by eight to ten senior managers, have aggressive, measurable goals, like reducing the number of unrecovered barrels of oil." Besides specialists assigned as subject matter experts and others including managers appointed as core members, such networks often have sponsors and champions at higher management levels. In this paper, the governance team and the direct and indirect reports of members of the governance team are considered as part of the formal structure of the network.

While the formal structure helps establish accountability and motivate participation of individuals within the structure, one potential drawback of the formal structure is the lack of functional diversity within the structure. The formal structure of a knowledge sharing network typically belongs to one or a few functional areas that are most closely related to the network. However, the literature on knowledge sharing highlights the importance of functional diversity in knowledge sharing networks (Cummings 2004). It is thus important to assess the relationship between the formal structure and participation behavior of those not in the formal structure. Specially, we consider *how does the formal structure influence participation in electronic knowledge sharing networks by individuals not in the formal structure versus those in the formal structure?*

The literature on global companies also underscores the need for social relationships in facilitating knowledge sharing (Hansen and Lovas 2004; Tsai 2002), but such social relationships are often lacking among members of the electronic knowledge sharing networks as the members are geographically distant from each other. Geographical distance influences knowledge sharing in multiple ways. At the individual level, it makes it more difficult for an individual to develop social relationships with others in the network, thus reducing the individual's motivation for participation. At the network level, geographic distance manifests in the form of network geographic diversity, which increases the potential benefits of knowledge sharing and individuals' motivation to share knowledge (Singh 2005). To what degree the formal structure can overcome the negative impact of geographic distance and enhance the value of geographic diversity is thus an important question for knowledge sharing networks. Hence, one question of great practical and theoretical importance is: *How does individual geographical distance and network geographic diversity influence the effect of formal structure on knowledge participation?*

In summary, there is a need to differentiate between voluntary versus formal nature of the networks. While prior research has mainly focused on voluntary knowledge sharing networks such as "communities of practice", geographically diverse corporate environments deploy formal structures in knowledge sharing networks and the understanding of how individuals in such structures participate warrants research. The research questions collectively can help render important managerial insight in terms of how to establish and foster knowledge sharing in corporations. The rest of the paper is organized as follows: we begin by presenting theoretical background and rationale for the hypotheses. We then describe our empirical study. Results are followed with implications and limitations.

## Theoretical Development and Hypotheses

It is widely accepted that participation in knowledge sharing networks – in the form of knowledge contributions and knowledge inquiries - is fundamentally rooted in an individual's autonomous actions (Gagne 2009; Nonaka and Takeuchi 1995; Osterloh and Frey 2000). Knowledge participation cannot be forced or mandated as knowledge contributions or inquiries require a cooperation of the employee; it is the choice of an employee whether to participate or not (Kim and Mauborgne 1998; Nonaka and Takeuchi 1995). In the information systems (IS) literature, knowledge contributions in distributed organizations are defined as "voluntary acts of helping others by providing information" (Olivera et al 2008, p. 23).

What is also well accepted in the literature is that employee motivation is critical for engaging in the effortful and time consuming knowledge processes (Alavi and Leidner 2001; Goodman and Darr 1998; Malhotra et al 2008; Roberts et al 2006). Motivation is critical in knowledge sharing because such behavior has to overcome various concerns over the accuracy and completeness of the knowledge, the ownership of knowledge, the efficacies with the technology, and the utilization of knowledge (e.g., Cabrera and Cabrera 2002; Gray and Meister 2004; Quigley et al 2007). Motivation is also critical for those posting inquiries as it takes time to formulate questions understandable to wide audiences.

The impediments are particularly high in global companies: will the employee with relevant knowledge reply to a request of an employee in another unit with whom he has no personal ties and no work interdependencies? Will he take the time away from daily tasks to compose a public reply virtually accessible by anyone in the corporation? Will the reply or inquiry be understood by someone with a different background? In electronic knowledge networks of a global company, his reply may be one of many to be integrated into a joint production. Will the contribution be valued? If he chooses not to contribute, it would be virtually impossible to identify whether he is doing so to withhold knowledge or because he is not confident with the quality or completeness of his knowledge. Or perhaps he is not replying because he lacks the necessary efficacy to express the knowledge in a format appropriate for general viewing. Perhaps he is facing multiple deadlines with a much needed focus on other critical matters.

As knowledge has grown increasingly strategic for firm sustained performance (Grant 1996), the challenges that management faces to positively influence employee knowledge participation has grown ever more complex and multifaceted (Foss 2007). One of the key complicating factors is the changing employment relationship with less employee-employer loyalty and less room for prosocial and extra-role

behaviors (Rousseau and Shperling 2003). When corporations establish electronic networks as part of formal structures, how are knowledge participation behaviors of the employees as part of the formal structure different from that of employees not part of the formal structure?

The literature has explored a range of intrinsic, extrinsic, and interpersonal motivations explaining individual behavior in knowledge sharing (Kalman et al 2002; Osterloh and Frey 2000; Roberts et al 2006). Intrinsic motivation “is valued for its own sake and appears to be self-sustained” (Calder and Staw 1975, p. 599). Intrinsic motivation is directed to the activity itself; the activity satisfies needs for competence and autonomy (Constant et al 1996; Osterloh and Frey 2000). Extrinsic, or instrumental, motivations involve obtaining external rewards such as monetary compensation (Ardichvili et al 2003; Goodman and Darr 1998). The reward becomes the goal itself. The interpersonal motivations originate from reciprocity or equity - helping others generate an expectation of future reciprocity (Olivera et al 2008). The reciprocal relationships build on personal relationships that employees have in organizations.

Intrinsic motivations are found to be influential in electronic networks where person-to-person social relationships and reciprocity are weak (Constant et al 1996; Kankanhalli et al 2005; Wasko and Faraj 2005). Roberts et al (2006) argue that intrinsic motivation alone might not be sufficient, and may even lead to detrimental outcomes, in corporate settings where there are many risks in knowledge sharing activities that are not aligned with the goals of the company. Although extrinsic motivations can increase knowledge sharing to be aligned with the organizational goals (Roberts et al 2006), external rewards can also crowd out intrinsic motivation (Gu and Jarvenpaa 2003; Osterloh and Frey 2000).

Yet, the knowledge sharing literature in information systems largely reports a positive role of external influences although more so in the context of knowledge contributions than knowledge inquiries (He and Wei 2009). Bock et al (2005) found a positive effect of subjective norms on sharing behaviors. King and Marks (2008) found supervisory control to significantly increase the frequency of employee knowledge sharing. Kulkarni et al (2006-7) found a positive impact of supervisor and coworker support on perceived usefulness of knowledge sharing. However, others suggest that too strong external influences build resistance (Galletta et al 2002; Malhotra et al 2008).

Beyond the dichotomy of extrinsic and intrinsic is endogenous motivation. Roberts et al (2006) and Malhotra et al (2008) suggest that little researched endogenous motivation, or internalized extrinsic motivation, may in fact play a key role in organizational knowledge sharing networks. Endogenous motivation results from combinations of perceived external influences and personal volition. Employees engage in knowledge sharing because of the personal benefit such as enhanced status and career opportunities. Although status and career opportunities are extrinsic, employees “internalize these motivations so that they are self-regulated rather than externally imposed” (Roberts et al 2006, p. 985). The psychological feelings of autonomy, conflict, and external pressure all operate concurrently in endogenous motivation (Malhotra et al 2008).

Deci and Ryan (1985 and 1991) argue that people can be motivated to internalize the external pressures even when they have initially been hesitant to engage in the activity. Internalization can be in a form of identified or introjected motivation. Identified motivation focuses on the importance of the activity in achieving goals personally valued by the employee. Identified motivation may operate through feelings and thoughts such as “valued employees share their knowledge wherever they can.” Introjected motivation involved transforming an external pressure into internal regulation, not as a personal value but something that “one should do” (Koestner et al, 1996, p. 1025). Introjected motivation is experienced as an approval-based pressure. Individuals motivated by introjections are concerned with maintaining their status and image, and enhancing their feelings of worth and career opportunities in the organization (Foss et al 2009; Roberts et al 2006). Introjected motivation can also engender guilt, obligation, and stress. Nevertheless, both identified and introjected forms of endogenous motivation still preserve the ultimate choice of the individual to participate or not to participate that is argued to be fundamental in knowledge sharing (Osterloh and Frey 2000).

We hypothesize that those employees part of the formal structure of the network participate more – make more knowledge contributions and inquiries – than those outside of the formal structure of the network. The former experiences higher endogenous motivation, particularly higher introjected motivation. Formal

structures are perceived as more permanent and durable than informal organization structures (Bell and Zaheer 2007). Hence, an employee who is part of the formal structure is likely to internalize stronger external influences and have feelings and thoughts that are more enduring and continuous than an employee who is not part of the formal structure. Those who contribute without ties to the formal structure may experience identified motivation but not introjected motivation at the level of those part of the formal structure. Following Malhotra et al (2008, p. 268), we argue that it is “collections of motivations” that influence behavior.

*H1: Individuals who belong to the formal structure participate more than individuals who do not belong to the formal structure.*

As knowledge sharing networks consist of members who are part of the formal structure and those out of the formal structure, we theorize that people align themselves along these structures and thereby creating subgroups (Lau and Murnighan 1998). The electronic knowledge sharing networks are governed by functional areas in the global organization and members do or do not report up to these functional groups. The functional groups that govern the networks are often identified and displayed as part of the network site. Even when the network is owned by multiple functions, those functions are related in terms of some discipline, specialization, and departmentalization. So, those parts of the formal structure share a functional area characteristic. Members who share this functional area characteristic are likely to view themselves as part of the same subgroup and be influenced more by the behavior of those sharing this same functional area characteristic than by those who do not share this characteristic.

Those employees not part of the formal structure share this characteristic with others not part of the formal structure. Recognizing themselves not being part of the formal structure also provides a base for group identification. Those who view themselves as part of the same subgroup are more influenced by the behavior of someone in the same subgroup than in a different subgroup (Lau and Murnighan 1998). The rationale is based on influences that arise from cognitive categorization that builds on sharing a membership in a social category “ingroup” versus “outgroup” (Brewer and Brown 1998). The behavior of someone else in the same “in-group” of a network is likely to be internalized more than the behavior of someone not perceived to be part of the “in-group.”

*H2a: when the individual is part of the formal structure of the network, participation by members of the formal structure has a greater influence on individual knowledge participation than when the individual is not part of the formal structure of the network.*

*H2b: when the individual is not part of the formal structure of the network, participation by members out of the formal structure has a greater influence on individual knowledge participation than when the individual is part of the formal structure of the network.*

Whereas some argue that information and communication technology has practically eliminated the effects of geographic distance (Cairncross 1997), the prevailing finding is that geographic distance decreases knowledge flows (e.g., Bell and Zaheer 2007). For example, Majchrzak and Jarvenpaa (2010) found significant demotivating impacts on sharing from even relatively short driving distances. Further research on the relationship between geographic distance and knowledge sharing reveals that geographic distance itself doesn't limit knowledge sharing (Singh 2005). However, geographic distance limits individuals' ability to form inter-personal relationship which drives knowledge sharing. Formal structure provides a way to overcome this hurdle. As such, geographic distance has a less negative impact on knowledge sharing of those in the formal structure than those out of the formal structure. We thus theorize that the relationship between the formal structure and participation is moderated by the geographic distance of an employee from the other members in the network.

*H3: When the individual is geographically distant from the other members in the network (as opposed to when the individual is geographically close to the other members in the network), individuals who do belong to the formal structure participate more than those who do not belong to the formal structure.*

An aspect that might weaken the effect of formal structure on participation is the geographic diversity of the network. Galletta et al (2002) found that perceived value of the knowledge sharing activity itself influences knowledge contributions. Individuals assess the value of knowledge sharing before participating. A factor that can affect such evaluation is geographic diversity (Bell and Zaheer 2007). As the network members are dispersed across different locations, they bring with them unique localized knowledge (Cummings 2004). As geographic diversity of the network increases, so should the value of the network to its participants. Higher the geographic diversity in the network, more the employee may find the activity satisfying in its own right and have a sense that the contribution adds value because it offers a unique localized perspective and enhances what is contributed and inquired by others. The aforementioned motivation is especially strong for network members who are not part of the formal organization. For members who are part of the formal organization, their contribution is more driven by the sense of obligation, self-esteem and image reasons and hence are less strengthened by the concerns of providing unique information to the network.

*H4: When the geographic diversity of the network is high, individuals who do not belong to the formal structure participate more than those who do belong to the formal structure.*

## **Empirical Analysis**

### ***Research Context***

We investigate our research questions in the context of internal knowledge sharing networks at a global Fortune 500 company. The company has over 20,000 employees located in more than 30 countries. The company has long recognized the value of enterprise-wide knowledge sharing within and across business units to generate cost savings and productivity gains. Its knowledge sharing strategy has three key elements: 1) A dedicated and highly visible knowledge sharing unit within the corporate planning and strategy group. The unit manages all aspects of the enterprise knowledge sharing effort and directly reports to the head of corporate planning and strategy group. 2) A rigorous approval process for the establishment of knowledge sharing networks. Each network is required to be sponsored by one or more functional groups that are aligned with business units and must demonstrate a clear business case with support from leadership. In addition, each network must lay out a set of deliverables in service to the business, at both the global and the regional level. Over time, the company has established more than 100 knowledge sharing networks. 3) A network governance structure that explicitly designates a network governance team that includes “sponsors”, “leaders”, “core members” and “subject matter experts” for each network. The governance structure plays a key role in cultivating knowledge participation within the company and our research focus is on understanding how the formal structure influences individual participation in the knowledge sharing network.

### ***Data***

We obtain data on member characteristics and knowledge sharing activities in every knowledge sharing network since its inception until April 2010. We also obtain member activity data for May and June 2010 that allows us to identify member participation in the networks. This natural split of data allows us to develop a longitudinal model that uses the data before April 2010 to predict member participation in May and June 2010. Member characteristics include each member’s role in both the formal organization and the knowledge sharing networks. They contain member name, business unit, location, position, reporting relationship, network role and date when he first joined the network. As we mentioned above, an important aspect of the network sharing is that the company designates specific network leadership roles to members in each knowledge sharing network. Table 1 reports the percentage of “sponsors”, “leaders”, “core members”, “subject matter experts”, and “members” in all communities. Overall, 2 percent of the members in a community are sponsors or leaders, 7 percent are core members, 2 percent are subject matter experts and the remaining 88 percent are members.

	Frequency	Percent
Sponsors	279	0.86%
Leaders	373	1.14%
Core Members	2340	7.18%
Subject Matter Experts	811	2.49%
Member	28791	88.33%

Our data also reveal significant variations in the size and characteristic of knowledge sharing networks. Some communities involve thousands of employees across multiple continents while others involve a few co-located employees. Table 2 reports basic network characteristics of the knowledge sharing networks. It shows that an average knowledge sharing network has about 200 registered members, 2 sponsors, 12 subject matter experts, and 17 core members. We also find that most of the communities are geographically and organizationally diverse. On average, a knowledge sharing network involves members from 10 countries and 22 business units.

	Mean	Std Dev	Min	Max
Average Number of Members	198.74	226.58	1	1825
Average Number of Sponsors/Leaders	2.48	1.69	1	12
Average Number of Core Members	17.08	15.78	1	103
Average Number of Subject Experts	12.48	17.26	1	82
Average Number of Countries Members Represent	10.64	6.68	1	29
Average Number of Business Units Members Represent	21.51	11.92	1	61

### ***Empirical Model***

To assess the influence of formal structure on individual participation, we leverage the longitudinal nature of the data. The longitudinal nature of the data allows us to control for a member's intrinsic motivation by controlling for his past participation in the knowledge sharing network. Further, we note that a well-known problem of informal networks is the declining participation over time (McDermott and Archibald 2010). Thus, an important question to investigate is how formal structure influences members' continuous participation in the networks. To assess the question, we develop a logistic regression model that analyzes how an individual's past participation, their network roles and positions influence his continuous knowledge participation in the future.

### **Dependant Variable**

The dependent variable of our analysis is individual continuous participation in a given knowledge sharing network in May 2010 and June 2010. We differentiate two types of participation: knowledge contributions and knowledge inquires. Within each type of participation, we construct two measures. The first measure is a dummy variable that takes the value of 1 if a member continues to participate in the network and 0 otherwise. The second measure is the average monthly inquiries or contributions during

the later period. We use separate regression models for the analysis. Table 3 indicates that a given member has a 1.5% chance of making an inquiry in May and June 2010 with an average frequency of 0.012 inquiries per month, and 3.9% chance of making a contribution in May and June 2010 with an average frequency of 0.046 contributions per month.

### Independent Variables

We consider the following independent variables.

*Individual Past Participation:* An individual's past participation in the community is measured as the average monthly inquiries or contributions made by the individual during the 6-month period between September 2009 and March 2010. Table 3 shows that the average contribution rate is 0.035 per month while the average inquiry rate is 0.012 per month.

*Formal Structure:* We identify the formal structure of each knowledge sharing network as the network governance team and members who report directly or through his chain of command to a member of the network governance team. We use a dummy variable to identify a member's status of being part of the formal structure of the network. The variable takes the value of 1 if the member is part of the formal structure and value 0 otherwise. We note that the motivation of the network governance team could be different from their subordinates as they have accepted official network leadership roles with explicit obligations. It is also these leaders who are recognized in annual award ceremonies celebrating the best performing networks. Thus our analysis focuses on their subordinates (network members) who do not have official leadership roles. Table 3 shows that these subordinates account for about 7% of total network members.

*Participation of Members in and out of the Formal Structure:* We distinguish between participation of members in the formal structure from those out of the formal structure. We again measure participation using the average monthly inquiries and contributions made per member. Table 3 shows that members in the formal structure participate more in the knowledge sharing network both in terms of contributions provided and inquiries posted. On average, members in the formal structure post 0.029 inquiries and provide 0.063 responses per month while members out of the formal structure post 0.016 inquiries and provide 0.042 responses per month.

*Individual Geographic Distance:* We measure individual geographic distance in a knowledge sharing network as the average distance between a member and all other members in the community. We identify the longitude and latitude of every member location and use geographic software to calculate the direct distance (in miles) between a given member and all other members in the community. We then use the log value to control for skewness in the distribution of the distance variable. The distance measure is an individual level variable that varies for each individual in a community. Table 3 shows that the average distance between a member and others in the community is 8.120, indicating an average distance of 3361 miles.

*Network Geographic Diversity* We measure geographic diversity of a network using the entropy measure (Cummings 2004). We identify the percentage of members at each location for a given knowledge sharing network and use the following equation to calculate the measure:  $Network\ Geographic\ Diversity = \sum (percentage * \ln(1/percentage))$ . The entropy measure takes the value of 0 when all members are co-located at one location and positive value when network members are distributed across more than one location. The geographic diversity is a network level variable. Table 3 shows that the average geographic diversity is 2.774, equivalent to equal distribution of employees over 16 different locations.

### Control Variables

Extant studies suggest that culture and tenure could have a significant influence on individual contribution in knowledge sharing networks. To control for the influence of culture and tenure, we include three groups of control variables in the regression model.

*Regions:* We include a series of dummy variables for each member's region. The company designates eight regions for their operation: Asia Pacific, Alaska, Canada, Europe and West Africa, Lower 48 States,



Middle East and North Africa, Russia and Central Asia, and Others Regions. We create a dummy variable for each region to control for region and culture influence.

*Culture:* To further control for the influence of culture, we also include the cultural dimensions of Hofstede (1991) in our analysis. In particular, four of the five dimensions identified by Hofstede: Power Distance, Individualism, Masculinity, Uncertainty Avoidance, are likely to be associated with individual contribution to knowledge sharing network.

*Tenure:* Tenure is measured as time passed since a member first joined a knowledge sharing network. We take the log value of tenure to control for possible non-linearity in the influence of tenure.

<b>Table 3. Summary Statistics</b>				
	Mean	Std Dev	Min	Max
<i>Dependent Variables</i>				
Future Contributions (Dummy)	0.039	0.194	0	1
Future Contributions (Monthly)	0.046	0.323	0	23
Future Inquiries (Dummy)	0.015	0.123	0	1
Future Inquiries (Monthly)	0.012	0.168	0	22
<i>Independent Variables</i>				
Past Contribution Rate	0.035	0.172	0	5
Past Inquiry Rate	0.012	0.123	0	17.83
Formal Structure Without Leadership Role (Dummy)	0.075	0.264	0	1.00
Contribution Rate in the Formal Structure	0.063	0.105	0	1.86
Inquiry Rate in the Formal Structure	0.029	0.051	0	0.54
Contribution Rate out of the Formal Structure	0.042	0.057	0	0.54
Inquiry Rate out of the Formal Structure	0.016	0.024	0	0.17
Individual Geographic Distance (log value)	8.120	0.682	0	9.73
Network Geographical Diversity	2.774	0.735	0	4.01
<i>Control Variables</i>				
Power Distance	59.824	22.731	11	104
Individualism	47.844	34.430	14	90
Masculinity	57.537	10.929	8	95
Uncertainty Avoidance	43.085	11.148	8	92
Tenure (log value)	6.235	0.754	3.37	7.56

## Results

### *Knowledge Contribution*

Participation in knowledge sharing networks is examined in the form of knowledge contributions and knowledge inquiries. We start with our analysis on individual contribution to knowledge sharing

networks. We take a step-wise approach by first considering the impact of being part of formal structure but without leadership role on a member’s continuous contribution. Column 1 and 2 of Table 4 reports the result. The result shows that being in the formal structure significantly increases individuals’ probability of continuing contribution to the knowledge sharing network, supporting Hypothesis 1. The coefficient indicates that an individual’s likelihood of continuous contribution increases by 74% if they are part of the formal structure. The result also shows that being in the formal structure increases individuals’ average monthly contribution rate by 0.05 postings. Given the average monthly contribution rate of 0.046 (Table 3), the result suggests that being in the formal structure doubles the amount of contribution from employees. Our analysis also reveals that a member’s tenure with the community has a significant impact on his continuous contribution to the network. Column 1 also shows that none of the Hofstede (1991) culture dimensions are significant and the coefficients are close to zero. We therefore remove the culture control variables in the subsequent analysis.

We next analyze how others’ contribution behavior in knowledge sharing networks influence individual contribution. Our hypotheses suggest individuals are more influenced by others in the formal structure when they are part of the formal structure while they are more influenced by others out of the formal structure when they are out of the formal structure. To test the hypotheses, we include the average contribution rate of members in the formal structure and that of members out of the formal structure in the regression. We then add the interaction terms between a member’s formal structure status and the contribution rates of the two groups of members. Column 3 and 4 of Table 4 reports the result. The result indicates that members in the formal structure are, surprisingly, more influenced by contribution behavior of others out of the formal structure than those within the formal structure. This result rejects Hypothesis 2a. At the same time, our result also indicates that members out of the formal structure are more significantly influenced by others out of the formal structure than by members in the formal structure. The result supports Hypothesis 2b.

To consider the influence of individual geographic distance on the relationship of formal structure and contribution, we add the interaction term between individual geographic distance and his formal structure status to the regression model. Column 5 of Table 4 reports the results. Our analysis shows that individuals who are geographically distant from other members in the network are less likely to participate in the network. However, such trend differs systematically for those within the formal structure and those out of the formal structure. Individual geographical distance has a stronger negative effect on those out of the formal structure than those within the formal structure, indicating that the formal structure mitigates the negative influence of geographic distance. The result supports Hypothesis 3.

To assess the moderation effect of the network geographic diversity on the relationship of formal structure and contributions, we add the interaction term between network geographic diversity and an individual’s formal structure status to the regression model. Column 6 of Table 4 shows that geographic diversity generally has a positive impact on individuals’ participation in the knowledge sharing network. The effect again differs systematically for those in the formal structure and those out of the formal structure. Network geographic diversity has a more positive impact for individuals out of the formal structure than those in the formal structure. This result is in support of Hypothesis 4.

**Table 4. The Impact of Formal Structure on Individual Contribution Behavior**

	(1)	(2)	(3)	(4)	(5)	(6)
Individual Past Contribution Rate	4.26*** (0.14)	0.61*** (0.01)	4.97*** (0.15)	1.55*** (0.01)	4.94*** (0.15)	1.55*** (0.01)
Within Formal Structure	0.74*** (0.09)	0.05*** (0.08)	0.57*** (0.13)	-0.01 (0.01)	-0.20 (1.29)	-0.10 (0.11)
Out of Formal Structure * Contribution Rate within Formal Structure			-0.16 (0.32)	-0.07** (0.03)	-0.06 (0.32)	-0.07** (0.03)
Out of Formal Structure * Contribution Rate out of Formal			5.63***	0.28***	5.27***	0.25***

Structure			(0.61)	(0.07)	(0.63)	(0.06)
Within Formal Structure * Contribution Rate within Formal Structure			1.14** (0.47)	0.10 (0.07)	1.26*** (0.48)	0.09 (0.07)
Within Formal Structure * Contribution Rate out of Formal Structure			3.29*** (0.79)	0.55*** (0.10)	3.34*** (0.79)	0.57*** (0.10)
Out of Formal Structure * Individual Distance					-0.49*** (0.07)	-0.01** (0.01)
Within Formal Structure * Individual Distance					-0.34** (0.17)	0.01 (0.02)
Out of Formal Structure * Network Geographic Diversity					0.59*** (0.07)	0.01*** (0.00)
Within Formal Structure * Network Geographic Diversity					0.34** (0.17)	-0.03** (0.02)
Power Distance	-0.01 (0.01)	-0.01 (0.01)				
Individualism	0.00 (0.01)	0.00 (0.01)				
Masculinity	0.00 (0.01)	0.00 (0.01)				
Uncertainty Avoidance	0.00 (0.00)	0.00 (0.00)				
Tenure (log)	0.47*** (0.05)	0.02*** (0.00)	0.17*** (0.05)	0.01* (0.00)	0.18*** (0.05)	0.01* (0.00)
Region Fixed Effect	Included	Included	Included	Included	Included	Included
Number of Observations	22605	22605	30697	30697	30466	30466
R-square		21.00%		33.82%		33.90%
-2 Log Likelihood	7372.497		7722.297		7614.029	

### ***Inquiries***

In the above subsection, we consider how formal structure influences individual continuous contributions to the knowledge sharing network. In this subsection, we analyze the impact on an individual's future knowledge inquiry. We use the same empirical model except that the dependent variable and the independent variables are replaced with variables on knowledge inquiry behavior. The result of the analysis is reported in Table 5 and is largely consistent with our analysis on individual contribution behavior. In particular, we find that individuals in the formal structure post more inquiries than those out of the formal structure, supporting H1. We also find the influence between individuals out of the formal structure and those in the formal structure varies with the dependent variable used for the analysis. The analysis shows that individuals out of the formal network are always more influenced by their peers than those in the formal networks. On the other hand, individuals in the formal network are more influenced by those out of the formal network in terms of their participation propensity but more influenced by those in the formal network in terms of their participation level. The finding provides partial support to H2a and full support to H2b. The influence of individual distance from others in the network also varies systematically for those in the formal structure and those out of the formal structure. The analysis suggests that individuals in the formal structure are more likely to initiate knowledge inquiry with the

increase of geographic distance while those out of the formal structure are less likely to initiate knowledge inquires with the increase of geographic distance, in support of H3. Finally, the analysis reveals that geographic diversity of the network influences those in the formal structure and those out of the formal structure differently. Those out of the formal structure increases their inquires with the increase of geographic diversity while those in the formal structure are not influenced by the increase in geographic diversity, supporting H4.

**Table 5. The Impact of Formal Structure on Individual Inquiry Behavior**

	(1)	(2)	(3)	(4)	(5)	(6)
Individual Past Inquiry Rate	7.84*** (0.30)	0.24*** (0.01)	7.22*** (0.30)	0.23*** (0.01)	7.19*** (0.30)	0.23*** (0.01)
Within Formal Structure	0.75*** (0.14)	0.02*** (0.00)	0.75*** (0.14)	0.02*** (0.00)	0.75*** (0.14)	0.02*** (0.00)
Out of Formal Structure * Inquiry Rate within Formal Structure			2.69*** (0.71)	0.10*** (0.02)	2.76*** (0.70)	0.10*** (0.02)
Out of Formal Structure * Inquiry Rate out of Formal Structure			9.77*** (1.57)	0.27*** (0.04)	10.00*** (1.55)	0.27*** (0.04)
Within Formal Structure * Inquiry Rate within Formal Structure			4.17*** (1.30)	0.56*** (0.05)	4.91*** (1.53)	0.57*** (0.05)
Within Formal Structure * Inquiry Rate out of Formal Structure			5.58** (2.38)	0.14** (0.06)	5.24** (2.86)	0.14** (0.06)
Out of Formal Structure * Individual Distance					-0.26** (0.13)	-0.00** (0.00)
Within Formal Structure * Individual Distance					0.51** (0.24)	0.01*** (0.00)
Out of Formal Structure * Geographic Diversity					0.39*** (0.10)	0.00*** (0.00)
Within Formal Structure * Geographic Diversity					0.02 (0.25)	-0.01 (0.00)
Tenure (log)	0.26*** (0.08)	0.00*** (0.00)	0.26*** (0.08)	0.00*** (0.00)	0.27*** (0.07)	0.00*** (0.00)
Region Fixed Effect	Included	Included	Included	Included	Included	Included
Number of Observations	30727	30727	30697	30697	30466	30466
-2 Log Likelihood	4004.231		3922.294		3886.800	
R-square		6.5%		7.5%		7.5%

## Robustness

One key concept we develop in this study is the formal structure in knowledge sharing networks. We identify the network governance team and their subordinates as part of the formal structure and show that whether a member belongs to the formal structure has a significant impact on their knowledge

sharing behavior. We also distinguish between leaders in the formal structure from their subordinates that do not assume leadership positions in the networks. We theorize that the behavior of the latter group is driven by endogenous motivation, most likely by identified and introjected motivation, and find that empirical results are largely consistent with the hypotheses.

Besides analyzing the behavior of the subordinates in the formal structure, it is also valuable to develop a better understanding of the behavior of the governance team. In this section, we take a first step to assess knowledge sharing behavior of the network leadership team and how their behavior is influenced by those in and out of the formal structure. We perform the analysis on all members of the governance team and report the result in Table 6. Comparing the result with those in Table 4, the analysis reveals that the governance team is generally less influenced by others. At the same time, they demonstrate the same behavior as others in the formal structure with regard to the impact of individual geographic distance and network geographic diversity. Participation decreases when a governance team member is further away from other members in the network. On the other hand, a governance team member increases his participation when network geographic diversity increases.

	(1)	(2)	(3)	(4)	(5)	(6)
Individual Past Contribution Rate	3.86*** (0.21)	0.46*** (0.01)	3.74*** (0.22)	0.44*** (0.01)	3.67*** (0.22)	0.44*** (0.01)
Contribution Rate within Formal Structure			-0.35 (0.50)	0.01 (0.04)	-0.37 (0.50)	0.03 (0.04)
Contribution Rate out of Formal Structure			2.41** (1.22)	0.15 (0.11)	1.58 (1.26)	0.06 (0.10)
Individual Distance					-0.31** (0.14)	-0.02** (0.01)
Geographic Diversity					0.61*** (0.14)	0.04*** (0.01)
Tenure (log)	0.10 (0.09)	0.01 (0.01)	0.11 (0.09)	0.01 (0.01)	0.09 (0.09)	0.01 (0.01)
Region Fixed Effect	Included	Included	Included	Included	Included	Included
Number of Observations	3449	3449	3449	3449	3437	3437
-2 Log Likelihood	1856.049		1851.476		1821.853	
		27.08%		27.20%		27.70%

While we define formal structure as the network governance team and their subordinates, our discussion with the company reveals that formal structure may encompass more. To test the robustness of our result, we expand our definition of formal structure to members of the network governance team and all network members that come from the same business units<sup>1</sup>.

Table 7 reports the analysis with the new definition of formal structure. The analysis shows that the results are similar as employees both in and out of the formal structure are more influenced by the participation behavior of those out of the formal structure than those in the formal structure. We also find that geographic distance increases participation of those within the formal structure but decreases participation of those out of the formal structure. Further, geographic diversity has a stronger positive impact on those out of the formal structure than on those within the formal structure.

<sup>1</sup> There are 72 business units in this company.

<b>Table 7. The Impact of Formal Structure on Individual Participation Behavior</b>						
	(1)	(1)	(3)	(4)	(5)	(6)
Individual Past Participation Rate	4.40*** (0.12)	0.33*** (0.00)	4.02*** (0.12)	0.31*** (0.00)	3.99*** (0.12)	0.32*** (0.00)
Within Formal Structure	0.86*** (0.07)	0.06*** (0.00)	1.12*** (0.09)	0.04*** (0.00)	1.12*** (0.07)	0.04*** (0.00)
Out of Formal Structure * Contribution Rate within Formal Structure			0.33*** (0.08)	0.01* (0.00)	0.25*** (0.09)	0.01* (0.00)
Out of Formal Structure * Contribution Rate out of Formal Structure			5.61*** (0.43)	0.29*** (0.02)	5.66*** (0.43)	0.28*** (0.02)
Within Formal Structure * Contribution Rate within Formal Structure			0.47** (0.21)	0.08*** (0.01)	0.40* (0.22)	0.07*** (0.01)
Within Formal Structure * Contribution Rate out of Formal Structure			1.82*** (0.57)	0.22*** (0.04)	1.89*** (0.57)	0.21*** (0.04)
Out of Formal Structure * Individual Distance					-0.37*** (0.09)	-0.01*** (0.00)
Within Formal Structure * Individual Distance					0.20* (0.11)	-0.01*** (0.00)
Out of Formal Structure * Geographic Diversity					0.54*** (0.07)	0.01*** (0.00)
Within Formal Structure * Geographic Diversity					-0.34*** (0.11)	0.03*** (0.01)
Tenure (log)	0.15** (0.04)	0.01** (0.00)	0.18*** (0.04)	0.01*** (0.00)	0.19*** (0.04)	0.01*** (0.00)
Region Fixed Effect	Included	Included	Included	Included	Included	Included
Number of Observations	30760	30760	30721	30721	30490	30490
-2 Log Likelihood	8895.329		8696.931		8587.134	
R-square		17.90%		18.77%		18.89%

## Discussion and Implications

The results suggest four key findings. First, our analysis reveals that being part of the formal structure increases individual contributions to the networks, confirming the value of formal structure in motivating contributions of those within the structure. Second, we find that formal structure has relatively little impact on those out of the formal structure. Contributions of those in formal structures neither crowds out contributions from members out of the formal structure, nor do higher levels of participation by members in the formal structure encourage participation by nonmembers. On the other hand, we find contributions by members out of the formal structure have significant impacts on both members in and out of the formal structure. Third, we find that the formal structure mitigates the negative influence of geographic distance on participation. Finally, our analysis reveals that network geographic diversity has a positive impact on participation and the positive impact is stronger for those out of the network.

Before discussing the implications of these findings, the limitations of the study need to be considered. First, we did not examine the quality of contributions and quality of inquiries. One reason why those in the formal structure may not have impact on those out of the formal structure may be the lower quality of contributions as members in the formal structure just contribute out of the obligation, duty, or requirement. Those who participate voluntarily might do it more for their own personal value and competence development and engage in more deeply in their contributions. However, in this study we did not measure quality of contributions, a topic that warrants future research.

Second we assume that the formal structure of a network is static. We captured the formal structure that existed in April 2010. Third, our analysis only includes those networks still in existence in May 2010 and ignores those that have been discontinued. Fourth, we model the formal structure as a single group without differentiating leadership roles. In reality, sponsor, core member and subject matter experts play different roles in the network and their influence is likely to differ. Incorporating and modeling the different roles in future research will help develop a more nuanced understanding of the impact of the formal structure. Fifth, while we control for an individual's intrinsic motivation by controlling for his past contribution, other factors could also influence an individual's contribution behavior. In particular, an individual's prior face-to-face interactions with members in the network could have a significant influence on his future behavior. Sixth, we have not controlled for extrinsic rewards except for separating the governance team from members. In the setting of our empirical study, it is the network overall and specifically the governance team that seems to be the target of external rewards and recognition for a well performing network. All these limitations invite future research. Future research can particularly benefit from a more detailed analysis of individual interactions in knowledge sharing networks and combining the online interactions with their offline counterparts.

Taken together, the findings make contributions to the literature particularly in terms of suggesting future research. The study provides an initial look into individual contributions in knowledge sharing networks with formal structures. The formal structures of networks are seen as particularly critical in global companies where there is a risk that highly knowledgeable employees may not share their knowledge particularly when they are distant and isolated from others (Foss et al 2009). Governance has been examined in the context of volunteer networks in terms of how networks establish and maintain their own rules and structures (e.g., Markus 2007), but not how the networks are embedded in the formal organization and how the formal structure impacts the networks' functioning.

This initial look suggests that the impact of formal structure is a double-edged sword. While it has positive impact on members within the formal structure, it has little impact on members out of the formal structure. The analysis indicates a potential friction between those in the formal structure and those out of the formal structure given their different contribution rates and influence. This has implications for both practice and future research.

The study contributes to the literature that goes beyond extrinsic-intrinsic dichotomy of motivations by examining organizational knowledge sharing in a global corporate setting. Roberts et al (2006) examined endogenous motivation in open source communities. Malhotra et al (2008) investigated the use of web-based education platform at a large university. Malthora et al (2008) found negative effects of introjected motivation but those might be explained by the public educational setting where people might more easily experience conflict or loss of freedom from external influences. While we argue that even in the formal structures knowledge sharing is still largely based on volition, external influences are likely to be more internalized and influence behaviors than in informal structures of the networks. Although we do not deny that external influences as internalized might at times create conflict in the form of anxiety and stress, such emotions (as long as balanced with positive emotions) might help to increase and sustain knowledge sharing participation particularly in challenging corporate environments with ever increasing daily demands on employees that are geographically distant.

From a practice perspective, employees often face many competing demands for their time, embedding formal structure has become a popular strategy among large firms to encourage participation in knowledge sharing networks. While practitioners have hailed the benefits of formal structure on encouraging contributions within the structure, few have noted that the formal structure affects the relationship between those within the structure and those out of the structure, with potential consequences. The organizations need to give special consideration to the size of the formal and informal aspects of the electronic knowledge sharing networks. It appears that the establishment of a larger formal

aspect of the network will reduce the size of the informal aspect of the network. While the formal aspects may bring about greater stability and functional excellence, the informal aspects are needed to promote change and wider horizontal knowledge sharing beyond functional boundaries. Hence, those electronic sharing networks that promote operational excellence, larger formal structures might be appropriate compared to those networks that are created to cultivate broad-based innovation. Hence, the type of the network can be an important factor to consider. A rich line of inquiry waits to examine how the formal and informal aspects of the networks compete and complement each other.

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