CAN I BORROW YOUR EXPERTISE?
INTEGRATING TRANSACTIVE MEMORY SYSTEM, SOCIAL NETWORK, AND SOCIAL RESOURCES THEORY

BY

WOONKI HONG

DISSERTATION

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Doctoral Committee:

Professor Emeritus John J. Lawler, Chair and Director of Research
Assistant Professor Amit Kramer
Assistant Professor Ravi Gajendran
Associate Professor Aparna Joshi

ABSTRACT

As information and knowledge are increasingly critical resources in organizations, a key question facing organizations today is '*knowing who knows what*' rather than 'knowing what.' However, awareness of others' expertise does not necessarily lead to the utilization of that knowledge. Integrating transactive memory system, social network, and social resources theory, this study investigates expertise utilization processes at the interpersonal level. Drawn from 71 individuals and 1,898 observations of expertise utilization, the findings show that when team members' expertise is high, and individuals perceive themselves as lacking expertise, individuals are more likely to retrieve expertise from team members. The results also indicate that tie strength and psychological empowerment moderate expertise utilization process. Implications of these findings for research and practice are discussed.

To Yeonsun, Jeeyoul, and Jeenyu

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CHAPTER 1

INTRODUCTION

The complexity and rapid rate of change associated with knowledge and information have led organizations to extensively utilize teams to execute projects that extend beyond individual abilities. Teams are composed of members with varying areas of expertise, who must rely on one another to accomplish their goals. Similar to the benefits associated with the division of labor, individual members of a team are responsible for specific areas of expertise and everyone must coordinate their efforts to carry out the collective tasks. In this regard, the division of cognitive labor refers to individuals being responsible for specific areas of expertise so that teams can integrate expertise possessed by team members for completing team goals (Brandon & Hollingshead, 2004; Wegner, 1987).

A team refers to a group of members working together with one or more common goals through differentiated work roles within specified boundaries (Kozlowski & Ilgen, 2006). Team members might have frequent communication because of task and goal interdependencies and are thus more likely to know each group member's expertise. The transactive memory system (TMS) literature argues that when team members share the knowledge of *knowing who knows what* within the teams, they are more likely to utilize others' expertise, and thus a well-developed TMS will lead to enhanced team performance (Akgün, Byrne, Keskin, Lynn, & Imamoglu, 2005; Austin, 2003; Lewis, 2004). However, team members sometimes fail to recognize the member-expertise association and thus fail to seek expertise from the most relevant experts. Moreover, even when team members are aware of who is an expert in a specific domain, they may not utilize the expert due to a negative relationship or problems coordinating with other members.

Several lines of research address various conditions that prompt effective use of diverse expertise in teams such as team identification (Van der Vegt & Bunderson, 2005), knowledge-integration capability (Gardner, Gino, & Staats, 2012), task and goal interdependence (Van der Vegt, Van de Vliert, & Oosterhof, 2003), team diversity (Dahlin, Weingart, & Hinds, 2005), status characteristics and power distance (Bunderson, 2003), and transactive memory of knowing who knows what (Moreland & Myaskovsky, 2000). While several studies have explored team characteristics and structures that promote or hinder expertise utilization among team members, our understanding of dyadic processes in expertise utilization is limited. Specifically, prior research does not easily account for differences in interpersonal tendency of expertise retrieval within teams.

There have been a few attempts at focusing on dyadic interactions in terms of information seeking behavior (Borgatti & Cross, 2003), expertise retrieval (Yuan, Carboni, & Ehrlich, 2010), and receipt of actionable knowledge (Cross & Sproull, 2004). Some explanations for interpersonal expertise utilization can be found in the transactive memory system (TMS) literature. These explanations emphasize the importance of cognitive structure by arguing that cognitive awareness of team members' expertise will be associated with expertise retrieval from the members (e.g., knowing who knows what, Akgün et al., 2005; Austin, 2003; Lewis, 2004). Another body of research in the social network literature emphasizes relational strength in interpersonal (or inter-unit) dyads. For example, ties between two people can result in a channel of information flow, and strong ties will facilitate expertise utilization between the people especially when the expertise is complex (i.e., tacit) while weak ties help people search new, non-redundant information (e.g., Burt, 2001; Granovetter, 1973; Hansen, 1999). Social resources theory can also help us understand expertise utilization behavior by prioritizing the expertise that team members possess. It suggests that people tend to retrieve expertise from the most expert person in that area (e.g., Lin, Ensel, & Vaughn, 1981; Seibert, Kraimer, & Liden, 2001). Those studies concur with the fact that individuals need others as a source of expertise to perform tasks, but differ in *why* and *what* makes focal individuals seek sources of knowledge in others. Although combining and integrating individual knowledge and expertise is becoming a competitive advantage for organizations (Nahapiet & Ghoshal, 1998), it is surprisingly fragmented and limited in explaining interpersonal expertise utilization.

The purpose of this study is to extend previous research on expertise utilization in teams by developing and testing a theoretical model at the interpersonal level. Throughout this article, I refer to an *actor* as the person who is utilizing (or retrieving) expertise from his or her team member and to a *peer* as the person who is sharing (i.e., being utilized for) his or her expertise. Drawing from TMS, social network, and social resource theory, this paper developed a model in which expertise utilization is a function of actor attributes, peer attributes, and the relationship between actor and peer. More specifically, which factors give actors an opportunity to utilize peer expertise and what conditions strengthen actors' expertise utilization behaviors were examined.

Motivational processes such as psychological empowerment and need for cognition are tested as moderating variables to strengthen the tendency toward expertise utilization. Individual motivation can play an important role in retrieving expertise. While relational embeddedness within a network might provide an opportunity to access diverse information, it does not automatically lead to materialized resources (Adler & Kwon, 2002). Identifying how individual differences can explain information benefits even in the same network positions, Anderson (2008) examines that a personality trait, *need for cognition*, can influence information seeking behaviors to acquire rich information through 'potential' social capital, and shows that social ties do not automatically transfer information without individual motivations. This paper tested hypotheses derived from this model using two-wave survey data obtained from a sample of project teams who were part of a company in the IT industry. The data were analyzed using cross-classified random effects modeling, a type of hierarchical linear model, that treats actor and peer at the same level of analysis and isolates the variance of the two crossed-level simultaneously (Rabe-Hesketh & Skrondal, 2008).

This study makes several contributions. First, it advances theory in expertise utilization at the interpersonal level. By bridging TMS, social network, and social resources theory, this study examines the idea that expertise utilization is a function of actor and peer expertise and tie strength, and that individual motivation allows actors to make the most of peer expertise. Although the rudimentary idea of TMS, social network, and social resources theory all rest on the implied assumption fact that people should rely on others for leveraging their collective capacity of expertise, this study is a first attempt toward integrating those theories into an understanding of expertise utilization at the dyadic level.

More specifically, this study answers Lewis & Herndon's (2011) call to examine the transactive process that has been ignored in previous TMS studies. Previous TMS research has focused on the structure of cognitive awareness of knowing who knows what among team members and then associating the cognitive structure with related outcomes. This study measures the perceived level of expertness for each domain of expertise within each peer in project teams, and associates the perceived level of peer expertise with expertise utilization. This approach allows for an examination of how cognitive awareness of peer expertise is translated to expertise utilization from that peer. Notably, drawing from social network and social resources theory, this study extends our understanding of the expertise utilization process by adding interpersonal tie strength and individual motivation as moderators of the relationship between expertise awareness and utilization.

CHAPTER 2

THEORY AND HYPOTHESES

The theoretical perspective of competitive advantage among organizations suggests that "a firm be understood as a social community specializing in the speed and efficiency in the creation and transfer of knowledge" (Kogut & Zander, 1996: 503). Compared with market mechanisms, researchers view firms as more capable of creating and sharing knowledge (Ghoshal & Moran, 1996; Nahapiet & Ghoshal, 1998). Organizations are knowledge reservoirs and serve as efficient institutions for transferring knowledge through employee interactions and the combination of members, tools, and tasks (Argote & Ingram, 2000).

In industrial society, contrary to traditional society in which one craftsman made a whole product, division of labor results in specializations of tasks so that individuals bond together as an organizing collective. However, Kogut and Zander (1996) point out that while the division of labor facilitates individual development of competence through specialization, it might also generate coordinating problems among competencies. Thus, what firms as social entities must do is to organize coordinated behaviors, organizational identity, and collective learning (Kogut & Zander, 1996). Similar to the traditional division of labor, TMS is also defined as the division of *cognitive* labor for encoding, storing, and retrieving others' expertise. Through TMS, individuals in the organization can specialize in their expertise, effectively coordinate to transact their expertise across their peers, and thus resulting in teams becoming an efficient form of memory system which may yield organizational advantages.

Transactive Memory System

The term "expertise" in this paper refers to the task-oriented knowledge and skill in which team members are specialized as a result of differentiated work roles within teams. Expertise areas may differ across teams based on the team tasks and project types. For example, project teams in an IT company might have various types of projects such as a human resource (HR) system customizing project or a mobile framework project. The expertise areas for the HR system project team would be HR business and policy, accounting and finance, and .NET programing. For the mobile framework project, architectural understanding of operating system and web user interface would be critical domains of expertise in order for the team to function. For a team to cultivate a pool of collective expertise areas, TMS literature suggests that each member should be responsible for non-overlapping expertise domains and be aware of the link between expertise and the team members who possess those domains so that they can retrieve relevant expertise (Brandon & Hollingshead, 2004; Lewis, 2003).

TMS was originally conceptualized to explain the informational processes of group mind (Wegner, 1987), which refers to "the shared division of cognitive labor with respect to the encoding, storage, retrieval, and communication of information from different knowledge domains" (Brandon & Hollingshead, 2004:633). Wegner (1987) uses individual memory system as an analogy to understand group memory system. When information is received by an individual, the person encodes the information and stores it in his or her own memory. When the information is needed, the person has to access the location where the information was stored in the memory system in order to retrieve it.

For example, when you arrive at your house, you might put your cell phone on the table in the kitchen, and your memory stores the information of where you placed the cell phone. After a while, you might forget where you put the phone and start to look for it. The need to look for the phone does not mean that you deleted the information in your memory system. Rather it might imply that you could not retrieve it from your memory. When you do find it, you would probably say, “I knew it” as the location in your memory is reinforced. Knowing the location of the phone is therefore not a matter of presence or absence of the information in your memory system, but the matter of remembering the location of the information in the memory system. In order to increase memory capacity, individuals can also use external memory aids to store and retrieve information such as a note or a computer.

Shifting this idea to expertise utilization in a dyadic relationship, an actor can use a peer as an external repository of expertise (Littlepage, Robison, & Reddington, 1997; Wegner, Erber, & Raymond, 1991), and utilize peer expertise once the actor has meta-knowledge of knowing what the peer knows (Lewis, 2003). If the actor does not know who the experts are in the specific areas, it is not likely that he or she can turn to the appropriate person who is holding the expertise. Empirical evidence has shown the positive effects of TMS on both dyadic and team level performance (see Ren & Argote, 2011 for a review paper). Another support for the importance of TMS comes from experimental studies. Wegner et al. (1991) examined dyadic memory tasks between couples who had been dating for at least three months and couples who were randomly assigned. The results showed that people in close relationships performed better in remembering items in the listed categories. It suggests that the intimate couples implicitly assign each partner a list of items to memorize that are related to their expertise, allowing for reduced cognitive labor by each individual and an increase in collective memory capacity. At the group level, Moreland

and Myaskovsky (2000) compared radio assembly tasks between groups trained together and groups trained individually, and found that the groups trained together performed better through increased awareness about the location of expertise relating to the tasks.

Previous studies in TMS measure. While researchers agree on the definition of TMS, such as 'the shared division of cognitive labor with respect to the encoding, storage, retrieval, and communication of information from different knowledge domains' (Brandon & Hollingshead, 2004:633; also see Wegner, 1987), empirical studies reveal that TMS is measured in many different ways. Whereas transactive memory implies *individual* meta-knowledge regarding knowing who knows what, TMS is a *consensus* of meta-knowledge by a team for retrieving the team's collective expertise through communication (Lewis, 2003). A group with a valid TMS implies that each member has differentiated specialties that do not overlap each other's knowledge domain, and, also, that group members have a high agreement with respect to who is responsible for each expertise area. Thus, TMS can make group members effectively coordinate and communicate with their expertise for carrying out complex tasks.

Measuring TMS might be a significant barrier to develop TMS research because the concept of TMS requires researchers to measure not only *knowing who knows what* structure but also the extent to which group members differentiate their expertise and how effectively they utilize one others' expertise. Measuring TMS in a field setting requires the consideration of specific research contexts with extensive help from participating organizations. Due to those difficulties, previous research has conducted experimental research in laboratory settings at the dyadic and group levels (Hollingshead, 1998; Hollingshead & Fraidin, 2003; Littlepage & Mueller, 1997; Moreland & Myaskovsky, 2000). One exceptional field study measuring TMS was conducted by Austin (2003). He conceptualized TMS as four components: group knowledge stock, consensus about knowledge sources, specialization of expertise, and accuracy of knowledge identification. Given the lack of other field studies, Lewis (2003) suggested an indirect measure of TMS that can be assessed through group member evaluations concerning the perceived level of expertise specialization, credibility, and coordination. This 15-item scale helped subsequent studies to test antecedents and consequences of TMS (Akgün et al., 2005; Zhang, Hempel, Han, & Tjosvold, 2007).

Research in the TMS literature can be summarized into two distinct approaches. One is to look at the structure of TMS and its nomological network at the group level. A majority of TMS studies belongs to this stream of research. They tend to focus on the cognitive consensus of *knowing who knows what*, and show *how* and *when* the cognitive structure of TMS is formed and *what* consequences TMS produces (see Ren & Argote, 2011). The second approach focuses on the process of how people recognize and retrieve others' expertise. There is a paucity of research that has been conducted in this area. Empirical studies consistently show that TMS produces above-average performance at either dyads or teams (Akgün et al., 2005; Austin, 2003; Moreland, 1999; Wegner, 1987; Wegner et al., 1991). Scholars also show that awareness and utilization of distributed expertise in teams could be biased. Hollingshead and Fraidin (2003) test how gender stereotypes bias expertise recognition, and show that people assign responsibilities of knowledge domain based on gender stereotypes. Bunderson (2003) also shows that employees infer team members' expertise through social status cues. Specifically, diffuse status cues such as gender, ethnicity, age, or attractiveness are more likely to influence expert recognition when groups are shorter tenured and power is more centralized.

Drawing on TMS literature, I argue that interpersonal expertise utilization is a function of self-perceived level of expertise (*knowing what the actor him/herself knows*), perceived level of peer expertise (*knowing what the peer knows*), and the *combination* of the two. TMS literature has emphasized the benefits of shared agreement of knowing who knows what with non-overlapping areas of expertise (Austin, 2003; Brandon & Hollingshead, 2004). Through division of cognitive labor with respect to the expertise areas, individuals can develop their special areas while seeking other expertise areas from peers (Lewis, 2004). A perquisite condition for expertise utilization requires both the existence of expertise in peers and cognitive awareness of who possesses the expertise. When an actor wants to receive help concerning a specific type of expertise from peers, the actor should know who possesses the task-relevant expertise. All other things being equal, an actor will turn to the most expert person for expertise utilization. For example, if an individual is connected with ten team members, and the person needs a specific expertise, he or she might not search all ten ties for the expertise, but turn to a specific individual who has the relevant expertise in order to maximize searching efficiency. In sum, the theory suggests that if the actor is the most knowledgeable in the specific area, he or she will be less likely to turn to peers for expertise.

Hypothesis 1. An actor's perceived level of peer expertise will be positively related with expertise utilization from the peer.

Hypothesis 2. An actor's perceived level of self-expertise will be negatively related with expertise utilization from peers in the expertise area.

Perceived level of peer- and self-expertise is not sufficient to fully explain expertise utilization; rather, how much expertise areas overlap between actor and peer will influence the utilization of expertise from the peer. In this study, I refer to expertise dissimilarity as the perceived level of differences in expertise areas between actor and peer. It is hypothesized that the relationship between expertise dissimilarity and expertise utilization will be an inverted U shape. A high degree of expertise dissimilarity will raise coordination difficulties while a high degree of expertise similarity will be redundant and discourage expertise utilization. A high degree of expertise dissimilarity is likely to raise coordination difficulties because informational diversity, such as educational and functional areas among group members, can generate task conflicts and miscommunications within the group (e.g., Jehn, Northcraft, & Neale, 1999). Also, expertise dissimilarity may lead to diverse perspectives, which could hinder efficiencies of team processes (Van der Vegt & Bunderson, 2005). Lastly, a high degree of expertise dissimilarity may reduce the ability of the actor to recognize the value of the peer expertise. On the other hand, when there is high degree of expertise similarity, expertise utilization may be unnecessary and redundant because the actor already possesses similar expertise.

For effectively utilizing peer expertise an actor needs to have a minimum level of understanding the expertise of his or her peers. Absorptive capacity perspective provides support to this argument in that "prior related knowledge confers an ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990:128). Similarly, Bunderson and Sutcliffe (2002) introduced intrapersonal functional diversity, referring to the wide range of functional experiences within an individual. They argued that in teams composed of individuals who are high in intrapersonal functional diversity, the team members are more likely to understand each other's functional areas, easily recognize the value of information that other members have, and share information. Taken together, a moderate level of expertise dissimilarity (or similarity) between actor and peer will increase the probability that an actor would utilize a peer expertise.

Hypothesis 3. The relationship between expertise dissimilarity between actor and peer and expertise utilization will be in inverted U shape such that a moderate degree of expertise dissimilarity will have the strongest effect on the likelihood of expertise utilization.

Social Network and Social Resource theory

Social capital is defined as "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" (Nahapiet & Ghoshal, 1998:243). This paper applies social capital theory lens to understand the dynamics of TMS. Nahapiet and Ghoshal (1998) suggest three facets of social capital: relational, structural, and cognitive. The relational dimension focuses on a particular relationship that two or more people have with each other, such as friendship, liking, and trust. The structural dimension emphasizes the connectedness of people, such as network density and structural holes. Finally, the cognitive dimension indicates the positive role of shared language and common understanding of each other. Whereas social network literature focuses on network ties and configuration for conveying information or expertise, the traditional TMS literature emphasizes awareness of expertise or distributed specialties, which is related to the cognitive dimension of social capital.

Drawing from the TMS literature, hypotheses 1 through 3 concern the relationship between cognitive awareness of expertise and expertise utilization at the dyadic level. Recent studies, however, have indicated that a limitation of the TMS literature is that previous studies have neglected the transactive *process* of expertise recognition (Lewis & Herndon, 2011).

Research shows that expertise recognition is not necessarily connected to expertise utilization, and relational quality or person characteristics influence the expertise utilization process. Casciaro and Lobo (2008) showed that interpersonal affect played an important role in initiating task-related actions. For example, in choosing between a “lovable fool” who is not likely to be helpful in task accomplishment but, still, is an enjoyable person and a “competent jerk” who is smart enough to complete a task but is mostly avoided due to his personality, research shows people tend to choose lovable fools over competent jerks (Casciaro & Lobo, 2005). Yuan et al. (2010) examined the moderating role of affective tie in expertise recognition-retrieval relationship, and showed that people tend to seek expertise from the person who has positive affect. At the team level, Rau (2005) tested relationship conflict as a moderator of the relationship between TMS and team performance in bank top management teams. They suggested that relationship conflict hinders the credibility of other team members’ expertise, and that individuals are not likely to ask for information from those with whom they have conflict. Taken together, these findings suggest that quality of relationships might be an intervening factor in the expertise recognition-utilization process.

Social network and social resources theory advance our understanding of the relational aspect of interpersonal expertise utilization. Previous social network studies, particularly in tie strength literature, have focused on characteristics of relational qualities between individuals, and assume that network ties are channels for conveying knowledge and information (Burt, 2001; Coleman, 1988; Granovetter, 1973). These studies suggest that individuals connected through strong ties tend to have similar attributes and are thus more likely to have redundant information, while dissimilar attributes are correlated with people of weak ties and are thus more likely to be related to novel information. For example, Hansen (1999) shows that weak ties are beneficial for information search, whereas strong ties are advantageous in transferring tacit knowledge. In creativity literature, Perry-Smith (2006) argued that non-redundant and new perspectives could enhance individual creativity, and that the number of weak ties has positive association with non-redundancy of information. These findings suggest that the number of weak ties that the focal actor has represents the amount of novel knowledge and information (e.g., expertise) that the person can access. Let's assume that there are two possibilities when people seek to access new expertise: accessing expertise through weak ties and accessing expertise through strong ties. Social network theory predicts that there is a greater probability of accessing new expertise through weak ties than through strong ties.

P (searching new expertise *through weak tie)* > P (searching new expertise *through strong tie*)

Further, social network theory assumes that the probability of accessing new expertise through many weak ties is higher than when only few weak ties are present (e.g., Perry-Smith, 2006). The basic assumption of this prediction is that resources are randomly distributed among tie contacts, and that individuals with more ties have a greater probability of finding the desired resources.

P (searching new expertise *through many weak ties*) > P (searching new expertise *through few weak ties*)

While social network studies have emphasized associability or connectedness as a source of social capital, they have paid little attention to competencies and resources of network tie contacts (Adler & Kwon, 2002). On the other hand, social resources theory states that it is the nature of resources held by the connected ties that gives advantages rather than ties or relationships per se (Lin et al., 1981; Seibert et al., 2001). It further suggests that the resources of peers play an important role in conveying the appropriate resources that the actor requires. For example, when employees seek careen progression, contacts from higher levels in the organizations would be in a better position – relative to lower level ties – to give relevant advice and career sponsorship (Seibert et al., 2001). Social resources theory pays attention to the selective searching behavior of actors in the consideration of the resources that peers have. Advancing Granovetter's (1973) findings in job seeking behavior, Lin et al. (1981) found that job seekers are more likely to use weak ties for job attainments than strong ties. Yet, they further examined the social status of these weak ties as a mediator in the relationship between weak ties and job attainment. They found that tie strength is negatively related with social status of tie contacts, and the social status of the contacts has a positive relationship with job attainments. This connection implies that resources might not be randomly distributed among weak ties, and job seekers tend to utilize high status weak ties rather than low status weak ties (e.g., prestige principle, Lin et al., 1981). Seibert et al. (2001) stressed the importance of exchanging resources via network ties for fulfilling a focal employee's instrumental objectives, and show a fully mediated path of social resources between social network and career success.

Aligning social network literature with social resources theory in regards to the expertise utilization process, this paper focuses on peer expertise as a primary resource for completing tasks, and hypothesizes that the expertise utilizing behaviors is moderated by tie strength. More specifically, if an actor knows that a peer has appropriate expertise (hypothesis 1), the probability of utilizing the expertise through strong ties will be higher than the probability of utilizing the expertise through weak ties. Also, if the actor knows that the peer has no expertise, the probability of utilizing the expertise will be zero, regardless of the tie strength.

P (*utilizing expertise through weak tie* | *peer has expertise*)	<	P (*utilizing expertise through strong tie* | *peer has expertise*)	
P (*utilizing expertise through weak tie* | *peer has no expertise*)	=	P (*utilizing expertise through strong tie* | *peer has no expertise*)	close to zero

The degree of actor expertise and expertise utilization behavior as suggested in hypothesis 2 will be differentiated by tie strength. When the actor has no expertise, he or she will turn to peers to retrieve the expertise but will be more likely to do so when strong ties are present. However, if the actor has the expertise, expertise retrieval would not be triggered regardless of tie strength since the actor already has the expertise.

P (*utilizing expertise through weak tie* | *actor has no expertise*)	<	P (*utilizing expertise through strong tie* | *actor has no expertise*)	
P (*utilizing expertise through weak tie* | *actor has expertise*)	=	P (*utilizing expertise through strong tie* | *actor has expertise*)	close to zero

This result might be due to the cost inherent in the expertise seeking behavior. First, information seeking behaviors could disclose an actor's inferiority in the given areas of expertise, and this might represent a risk for individuals who want to maintain positive self-images (Lee, 2002). Second, individuals tend to feel discomfort and unpleasantness when a potential provider of expertise withholds his or her expertise; thus actors are more likely to seek expertise of those who are more likely to comply with the request (Flynn & Lake, 2008).

Hypothesis 4a. Tie strength will moderate the relationship between perceived level of peer expertise and expertise utilization such that the relationship will be stronger when an actor has a strong tie with a peer.

Hypothesis 4b. Tie strength will moderate the relationship between perceived level of self-expertise and expertise utilization such that the relationship will be stronger when an actor has a strong tie with a peer.

Not only dyadic relationships but also network structure would influence the expertise retrieval process. Network structure refers to "the overall pattern of connections between actors" (Nahapiet & Ghoshal, 1998: 244). Two research streams, *structural holes* and *closure perspective*, have been represented as two primary benefits of network structure (Burt, 2005). The structural holes perspective focuses on individual private advantage of information by linking two cluster groups. That is, an individual in the structural holes position can access diverse information and manipulate information flow between disconnected actors. Thus, the structural holes position enjoys informational advantages and less constraint by the embedded network. For example, Burt (2001) studied the effects of structural holes, showing that when managerial employees in the organization are in the less constrained network positions (i.e., structural holes position), the managers are associated with higher individual outcomes, such as performance evaluation, promotions, and compensation.

On the other hand, the closure perspective suggested by Coleman (1988) shows how densely connected groups can effectively facilitate social norms and obligations. Network density refers to the number of connections among group members relative to the total number of possible ties. Two actors in a dense network may share common information, easily monitor each other's behavior, thereby reducing opportunism and increasing trust. Empirical research has also demonstrated that groups in dense networks are positively related with knowledge sharing and team performance (Balkundi & Harrison, 2006).

At the interpersonal level, I argue that shared friends may play a role in seeking expertise. *Shared friends* refers to the extent to which an actor and peer share common network ties (e.g., structural equivalence, Burt, 1992). If the actor is aware that his or her friends are also friends of a peer, the actor might expect that he or she could go to the peer for retrieving expertise due to the assumption that structural embeddedness, such as common friends, will generate trust and willingness to help (Burt, 2001; Granovetter, 1985).

> *Hypothesis 5a.* Shared friends between actor and peer will moderate the relationship between perceived level of peer expertise and expertise retrieval such that the relationship will be stronger when there is a high degree of shared friends.

> *Hypothesis 5b.* Shared friends between actor and peer will moderate the relationship between perceived level of self-expertise and expertise retrieval such that the relationship will be stronger when there is a high degree of shared friends.

Individual Motivation

To better understand expertise utilization behavior, it is important to investigate individual characteristics. Social capital is defined as "the advantage created by a person's location in a structure of relationships" (Burt, 2005:4), and network studies focus on the associations between network positions and their consequences. Several somewhat ignored properties of utilizing social capital have recently emerged to explain motivation in expertise utilization behavior. Recent research shows that motivational factors explain additional variances in information gathering (Anderson, 2008) and knowledge acquisition and provision (Reinholt, Pedersen, & Foss, 2012), even when individual actors possess equally valuable network positions such as network size, network centrality, and tie strength. Adler and Kwon (2002) also suggest that, whereas interpersonal relations or network ties might generate opportunities to access available resources to the focal actor, individual motivation will help the actor transalte potential resources into realized resources. As outlined in hypotheses 1 and 2, this paper suggests that individual motivation will moderate the expertise utilization process (1) when a peer has expertise and (2) when an actor has no expertise. This paper proposes two individual motivations: psychological empowerment (i.e., task-oriented intrinsic motivation) and need for cognition (i.e., cognitive-oriented intrinsic motivation).

Psychological empowerment. Psychological empowerment is an individual perception of one's self about specific work duties rather than a general personality trait (Spreitzer, 1995). Whereas the traditional conceptualization of empowerment is delegation of authority or sharing power with subordinates, some researchers regard empowerment as a motivational belief of self-determination (Conger & Kanungo, 1988; Thomas & Velthouse, 1990). Thus, empowerment can be viewed as *enabling* which implies "creating conditions for heightening motivation for task accomplishment through the development of a strong sense of personal efficacy" (Conger & Kanungo, 1988: 474). Spreitzer (1995) developed the construct of psychological empowerment, and defined it as "a motivational construct manifested in four cognitions: meaning, competence, self-determination, and impact" (p. 1444). Research shows that employees high in psychological empowerment actively engaged in task accomplishment and innovative behaviors (Spreitzer, 1995), and organizational commitment (Avolio, Zhu, Koh, & Bhatia, 2004; Liden, Wayne, & Sparrowe, 2000).

Self-determination theory also supports this argument (Ryan & Deci, 2000). According to self-determination theory, people are proactive and take responsibility for their duties when they are self-determined. Specifically, when autonomous motivation (i.e., perceived level of self-determination) is high, individuals are more likely to acquire knowledge and expertise from co-workers (Reinholt et al., 2012). Quigley, Tesluk, Locke, and Bartol (2007) also show that when people have a high degree of self-efficacy – one of the dimensions of psychological empowerment – they tend to set higher goals and strive to achieve higher levels of performance, which leads to utilization of available knowledge and expertise among other members. Therefore, it can be expected that an actor's high degree of psychological empowerment will result in proactively seeking expertise from peers to complete their tasks, and the impact of psychological empowerment will be stronger when there are opportunities to make the most of peer expertise (i.e., high level of peer expertise) or when actors lack expertise to complete tasks.

Hypothesis 6a. Psychological empowerment of an actor will moderate the relationship between perceived level of peer expertise and expertise utilization such that the relationship will be stronger when the actor has a high degree of psychological empowerment.

Hypothesis 6b. Psychological empowerment of an actor will moderate the relationship between perceived level of self-expertise and expertise utilization such that the relationship will be stronger when the actor has a high degree of psychological empowerment.

Need for cognition. Need for cognition refers to “the tendency for an individual to engage in and enjoy thinking” (Cacioppo & Petty, 1982:116). It represents dispositional differences of intrinsic motivation in effortful cognitive activities rather than intellectual ability (Fleischhauer et al., 2010). Research on need for cognition has predicted various outcomes of individual cognitive performance (Cacioppo, Petty, Feinstein, & Jarvis, 1996). Researchers show that people high in need for cognition tend to engage in effortful information-processing activities. For example, Levin, Huneke, and Jasper (2000) conducted an experiment evaluating computerized information search and decision tasks. The results show that subjects high in need for cognition considered more alternative options and spent more time when they selected a notebook computer. Another experiment conducted by Cacioppo, Petty, Kao, and Rodriguez (1986) shows that people high in need for cognition paid more attention to issue-relevant information and deliberately thought about the issue and translated that information to others in strong, persuasive ways.

Meta-analytic evidence also suggests that individuals high in need for cognition were more likely to engage in information-seeking activities (Cacioppo et al., 1996). In an experiment wherein individuals engaged in evaluating different products, Verplanken, Hazenberg, and Palenewen (1992) examined whether individual differences in need for cognition cause differences in information seeking efforts. Their results show that subjects high in need for cognition were more likely to search information for testing the product. They concluded that individuals high and low in need for cognition “differ in their motivation to allocate cognitive effort to tasks they are confronted with” (p.133), and that need for cognition might be a motivational factor for external information search. Using this same line of reasoning, Anderson (2008) investigated the relationship between need for cognition and acquisition of information from network ties. The findings suggest that individual differences in need for cognition explained variances in the amount and diversity of information that subjects acquired. Following previous research in need for cognition, this study argues that actors who enjoy cognitive activities will influence the expertise utilization process from peers. More specifically, the influence of need for cognition on expertise utilization will be prominent when there is a higher degree of peer expertise or lack of actor expertise.

> *Hypothesis 7a.* Need for cognition of an actor will moderate the relationship between perceived level of peer expertise and expertise utilization such that the relationship will be stronger when the actor has a high degree of need for cognition.

> *Hypothesis 7b.* Need for cognition of an actor will moderate the relationship between perceived level of self-expertise and expertise utilization such that the relationship will be stronger when the actor has a high degree of need for cognition.

CHAPTER 3

METHOD

Data

Data for this study were collected from project teams within an IT solution providing company located in Korea. The firm provides IT infrastructure consulting such as ERP (Enterprise Resource Planning) systems, mobile business applications, and CRM (Customer Relationship Management). Preliminary interviews with the human resource manager and the chief executive officer and available company data confirmed that the company structure consists of project teams and operation management teams. Once a new project is generated in the company, management identifies knowledge and skills that are required for the project and assembles team members who have the necessary expertise for the project. If the current employees do not have enough skills and knowledge, outsourced consultants are used. For this reason, each team project has a significant number of outsourced consultants that have diverse expertise domains in which team members rely on each member's expertise for completing their tasks.

Twenty-three project teams were identified and the team leader in each of these teams was asked to provide the names of all team members. The average team size was 7.7 and ranged from 3 to 19. Also, team leaders were asked to list the specific domains of expertise that were critical for successful team functioning and to indicate the level of importance of each identified expertise on a scale from 1 (less important) to 5 (most important). Team leaders also identified task characteristics such as time pressure of the project and team interdependence. The average number of expertise areas identified by leaders was 4.9 with a range from three to nine, confirming that expertise varies across the project teams. Since this paper defines expertise as task-oriented knowledge and skills in which team members are specialized for successful team functioning, expertise areas with an importance level of four or higher were included in the team members' survey, which resulted in 3.4 average expertise areas for each team.

The total number of individuals identified by the team leaders was 177 of which 118 were employees and 59 mere consultants. The survey questionnaires were translated and back translated from English to Korean by four bi-lingual Ph.D. students following procedures outlined by Brislin (1980). The first survey was distributed online to all 177 individuals. Eighty employees and thirteen consultants responded to the survey (68% and 22% response rate, respectively). The second survey was sent a month later to employees who had responded to the first survey. The final number of participants for this study was 71 individuals (67 employees and 4 consultants) from 22 teams for a response rate of 40%. The average tenure of participant employees was about five years and 83% were male.

Measures

Perceived level of peer expertise. Previous research has measured perceived level of peer expertise in general terms. For instance, Borgatti and Cross (2003) and Yuan et al. (2010) asked the participants to indicate the level of awareness of their co-worker expertise, and linked expertise awareness to the expertise retrieval process. One possible concern about this measure could be that expertise awareness is confounded with expertness. It might be possible that the rater is well aware of the lack of expertise of a team member or that the knowledge or expertise that the team member has would not be relevant to his or her task. Bunderson (2003) also measured perceived expertise, asking the participants to indicate team members who “have the most knowledge and expertise in the work that your team performs,” and, thus, his measure became a dichotomous variable. In this study, the most relevant expertise areas were specified for the team members, and each individual member was asked to indicate team members’ knowledge and expertise in those specific areas using a Likert scale ranging from 1 (very low) to 5 (very high). Since expertise awareness is the knowledge of the connections between expertise and people (Brandon & Hollingshead, 2004), measuring individual cognitive awareness of knowing who knows what in each expertise area is the most relevant measures for the purpose of this study.

Perceived level of self-expertise. Self-perception of expertise level was also measured by asking individuals to indicate their own level of expertise in the areas that were provided as central areas of expertise by the team leader. Even with the possibility of biased overestimation of their skills and knowledge, empirical findings show that people tend to assess their expertise realistically and consistent with their actual levels of expertise (Austin, 2003).

Expertise dissimilarity. Expertise dissimilarity was calculated using the Euclidean distance formula. Unlike binary measures used in previous research (e.g., Reagans & McEvily, 2003), the Euclidean distance measures can capture the level of expertise, and thus expertise dissimilarity between person *i* and *j* is as follows. Even though person *i* is not an expert in C language programming, he or she might have some knowledge about programming allowing him or her to communicate with person *j*, who is an expert in that area. Binary measures will not be able to capture such a level of expertise dissimilarity while Euclidean measures allow it. Expertise dissimilarity was calculated by the following formula:

$Expertise\ dissimilarity_{ij}=\left[\sum_k (a_{ik} - a_{jk})^2\right]^{1/2}$ where a_{ik} is the level of expertise of person *i* in the *k* area, and a_{jk} is equal to person *j*'s level of expertise in the *k* area.

Tie strength. Tie strength was measured by network proportion of tie intensity, a widely used measure in network research (Burt, 1984; Krackhardt, 1992; Reagans & McEvily, 2003). Each participant was provided with the roster of their team members and was asked to indicate the relationship in terms of emotional closeness and communication frequency. The items are "How frequently do you communicate with this person?" and "How close is this person in terms of emotional attachment?" Tie strength between person *i* and person *j* was calculated by tie intensity between person *i* and person *j* divided by aggregated level of tie intensity across person *i*'s network.

$Tie\ strength_{ij} = z_{ij} \ / \sum_{q=1}^{N} z_{iq,q=j}$ where z_{ij} is the intensity of the relationship between *i* and *j* as a product of emotional closeness and communication frequency. N refers to the total number of person *i*'s network ties, and q refers to team members of person *i*.

Shared friends. I adapted the measure of structural equivalence to calculate shared friends. Structural equivalence, in general, refers to the competition between two persons in regards to the extent how much resources overlap between the two persons for survival, and it can be calculated by the Euclidean distance formula (Burt, 1992; Burt, 1987). With inclusion of tie strength this measure could be used to indicate how many friends are shared between person *i* and person *j*.

$Shared\ friends_{ij} = \left[\sum_q (p_{iq} - p_{jq})^2\right]^{1/2}$ for $q \neq i, j$, where p_{iq} is a tie strength between person *i* to person *j*. Zero distance between *i* and *j* indicates that they have identical friends in the network.

Psychological empowerment. Spreitzer's (1995) twelve-item scale was used to measure psychological empowerment. This measure consists of four dimensions: meaning, competence, self-determination, and impact. Sample questions include "The work I do is very important to me" for meaning, "I am self-assured about my capabilities to perform my work activities" for competence, "I can decide on my own how to go about doing my work" for self-determination, and "I have a great deal of control over what happens in my department" for impact. Cronbach's alpha for the twelve-item scale is 0.90.

Need for cognition. Cacioppo, Petty, and Kao's (1984) eighteen-item scale was used to measure need for cognition. Sample questions include "I would prefer complex to simple problems" and "I would rather do something that requires little enough thought than something that is sure to challenge my thinking abilities (reversed)." Cronbach's alpha for the eighteen-item scale is 0.80.

Expertise utilization. Previous studies measured information seeking behavior or expertise retrieval given a target person's name or a list of group members (Borgatti & Cross, 2003; Yuan et al., 2010). This approach assumes that people tend to search information through network ties. However, TMS theory focuses on the cognitive ties between expertise and people, assuming that people search expertise from a specific person who is linked with that expertise. Thus, a modified version of Borgatti and Cross's (2003) survey item was used, reflecting the expertise utilization process in TMS theory. A list of types of expertise was given to the participants, and each participant was asked to indicate to what extent they have turned to each team member in the given areas of expertise using a Likert scale ranging from 1 (rarely) to 5 (very frequently).

Control variables. Brandon and Hollingshead (2004) suggest that cognitive interdependence is a prerequisite condition for developing transactive memory development. Empirical research also shows the significant relationship between task interdependence and transactive memory system at the team level (e.g., Zhang et al., 2007). It might be possible that team level task dependency could influence expertise retrieval behavior among team members. To control for this possibility, each team leader was asked to indicate to what extent his or her team is task interdependent at the team level. A six-item scale from Wageman and Gordon (2005) was used to measure team task interdependence. Sample items includes “Members of the team I lead work as a team, not a collection of individuals with their own tasks to perform” and “Members of the team I lead work together a lot.” Cronbach’s alpha for the six-item scale is 0.83. The team leaders also indicated the degree of time pressure faced on the team projects with three items (Gardner, 2010). Under high time pressure, it is possible that team members would be stressed out and, as a result, less likely to turn to other team members for expertise. A sample item is “Our team feels we are working under excessive time pressure.” Cronbach’s alpha for this scale was 0.74. Task dependency at the dyadic level was also controlled because it could be assumed that a person would be more likely to seek task related knowledge from team members with whom he or she has dependence (De Jong, Van der Vegt, & Molleman, 2007). The item was “How dependent are you on your team members listed below for materials, means, information, etc. in order to carry out your work adequately?” Since status difference between an actor and a peer might influence an actor’s behavior, status of the peer was controlled for by adding a dummy variable (1 if the peer is a leader in the team, and 0 otherwise). Finally, team size and individual level demographic characteristics of gender and organizational tenure were also included as control variables.

Analysis

The variable, *shared friends*, can only be calculated when a pair of team members responded to the survey. For example, if there are six team members with three expertise areas, each individual member can evaluate twelve expertise levels for each member in each expertise area. If three members responded to the survey, the number of observations of expertise retrieval will be 45. However, *shared friends* can only be calculated among pairs, and three pairs exist in the example. This limitation leads to 18 missing values of observations (40% reduction). The data set in this study has 49% missing observations in *shared friends*. There are two approaches to deal with these missing observations: one is to drop out all the missing observations, and the other is to impute the missing values to look like a complete dataset (Longford, 2008). The imputation method requires assumptions about missing values. If the missing values are completely at random (MCAR) or missing at random (MAR), the imputation method would hold. Otherwise, if the missing values are not at random and correlated with unobservable it would not be feasible. The characteristics of missing values in the current dataset would not be at random since it drops out all of the observations at the second level in the model (peer level). It thus might be difficult to impute the missing values. In addition to that, 49% missing observations is a large amount of imputation, which makes the imputed values not valid. Also, simply dropping out the missing observations would lose a significant amount of information and could lead to biased estimation. Thus, I decided to drop out the *shared friends* variable.

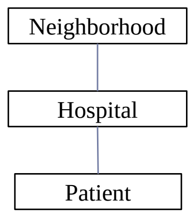
The dependent variable of this study is expertise utilization from each peer in each expertise area. Because the unit of analysis is an expertise level that is being utilized by an actor, independence across observations cannot be assumed (Krackhardt, 1988). For example, when an actor is trying to utilize expertise from a peer in the expertise domain of *ERP (SAP) retail logistics* which is one of the expertise areas identified in the survey, it might be possible that regardless of the peer expertness, the peer is more socially likeable than others, and so the actors are more likely to turn to the peer for retrieving expertise. Gender, age, or attractiveness of the peer would bias an actor's perception of peer expertise and expertise retrieval tendency (e.g., Bunderson, 2003; Hollingshead & Fraidin, 2003).

At the same time, there might be differences of expertise utilization tendency across actors such that extravert actors are more likely to reach out to other team members for expertise than introvert actors. Consequently, showing systematic variances within actors allows for treating expertise utilization as nested within actors. Thus, the data show a non-hierarchical structure such that perceived peer expertise and expertise utilization are nested within both actor and peer simultaneously. To deal with this complex data structure, data analyses utilize cross-classified random effect modeling (Beretvas, 2010; Rabe-Hesketh & Skrondal, 2008).

Cross-classified random effect model has been widely used in education and health research. For example, education researchers utilize cross-classified random effect model to predict student achievement scores cross-classified by middle schools and high schools (Beretvas, 2010). Figure 1 compares a pure hierarchical model with a cross-classified model. In nested model, patients attend hospitals within neighborhood in which they live, and so patients in neighborhood 1, for instance, can only go to the hospital 1 and 4 that are located in the neighborhood 1. In general, however, hospitals have patients from different neighborhoods, and people can choose any hospitals across the neighborhoods. Thus, patients can belong to any combination of hospitals and neighborhoods, and hospitals and neighborhoods become both clustering variables for patients. There are few empirical studies using cross-classified random effect model in management field. For example, Van der Vegt, Bunderson, and Oosterhof (2006) examined helping behavior at interpersonal level with social relation model, which is a specific type of cross-classified random effect model.

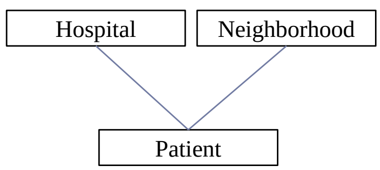
FIGURE 1
Example of cross-classified data structure

Nested model



	Neighborhood 1	Neighborhood 2	Neighborhood 3
Hospital 1	X X X		
Hospital 2		X X	
Hospital 3			X X X
Hospital 4	X X X		

Crossed classified model



	Neighborhood 1	Neighborhood 2	Neighborhood 3
Hospital 1	X X	X	
Hospital 2	X	X	
Hospital 3		X X	X
Hospital 4		X	X X X

Source: Rasbash and Browne (2008)

Table 1 shows an example of the data structure of expertise utilization in 4 team members with 3 expertise areas. Assumptions of cross-classified random modeling for this study are as follows: there are systematic variances within actors, there are systematic variances within peers, there are systematic variances within teams, and there are no systematic variances within expertise.

TABLE 1
Example of data structure in 4 team members with 3 expertise areas.

	Peer 1			Peer 2			Peer 3			Peer 4		
Expertise	1	2	3	1	2	3	1	2	3	1	2	3
Actor 1				x	x	x	x	x	x	x	x	x
Actor 2	x	x	x				x	x	x	x	x	x
Actor 3	x	x	x	x	x	x				x	x	x
Actor 4	x	x	x	x	x	x	x	x	x			

The final dataset for this study has 1,898 expertise utilization observations from 166 peers by 71 individuals in 22 teams. Cross-classified random effect modeling of this study has three-level with two hierarchies and cross-classified factors at level two (see Beretvas, 2010). Expertise utilization from peers by actors presents level 1 (*i*), and it is cross-classified by actors (j_1) and peers (j_2) at level 2, which are both nested within teams (*k*) at level 3. Thus, the unconditional model of expertise utilization (Y_i) appears as follows at level 1 (expertise utilization):

$$Y_{i(j_1,j_2)k} = \pi_{0(j_1,j_2)k} + e_{i(j_1,j_2)k}$$

at level 2 (actors and peers):

$$\pi_{0(j_1,j_2)k} = \beta_{000k} + u_{0j_{10}k} + u_{00j_2k}$$

and at level 3 (teams):

$$\beta_{000k} = \gamma_{0000} + v_{000k}$$

As a single equation, it can be shown:

$$Y_{i(j_1,j_2)k} = \gamma_{0000} + v_{000k} + u_{0j_10k} + u_{00j_2k} + e_{i(j_1,j_2)k} \qquad (1)$$

Therefore, four variance components can be found in the cross-classified random effect modeling of this study (v_{000k}, u_{0j_10k}, u_{00j_2k}, and $e_{i(j_1,j_2)k}$).

I analyze cross-classified random effect model with STATA software using *xtmied* syntax, which is developed for running nested model of multilevel data structure. Since there is no customized statistical software package for cross-classified random effect model, STATA can deal with the crossed data structure by creating an artificial level-2 unit. STATA treats that actors and peers are nested within this artificial level, and generates dummies for each actor and peer. The equitation (1) can be rewritten as

$$Y_{i(j_1,j_2)k} = \gamma_{0000} + v_{000k} + \sum_{s} A_s Actor_s + \sum_{t} P_t Peer_t + e_{i(j_1,j_2)k}$$

where *s* and *t* refer to members of actor and peer within team *k*, and A_s and P_t represent the random coefficients of each actor and peer dummy. To run the cross-classified random effect model, STATA can set up three conditions: (1) All the random effects of actor dummies are forced to be equal, which is corresponding to the actor variance, (2) all the random effects of peer dummies are forced to be equal, which is corresponding to the peer variance, and (3) the covariances between actor and peer are constrained to be zero. Thus, the variance-covariance matrix for the random slopes of the actor and peer dummies as follows

$$\mathrm{u} = \begin{pmatrix} u_{\text{actor1}} \\ u_{\text{actor2}} \\ \cdots \\ u_{\text{actors}} \\ v_{\text{peer1}} \\ v_{\text{peer2}} \\ \cdots \\ v_{\text{peert}} \end{pmatrix} \sim \mathrm{N}(\mathbf{0}, \mathbf{G})\ ; \quad \mathrm{G} = \begin{pmatrix} \sigma_u^2 I_{actor} & 0 \\ 0 & \sigma_v^2 I_{peer} \end{pmatrix}$$

where σ_u^2 and σ_v^2 represent actor and peer variances respectively that are shown as u_{0j_10k} and u_{0j_10k} in equation (1).

Table 2 represents the variance components of cross-classified random effect modeling. It shows that 7% of variance in perceived expertise is attributable to the differences among teams, 13% to the differences among actors, and 24% to the differences among peers. In terms of expertise utilization, about 10% of the total variances are accounted for by teams, 26% by actors, and 20% by peers.

TABLE 2
Results of Cross-classified Random Effect Model:
Variance Components of Perceived Peer Expertise and Expertise Utilization[a]

	Perceived Peer Expertise	Expertise Utilization
Team level	0.112 (7%)	0.194 (10%)
Actor level	0.190 (13%)	0.509 (26%)
Peer level	0.365 (24%)	0.385 (20%)
Residual	0.845 (56%)	0.907 (45%)

[a] n = 1,898 observations from 71 individuals evaluating an average of 7.7 peers in an average of 3.4 expertise areas in 22 teams.

CHAPTER 4

RESULTS

Means, standard deviations, and correlations for all variables of this study are presented in Table 3. Because lower level variables were aggregated to higher level to calculate correlations in most multilevel studies, the correlation among the study variables should be interpreted with caution (e.g., Judge & Hurst, 2008; Judge, Klinger, & Simon, 2010). Previous empirical research using a cross-classified random effect model have reported correlation tables at the lowest level (De Jong et al., 2007; Van der Vegt et al., 2006). This study followed the procedure of previous studies to report correlations among study variables. The correlations in Table 3 were calculated at expertise level, and those correlations are generally consistent with the above hypotheses with, for example, positive and significant correlation between perceived peer expertise and expertise retrieval.

TABLE 3

Means, Standard Deviations, and Correlations

Variable	Mean	s.d.	(1)	(2)	(3)	(4)	(5)	(6)
(1) Expertise retrieval	2.33	1.42						
(2) Perceived expertise level	3.12	1.24	0.60**					
(3) Self perception of expertise	3.16	1.20	0.08**	0.12**				
(4) Expertise dissimilarity	4.59	2.88	-0.06**	-0.12**	0.19**			
(5) Tie strength	0.13	0.11	0.28**	0.13**	0.14**	-0.21**		
(6) Need for cognition	3.14	0.37	0.28**	0.19**	0.23**	-0.12**	0.00	
(7) Psychological empowerment	3.75	0.56	0.27**	0.24**	0.43**	-0.07**	0.04	0.40**
(8) Task dependence toward peer	2.68	1.37	0.50**	0.23**	0.12**	0.01	0.33**	0.22**
(9) Peer status (leader = 1)	0.10	0.30	0.13**	0.08**	0.03	-0.01	0.20**	0.01
(10) Actor gender (male = 1)	0.81	0.40	0.08**	0.06**	0.22**	-0.00	0.01	0.32**
(11) Tenure (months)	60.34	52.10	0.05*	-0.05*	0.21**	0.08**	0.07**	0.15**
(12) Team task dependence	3.61	0.75	-0.02	-0.09**	-0.18**	0.13**	-0.15**	0.01
(13) Time pressure of team project	3.65	0.79	-0.25**	-0.17**	-0.31**	0.25**	-0.41**	-0.09**
(14) Team size	10.89	4.98	-0.31**	-0.13**	-0.30**	0.24**	-0.59**	-0.13**

Note. The correlations were calculated at the peer expertise level.

* $p < 0.05$

** $p < 0.01$

TABLE 3 (Cont.)

Variable	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Expertise retrieval							
(2) Perceived expertise level							
(3) Self perception of expertise							
(4) Expertise dissimilarity							
(5) Tie strength							
(6) Need for cognition							
(7) Psychological empowerment							
(8) Task dependence toward peer	0.13**						
(9) Peer status (leader = 1)	0.04	0.18**					
(10) Actor gender (male = 1)	0.21**	0.06*	0.01				
(11) Tenure (months)	0.04	0.21**	-0.06**	0.09**			
(12) Team task dependence	0.03	-0.02	-0.02	-0.02	0.13**		
(13) Time pressure of team project	-0.15**	-0.23**	-0.09**	-0.15**	-0.25**	0.29**	
(14) Team size	-0.10**	-0.30**	-0.13**	-0.07**	-0.18**	0.39**	0.71**

Note. The correlations were calculated at the peer expertise level.

* $p < 0.05$

** $p < 0.01$

Table 4 presents the results of cross-classified modeling analyses. Model 1 is a baseline model consisting only of control variables. The results shows that task dependence with peer had a strong positive effect on expertise retrieval ($p < 0.01$). Also, time pressure in team shows a negative relationship with expertise retrieval ($p < 0.05$). This suggests that individuals are not likely to approach their team members to seek expertise when they are working without sufficient time for completing their tasks.

In Model 2 the main independent variables were added, and in Models 3-5, each hypothesized two way interaction were examined. Mean-centered values were used for the interaction terms to deal with multicollinearity problems (Aiken, West, & Reno, 1991). Finally, Model 6 presents all the study variables and their effects in predicting expertise retrieval behaviors of actors.

TABLE 4
Results of Cross-classified Random Effect Model:
Predicting Actor's Expertise Utilization from Peer

Variables	Model 1	Model 2	Model 3	Model 4
Intercept	1.90 **	0.03	-0.14	-0.12
Task dependence toward peer	0.37 **	0.27 **	0.24 **	0.22 **
Peer status (dummy: 1: Leader)	0.18	0.06	0.04	-0.06
Actor gender (1: Male)	0.18	0.07	0.04	-0.13
Actor tenure (Months)	0.00	0.00	0.00	0.00
Team task dependence	0.10	0.16	0.14	0.14
Time pressure of team project	-0.15	-0.05	-0.06	-0.06
Team size	-0.04	-0.05 *	-0.03	-0.03
Perceived level of peer expertise		0.56 **	0.56 **	0.58 **
Perceived level of self-expertise		-0.07 **	-0.06 **	-0.08 **
Expertise dissimilarity		0.02 *	0.02 *	0.02 *
Expertise dissimilarity square		0.00	0.00	0.00
Tie strength			0.95 **	1.05 **
Peer expertise × Tie strength				1.58 **
Self-expertise × Tie strength				-0.75 **
Psychological empowerment				
Peer expertise × Psychological empowerment				
Self-expertise × Psychological empowerment				
Need for cognition				
Peer expertise × Need for cognition				
Self-expertise × Need for cognition				
Model deviance	-2726.68	-2358.53	-2353.56	-2315.83

* $p < 0.05$, ** $p < 0.01$, Two tailed tests.

TABLE 4 (Cont.)

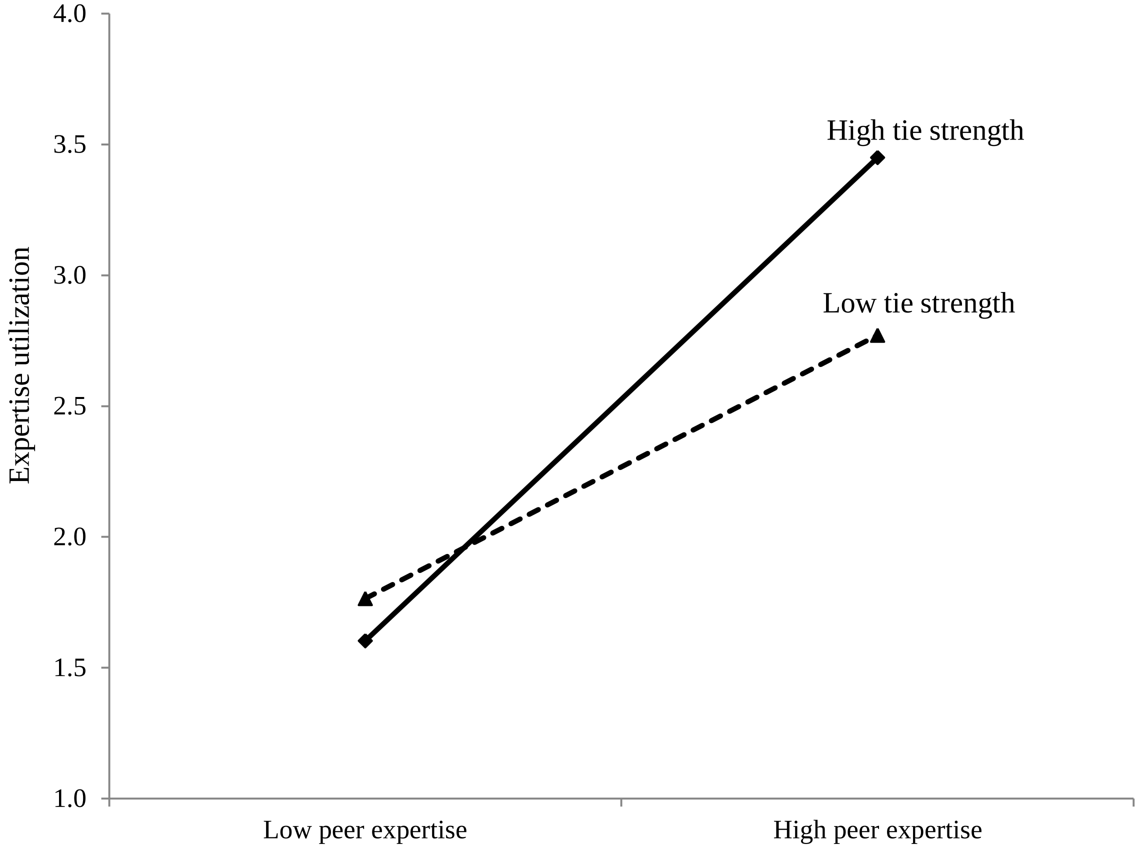
Variables	Model 5	Model 6	Model 7	Model 8	Model 9
Intercept	-1.09	-1.20	-0.99	-0.95	-2.16 *
Task dependence toward peer	0.27 **	0.27 **	0.27 **	0.26 **	0.22 **
Peer status (dummy: 1: Leader)	0.06	0.06	0.06	0.07	-0.06
Actor gender (1: Male)	-0.04	-0.05	-0.01	-0.01	-0.18
Actor tenure (Months)	0.00	0.00	0.00	0.00	0.00
Team task dependence	0.17	0.19	0.16	0.18	0.17
Time pressure of team project	-0.03	-0.02	-0.07	-0.07	-0.05
Team size	-0.05 *	-0.05 *	-0.05 *	-0.05 *	-0.03
Perceived level of peer expertise	0.56 **	0.56 **	0.56 **	0.56 **	0.58 **
Perceived level of self-expertise	-0.06 **	-0.07 **	-0.06 **	-0.06 **	-0.10 **
Expertise dissimilarity	0.02 *	0.02 *	0.02 *	0.02 *	0.02 *
Expertise dissimilarity square	0.00	0.00	0.00	0.00	0.00
Tie strength					1.10 **
Peer expertise × Tie strength					1.56 **
Self-expertise × Tie strength					-0.77 **
Psychological empowerment	0.31 *	0.33 *			0.26
Peer expertise × Psychological empowerment		0.07 *			0.05
Self-expertise × Psychological empowerment		-0.17 **			-0.17 **
Need for cognition			0.37	0.36	0.38
Peer expertise × Need for cognition				0.09	0.07
Self-expertise × Need for cognition				-0.08	-0.06
Model deviance	-2355.95	-2345.53	-2356.98	-2355.74	-2301.09

* $p < 0.05$, ** $p < 0.01$, Two tailed tests.

Hypothesis 1 predicts that an actor's perceived level of peer expertise is positively related to the actor's expertise utilization from the peer. The coefficient estimate for perceived level of peer expertise was positive and significant ($p < 0.01$), supporting hypothesis 1. In hypothesis 2, this study argues that an actor's perceived level of self-expertise is negatively related to the actor's expertise utilization from the peer. Supporting hypothesis 2, the coefficient estimate for perceived level of self-expertise was negative and significant ($p < 0.01$). Hypothesis 3 predicts that the relationship between expertise dissimilarity between actor and peer and expertise utilization is an inverted-U shape. The result for expertise dissimilarity is less clear and only partially supports hypothesis 3. The result shows that there is a linear relationship between expertise dissimilarity and expertise utilization ($p < 0.05$).

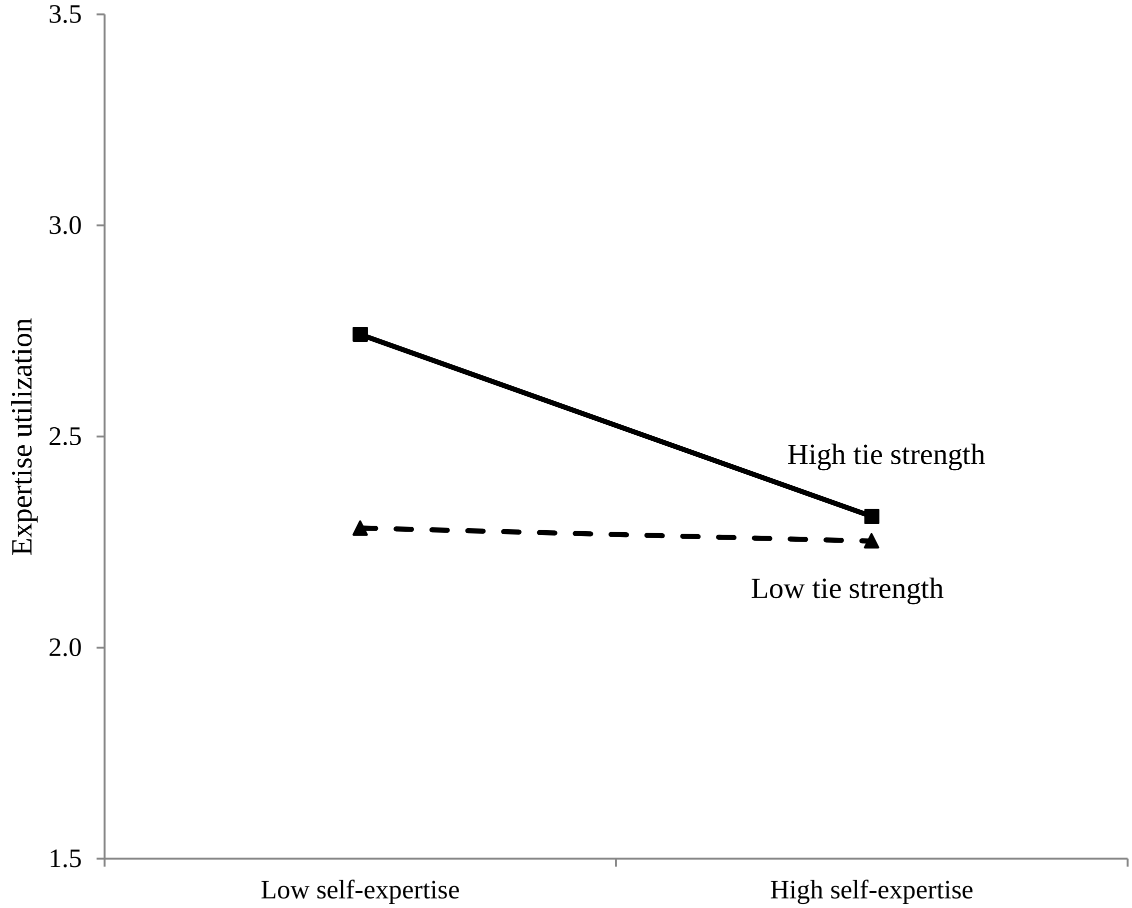
Hypothesis 4a predicts that tie strength moderates the relationship between perceived level of peer expertise and expertise utilization. The resulting coefficient was positive and significant supporting hypothesis 4a ($p < 0.01$). Figure 2 graphically presents the interaction between perceived level of peer expertise and tie strength. As predicted, the relationship between peer expertise and expertise utilization was stronger when the tie strength between actor and peer was higher. Also, hypothesis 4b was supported because the resulting coefficient was negative and significant ($p < 0.01$). The interaction between perceived level of self-expertise and tie strength is graphically presented in Figure 3. The interaction showed that the relationship between perceived level of self-expertise and expertise utilization was stronger when there was a high degree of tie strength between actor and peer

FIGURE 2
Interaction of Perceived Level of Peer Expertise and Tie Strength[a]



[a] High and low values were computed as the population mean plus or minus one standard deviation.

FIGURE 3
Interaction of Perceived Level of Self-Expertise and Tie Strength[a]



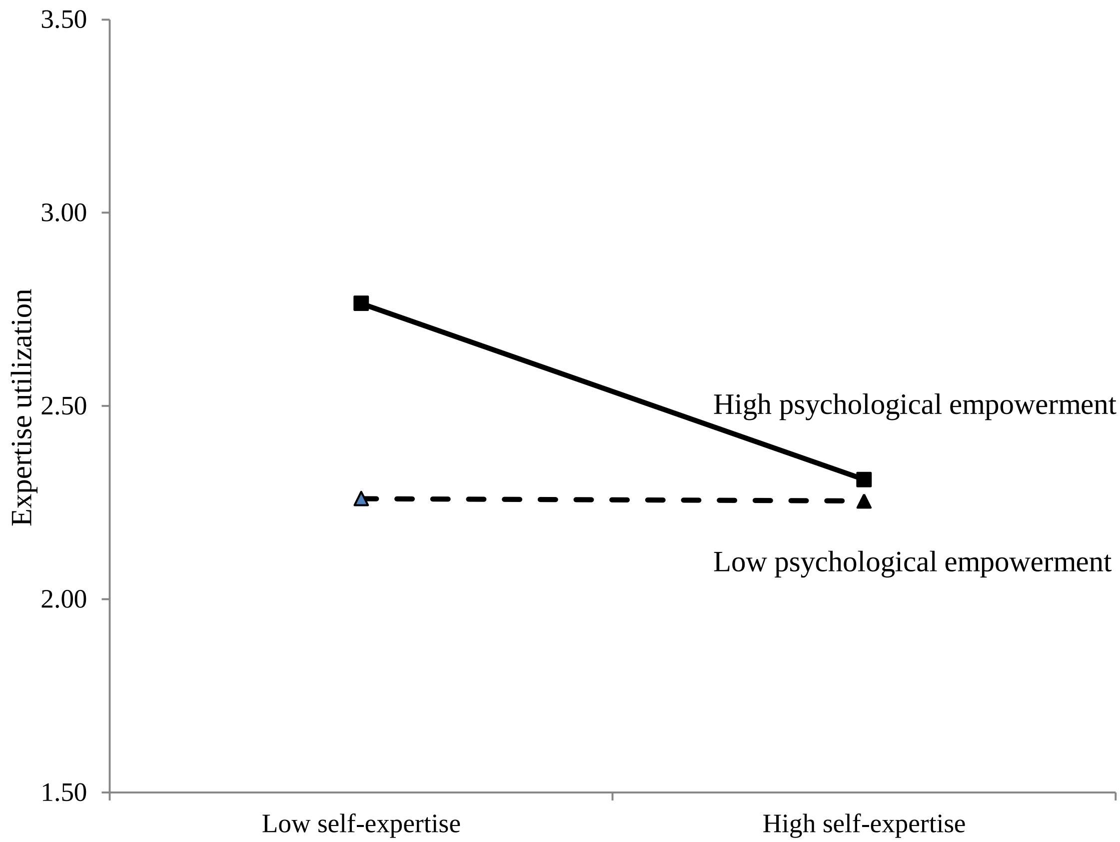
[a] High and low values were computed as the population mean plus or minus one standard deviation.

The variable for shared friends was dropped because of missing values. So, hypotheses 5a and 5b could not be tested. In hypothesis 6a psychological empowerment was suggested as an individual motivator that would moderate the relationship between perceived level of peer expertise and expertise retrieval. Hypothesis 6b predicts psychological empowerment moderates the relationship between self-expertise and expertise utilization. Results for the models presented in Table 4 showed that the interaction between psychological empowerment and self-expertise significantly predicted expertise utilization from peers ($p < 0.01$), supporting hypothesis 6b. However, the interaction between psychological empowerment and peer-expertise did not reach significance, not supporting hypothesis 6a. Figure 4 graphically presents the moderating relationship as hypothesized in hypothesis 6b. The interaction plot indicated that the relationship between perceived level of self-expertise and expertise utilization was stronger in actors high in psychological empowerment.

Finally, I examined the interaction effects of need for cognition on expertise utilization. Hypotheses 7a predicts that need for cognition will moderate the peer expertise-expertise utilization relationship, and hypothesis 7b also predicts the interaction effect on the relationship between self-expertise and expertise utilization. Unlike the predictions, models 7 through 9 show that the coefficients for need for cognition are not significant across all models, not supporting hypotheses 7a and 7b.

FIGURE 4

Interaction of Perceived Level of Self-Expertise and Psychological Empowerment[a]



[a] High and low values were computed as the population mean plus or minus one standard deviation.

CHAPTER 5

DISCUSSION

Organizations increasingly utilize teams to perform complex tasks and projects. In knowledge intensive environments, team members need to specialize in their own expertise as well as rely on others' expertise for completing the team's complex tasks. However, people often fail to recognize the value of expertise that their co-workers possess, and thus are not fully able to integrate all the team members' resources. Drawing from the TMS, social network, and social resources theory, a theoretical model of expertise utilization was examined with the goal of advancing our understanding of factors that facilitate the retrieval tendency of team members' expertise at the dyadic level. Hypotheses predicted in the theoretical model were supported in a multi-period, cross-classified random effect modeling in a sample of project team members from an IT company.

Overview of Findings

The findings of this study regarding the main predictor variables of perceived level of peer expertise and self-expertise in relationship with expertise utilization from peers were consistent with the hypotheses suggested in this study. The findings support the idea in TMS literature that awareness of knowing who knows what increases the probability of retrieving expertise from team members based on the expertise-member association. The negative relationship between perceived level of self-expertise and expertise utilization also supports that individual actors have a tendency to utilize peer expertise when they lack the relevant knowledge in the expertise area. These findings that are consistent with TMS literature suggest that if team members are aware of who are the experts in each area of expertise, individual actors might reduce cognitive load by assigning expertise responsibilities to each peer, and the actors could utilize peers as external memory aids (Hollingshead & Brandon, 2003). Contrary to the inverted-U shape relationship between expertise dissimilarity and expertise utilization in hypothesis 3, the result showed a positive and significant linear relationship. There might be two possibilities for this result. First, the nature of teams implies a group of members working together with one or more common goals through differentiated work roles within a specific boundary (Kozlowski & Ilgen, 2006). An inverted-U shape relationship was hypothesized with the expectation that in the presence of high expertise dissimilarity coordination and miscommunication problems would arise. However, team members used in the sample of project teams might have different work roles and expertise as well as a shared purpose and collective tasks. Differences in expertise areas between team members could indicate complementary knowledge for accomplishing the group goals, and, thus, more differentiated expertise would reflect the necessity of others' expertise. The lack of support for the inverted-U relationship can also be a result of measurement problems. The survey did not provide all the possible expertise areas, and as a result it might not fully capture the expertise dissimilarity between members.

Furthermore, the moderating role of tie strength in expertise utilization should be addressed. This study found that the presence of a strong tie between actor and peer moderated the relationships between peer expertise and expertise utilization and between self-expertise and expertise utilization. More specifically, the results show that when an actor indicated a low level of peer expertise, the actor was less likely to turn to the peer for expertise retrieval regardless of tie strength, but when the actor perceived that the peer had a high level of expertise, expertise utilization was more strongly associated with peer expertise under the condition of a strong tie between the actor and the peer. It implies that network ties do not necessarily convey expertise when the peer does not have the appropriate expertise the actor seeks. In addition, the findings of the moderating role of tie strength in the relationship between self-expertise and expertise utilization suggests that when the actor's expertise is low, the tie strength facilitates the expertise utilization process. However, if the actor perceives him- or herself as an expert, tie strength does not trigger expertise seeking behavior, regardless of tie strength. This implies that when employees are uncertain about information or knowledge, strong ties are more likely to reduce the risk of expertise seeking behavior (e.g., Flynn & Lake, 2008).

Psychological empowerment was suggested as an individual motivator that would moderate the relationship between perceived level of peer expertise and expertise retrieval. Consistent with previous empirical studies, the findings suggest that when actor expertise is low, psychological empowerment plays an important role in the expertise utilization process, but when the actor expertise is high, psychological empowerment does not influence expertise seeking behavior (Anderson, 2008). It suggests that when individuals are motivated to complete their tasks, they are more likely to seek their team members' expertise, but the influence is stronger when the actor lacks confidence in his or her knowledge. Another motivational factor, need for cognition in hypotheses 7a and 7b, was not supported. One possibility is that individuals high in need for cognition may deliberately muse about their task or problems. This type of person would not seek team members' expertise, and instead they would like to deal with it by themselves or they might turn to other sources of expertise such as handbooks or academic articles (e.g., O'Reilly, 1982).

Theoretical Contribution

With respect to TMS research, this study builds on a growing body of work that examines the expertise utilization process at the dyadic level. Previous studies on TMS in teams have focused on the cognitive structure of knowing who knows what and its related outcomes by assuming expertise awareness is directly translated to expertise utilization. Most of the studies focused on the nomological path of TMS structure and how it links to team outcomes (Akgün et al., 2005; Austin, 2003; Lewis, Lange, & Gillis, 2005; Rau, 2005). Yet, the expertise utilization process at a dyadic level has rarely been studied in TMS research (Lewis & Herndon, 2011). In particular, the expertise that the actor and the peer possess was examined as main independent variables to explain the expertise utilization process. This study's findings indicate that individuals tend to turn to their team members for retrieving expertise when the members have expertise, the focal individual lacks expertise, and expertise areas are non-overlapping. Those results support TMS arguments by showing the importance of cognitive awareness of who knows what, and also advance our understanding of expertise utilization process by including actor expertise and the combination of actor and peer expertise.

Social network theory furthers our understanding of the expertise utilization process by arguing that tie strength moderates the expertise awareness-utilization relationship. Even though team members are aware of who is the most knowledgeable in an expertise area, it is possible that they turn to second rank experts for retrieving expertise because of interpersonal relations among team members. Recent studies have found that cognitive awareness of team members' expertise might not be associated with expertise utilization (Borgatti & Cross, 2003; Casciaro & Lobo, 2008; Cross & Sproull, 2004). In order to test this possibility, this study included tie strength as a moderator in the expertise utilization process. Results revealed the actors' expertise seeking behaviors were strengthened under the condition of strong tie relations.

The current study also contributes to work in tie strength literature by incorporating actor and peer expertise in expertise retrieval. While previous studies in tie strength literature have emphasized different roles of strong and weak ties in information search and transfer (Cross & Cummings, 2004; Hansen, 1999; Perry-Smith, 2006), the current study argues that the presence of expertise in either actor or peer is one key to understanding the expertise utilization process. The findings of the current study reveal that relational quality does not play an important role in the expertise utilization process without absence of peer expertise. It implies that tie strength facilitates expertise being conveyed, but that it does not necessarily facilitate conveying expertise when the peer does not have the appropriate expertise the actor seeks. The results also show that when an actor perceives him- or herself as an expert, tie strength does not trigger expertise seeking behavior, regardless of tie strength. It implies that when employees are uncertain about information or knowledge, strong ties are more likely to reduce the risk of expertise seeking behavior (e.g., Flynn & Lake, 2008)

This study also examines a traditional premise in social network studies that people with strong ties are more likely to share information, and, thus, isolated groups with a dense network or strong ties might have redundant resources (Granovetter, 1973; Hansen, 1999; Levin & Cross, 2004). The current study provides an alternative view; densely connected teams can enjoy a non-redundant pool of expertise when team members develop a shared group mind of knowing who knows what. TMS literature argues that through shared meta-knowledge of who knows what, team members can retrieve collective knowledge stock possessed by the team while each member develops their own expertise domain (Austin, 2003; Lewis, 2004). It may suggest that strong ties facilitate a shared mental model of division of cognitive labor by assigning each member a specialization in non-overlapping domains of expertise, which increases the available pool of expertise domains (e.g., Mohammed & Dumville, 2001; Zhang et al., 2007).

Finally, as pointed by Anderson (2008), past research rarely examined the role of motivational aspects in knowledge transfer and information. This study examined the role of motivation in the form of psychological motivation and need for cognition for patterns of expertise utilization. Other scholars have also acknowledged the importance of motivation in the use of social resources (Adler & Kwon, 2002; Burt, 1992). To further advance our understanding of motivational factors in expertise utilization, psychological empowerment and need for cognition were considered in this study. Psychological empowerment was found to strengthen expertise retrieval tendency, but the moderating effect of need for cognition was not supported. The results contribute to the premise in social network and social resources literature that accessible resources possessed by team members will not fully materialize into realized resources without a motivated focal actor. Particularly, the findings suggest that the task-oriented motivation of psychological empowerment is an important driver for expertise utilization of peers.

Limitations and Future Direction

Several limitations of this study should be addressed. First, a same-source bias should be considered. The same participants (i.e., team members) were asked to indicate both dependent and independent variables. Team members evaluated a perceived level of peer expertise and their tendency to utilize peer expertise. However, because the purpose of this study was to examine the individual tendency of expertise utilization based on their cognitive awareness of peer expertise and because there was a time lag of four weeks between the first and the second survey questionnaires, same-source bias is not likely to affect the findings of this study (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). In addition, common method bias would deflate estimated interaction effects, and, thus, the significant results of the interaction effects of this study signal strong support of hypothesized relationships (Siemsen, Roth, & Oliveira, 2010).

Second, this study used expertise utilization as a dependent variable using a Likert item scale ranged from 1 to 5 and treated it as a continuous variable. It must be assumed that the response categories in expertise utilization are at equal intervals, and the distribution needs to be normal (Carifio & Perla, 2007; Jamieson, 2004). The normality test did not support the assumption of normal distribution of expertise utilization, and thus caution is required in interpretation of results.

Third, sources of expertise were restricted to team members as opposed to several other sources, and this might not reflect actual work environments. For example, O'Reilly (1982) investigated information sources and their frequent use, and identified handbooks, newsletters, and other group members as sources of information that are available to the focal individuals. It is possible that depending on expertise characteristics (e.g., codified or non-codified knowledge) people use different sources for seeking information (Hansen, 1999). Future researchers could broaden the scope of this study by including characteristics of expertise and types of expertise sources.

Fourth, this study focused on expertise utilization and treated expertise as a primary resource retrieved from the members. Other types of resources that are generated by connections with team members are also certainly important. A qualitative study conducted by Cross and Sproull (2004) showed that people seek information from others in order to obtain actionable knowledge, which is defined as “knowledge that leads to immediate progress on a current assignment or project” (p.446). They identified five components of actionable knowledge: solution, referrals, problem reformulation, valuation, and legitimation. Likewise, Austin (2003) suggested that an external knowledge relationship (e.g., knowing who knows who) in teams explains unique variances in team performance, thereby implying that people can use team members as referrals (e.g., pointers to other people, Borgatti & Cross, 2003).

Fifth, I evaluated the perception of peer expertise rather than an objective level of expertise. This measure is grounded in the prior literature (e.g., Borgatti & Cross, 2003). However, it is also important for team members to have an accurate perception of peer expertise. If each team member has a different perception of who knows what, retrieving expertise would rattle across the members. Looking at the factors that leads to the bias or accuracy of cognitive awareness of team members’ expertise and what makes team members reach consensus of expertise awareness will be a fruitful venue for future research (e.g., Bunderson, 2003; Hollingshead & Fraidin, 2003).

Finally, this study did not address the question of how peers provide their expertise to actors. Even though I tried to capture the amount of expertise utilization at a dyadic level by measuring the degree of likelihood of a focal individual to turn to their team members for retrieving expertise, it may not fully explicate the transactive process unless expertise providing behavior is considered. Helping expertise might require peers’ time and efforts, and it is possible that asking and providing expertise is a different function from expertise utilization (e.g., power dependence, Van der Vegt et al., 2006). Future research should examine the reciprocal exchange relationship in expertise transactions.

Managerial Implication and Conclusion

Understanding the relationship between expertise awareness and expertise utilization is important for team and organizational performance. This study shows that the relationship between expertise awareness and expertise utilization is moderated by the quality of relationship between people. The results suggest that if tie strength is low, people tend not to seek peer expertise even if the peer possesses valuable expertise for task completion. This might be one reason that all-star teams do not perform as well as expected based on their individual abilities (e.g., Mankins, Bird, & Root, 2013). All-star teams might consist of the best individuals in the given field, but the best players might not trust the abilities of each other, and team performance may be affected by that.

The current study suggests four steps for creating effective teams in knowledge intensive tasks. First, create a team with the best individuals who are specialists in specific expertise domains. Based on the social resources theory (Lin et al., 1981), team members should have the knowledge and skills that are valuable for the team tasks, so that other members can utilize those resources. For the team to be more efficient, team members should have non-overlapping expertise areas. As suggested by TMS literature, team members could deepen their knowledge with specialization, and the team could increase the collective capacity of knowledge if they are focused on differentiated expertise areas (Wegner, 1987; Wegner et al., 1991). Second, let team members become aware of each other’s expertise. Even though team members have sufficient knowledge and expertise, it might not be possible to transact those resources if they do not know who has the appropriate expertise. Without meta-knowledge of knowing who knows what, people might turn to a secondary expert in an area of need or they could spend an avoidable amount of time finding the primary expert. Third, team members need to closely work with each other. Once the resources and cognitive awareness have been established, the relationship quality among team members could hinder or facilitate the coordination of team members' expertise (Borgatti & Cross, 2003; Casciaro & Lobo, 2005). There might be advantages of both weak and strong ties in searching and transferring knowledge (e.g., Granovetter, 1973) but this study finds that in knowledge-based teams, once co-workers' expertise is recognized, strong ties make people feel more comfortable and safe in seeking expertise (e.g., Hansen, 1999). Lastly, team members need to be motivated to complete the task. Adler and Kwon (2002) argue that individual motivation actualizes the potential resources of their social ties into practical use. More specifically, the finding of the current study suggests psychological empowerment will stimulate individuals to actively seek expertise from team members when the focal individuals can not accomplish assigned tasks with their own knowledge.

This study also suggests practical implications for human resource managers. First, human resource (HR) practices can enhance cognitive awareness of who knows what in teams. As suggested by Brandon and Hollingshead (2004) cognitive interdependence is a prerequisite condition for TMS development; group-based compensation and evaluation practices can facilitate interdependency among team members. Also, Moreland and Myaskovsky (2000) found that group training could not only enhance team communications but also develop shared perceptions of knowing who knows what. In terms of enhancing individual motivation for expertise utilization, HR managers could utilize an empowerment practice that reduces the hierarchical structure of decision making and delegate more power to individual employees. Second, recent findings in HR studies argue that HR practices can change social structure among team members, which will influence expertise retrieval (Evans & Davis, 2005; Leana & Van Buren, 1999). For example, Kaše, Paauwe, and Zupan (2009) examined how HR practices could change interpersonal relationships by showing that work design and training and development practices positively impact structural, affective, and cognitive relations among employees.

APPENDIX A
SUPPLEMENTARY ANALYSIS

I conducted supplementary analyses with the shared friends variable even though it might generate systematic bias. The shared friends has 926 missing values since the variable can only be calculated when a pair of team members responded to the first round of survey. After dropping missing values in shared friends, the final number of observations resulted in 972 with 70 actors evaluating 89 peers. Table A.1 shows the results of the cross-classified random effect model with the shared friends variable. In terms of the shared friends variable, hypothesis 5a predicts that shared friends moderates the relationship between perceived level of peer expertise and expertise utilization, and the relationship strengthens the relationship. The resulting coefficient was negative and significant ($p < 0.01$), which is opposite direction. However, the interaction between shared friends and perceived level of self-expertise did not reach significance, not supporting hypothesis 6b.

Table A.2 shows the results of hypotheses testing with / without shared friends. Since there are about 49% missing values in shared friends, dropping all the missing values in the analysis might raise concerns of systematic bias (Longford, 2008). However, the results are consistent with each other.

TABLE A.1
Results of Cross-classified Random Effect Model with Shared Friends Variable

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	2.37 **	0.03	0.06	0.27	-0.82	-0.92
Task dependence toward peer	0.32 **	0.25 **	0.25 **	0.24 **	0.25 **	0.25 **
Peer status (dummy: 1: Leader)	0.31	0.13	0.16	0.09	0.17	0.16
Actor gender (1: Male)	0.19	-0.05	-0.05	-0.09	-0.14	-0.14
Actor tenure (Months)	0.00	0.00	0.00	0.00	0.00	0.00
Team task dependence	0.09	0.18	0.18	0.18	0.19	0.20
Time pressure of team project	-0.30	-0.09	-0.09	-0.10	-0.07	-0.07
Team size	-0.03	-0.04	-0.04	-0.04	-0.04	-0.04
Perceived level of peer expertise		0.62 **	0.622 **	0.60 **	0.62 **	0.62 **
Perceived level of self-expertise		-0.11 **	-0.11 **	-0.12 **	-0.11 **	-0.11 **
Expertise dissimilarity		0.01	0.01	0.01	0.01	0.01
Expertise dissimilarity square		0.01	0.01	0.01	0.01	0.01
Tie strength			-0.12	-0.11		
Peer expertise × Tie strength				1.07 **		
Self-expertise × Tie strength				-0.04		
Psychological empowerment					0.24	0.26
Peer expertise × Psychological empowerment						0.00
Self-expertise × Psychological empowerment						-0.11 *
Need for cognition						
Peer expertise × Need for cognition						
Self-expertise × Need for cognition						
Structural equivalence						
Peer expertise × Shared friends						
Self-expertise × Shared friends						
Model deviance	-1427.51	-1190.62	-1190.58	-1179.47	-1189.15	-1187.05

* $p < 0.05$, ** $p < 0.01$, Two tailed tests. Sample size is 972 because of missing values in shared friends variable.

TABLE A.1 (Cont.)

Variables	Model 7	Model 8	Model 9	Model 10	Model 11
Intercept	-0.85	-0.64	0.02	-0.01	-1.07
Task dependence toward peer	0.24 **	0.24 **	0.25 **	0.25	0.23 **
Peer status (dummy: 1: Leader)	1.67	0.17	0.16	0.13	0.07
Actor gender (1: Male)	-0.12	-0.10	0.05	-0.08	-0.21
Actor tenure (Months)	0.00	0.00	0.00	0.00	0.00
Team task dependence	0.18	0.18	0.18	0.19	0.19
Time pressure of team project	-0.10	-0.10	-0.09	-0.06	-0.07
Team size	-0.04	-0.04	-0.04	-0.04	-0.04
Perceived level of peer expertise	0.62 **	0.62 **	0.62 **	0.62 **	0.60 **
Perceived level of self-expertise	-0.11 **	-0.11 **	0.11 **	-0.11 **	-0.12 **
Expertise dissimilarity	0.01	0.02	0.01	0.01	0.01
Expertise dissimilarity square	0.01	0.01	0.01	0.01	0.01
Tie strength					-0.02
Peer expertise × Tie strength					0.94 **
Self-expertise × Tie strength					-0.49 *
Psychological empowerment					0.16
Peer expertise × Psychological empowerment					0.00
Self-expertise × Psychological empowerment					-0.14 *
Need for cognition	0.32	0.25			0.24
Peer expertise × Need for cognition		0.03			0.03
Self-expertise × Need for cognition		0.05			0.06
Structural equivalence			0.07	-0.62	-0.07
Peer expertise × Shared friends				-1.05 **	-0.88 **
Self-expertise × Shared friends				-0.06	-0.15
Model deviance	-1189.51	-1189.30	-1190.61	-1182.29	-1168.62

* $p < 0.05$, ** $p < 0.01$, Two tailed tests. Sample size is 972 because of missing values in shared friends variable.

TABLE A.2
Results of Hypothesis Testing With / Without Shared friends

	Shared friends	
	without[a]	with[b]
Hypothesis 1	Supported	Supported
Hypothesis 2	Supported	Supported
Hypothesis 3	Not supported (Only linear relationship exists)	Not supported
Hypothesis 4a	Supported	Supported
Hypothesis 4b	Supported	Supported
Hypothesis 5a	Not available	Not supported
Hypothesis 5b	Not available	Not supported
Hypothesis 6a	Not supported	Not supported
Hypothesis 6b	Supported	Supported
Hypothesis 7a	Not supported	Not supported
Hypothesis 7b	Not supported	Not supported

[a] sample size is 1898.
[b] sample size is 972.

APPENDIX B

SURVEY QUESTIONNAIRES[1]

English version

Expertise utilization

When you need the knowledge and information from [*expertise area 1*], how often have you turned to this person for retrieving this expertise?

Expertise area 1	1 Very Low	2 Low	3 Average	4 High	5 Very High
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					

When you need the knowledge and information from [*expertise area 2*], how often have you turned to this person for retrieving this expertise?

Expertise area 2	1 Very Low	2 Low	3 Average	4 High	5 Very High
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					

When you need the knowledge and information from [*expertise area 3*], how often have you turned to this person for retrieving this expertise?

Expertise area 3	1 Very Low	2 Low	3 Average	4 High	5 Very High
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					

[1] Survey questionnaires is an example of six team members with three expertise areas

Perceived level of peer expertise and self-expertise

Please indicate your team members' level of knowledge and expertise in [*expertise area 1*].

Expertise area 1	1 Very Low	2 Low	3 Average	4 High	5 Very High
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					
Myself					

Please indicate your team members' level of knowledge and expertise in [*expertise area 2*].

Expertise area 2	1 Very Low	2 Low	3 Average	4 High	5 Very High
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					
Myself					

Please indicate your team members' level of knowledge and expertise in [*expertise area 3*].

Expertise area 3	1 Very Low	2 Low	3 Average	4 High	5 Very High
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					
Myself					

Tie strength

How close are you with each person?

	1 Acquaintance	2 Distant colleague	3 Friendly colleague	4 Good friend	5 Very close friend
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					

How frequently do you communicate with each person on average?

	1 Rarely	2	3 Sometimes	4	5 Very frequently
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					

Task interdependency at dyadic level

How dependent are you on your coworkers listed below for materials, means, information, etc. in order to carry out your work adequately?

	1 Not dependent	2	3 Moderate dependency	4	5 Fully dependent
Peer 1					
Peer 2					
Peer 3					
Peer 4					
Peer 5					

Psychological empowerment

1. The work I do is very important to me.
2. My job activities are personally meaningful to me.
3. The work I do is meaningful to me.
4. I am confident about my ability to do my job.
5. I am self-assured about my capabilities to perform my work activities.
6. I have mastered the skills necessary for my job.
7. I have significant autonomy in determining how I do my job.
8. I can decide on my own how to go about doing my work.
9. I have considerable opportunity for independence and freedom in how I do my job.
10. My impact on what happens in my department is large.
11. I have a great deal of control over what happens in my department.
12. I have significant influence over what happens in my department.

Need for cognition

1. I would prefer complex to simple problems.
2. I like to have the responsibility of handling a situation that requires a lot of thinking.
3. Thinking is not my idea of fun. (reversed)
4. I would rather do something that requires little enough thought than something that is sure to challenge my thinking abilities. (reversed)
5. I try to anticipate and avoid situations where there is likely chance I will have to think in depth about something. (reversed)
6. I find satisfaction in deliberating hard and for long hours.
7. I only think as hard as I have to. (reversed)
8. I prefer to think about small, daily project to long-term ones. (reversed)
9. I like tasks that require little thought once I've learned them. (reversed)
10. The idea of relying on thought to make my way to the top appeals to me.
11. I really enjoy a task that involves coming up with new solutions to problems.
12. Learning new ways to think doesn't excite me very much. (reversed)
13. I prefer my life to be filled with puzzles that I must solve.
14. The notion of thinking abstractly is appealing to me.
15. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.
16. I feel relief rather satisfaction after completing a task that required a lot of mental efforts. (reversed)
17. It's enough for me that something gets the job done; I don't care how or why it works. (reversed)
18. I usually end up deliberating about issues even when they do not affect my personality.

Survey Questionnaires for team level variables evaluated by project leaders

List of expertise areas

Each project team in your company is operating different projects and tasks in different business areas, and your team members might need to possess specific expertise areas based on the project. What are specific expertise areas that are important for your team function? Please write the list of **specific expertise areas** that is critical in order to successfully carry out your team project, and also indicate the importance of each expertise area.

Importance scale

1 2 3 4 5

Less important — Most important

Expertise areas for your team project	Importance

*Each project team might have different number of expertise areas based on team tasks.

Team task interdependence

1. Members of the team I lead work as a team, not a collection of individuals with their own tasks to perform.
2. Team members' work is not done until everyone has done his or her part.
3. Members of the team I lead often have to share materials and ideas to get their work done.
4. Members of the team I lead work together a lot.
5. My team frequently needs to count on one another.
6. Individuals on my team often have to speak with their teammates to do their part well.

Time pressure for team project

1. We feel we are working under excessive time pressure
2. Given more time, we can perform a more robust audit [project]
3. We have sufficient time to complete our task to an acceptable quality (reversed)

SURVEY QUESTIONNAIRES[2]

Korean version

Expertise utilization

다음은 각 지식영역에 대한 지식활용과 교환이 어떻게 이루어지고 있는지를 표현하는 문장입니다. 다음 문장에 얼마나 동의하는지 표시해 주세요.

내가 업무 수행중 [*전문영역 1*]에 대한 지식과 정보가 필요했을 때에, 나는 이 사람에게 얼마나 정보를 얻었다.

전문 영역 1	1 거의 그렇지 않음	2 그렇지 않음	3 보통임	4 그러함	5 매우 그러함
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					

내가 업무 수행중 [*전문영역 2*]에 대한 지식과 정보가 필요했을 때에, 나는 이 사람에게 얼마나 정보를 얻었다.

전문 영역 2	1 거의 그렇지 않음	2 그렇지 않음	3 보통임	4 그러함	5 매우 그러함
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					

내가 업무 수행중 [*전문영역 3*]에 대한 지식과 정보가 필요했을 때에, 나는 이 사람에게 얼마나 정보를 얻었다.

전문 영역 3	1 거의 그렇지 않음	2 그렇지 않음	3 보통임	4 그러함	5 매우 그러함
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					

[2] Survey questionnaires is an example of six team members with three expertise areas

Perceived level of peer expertise and self-expertise

[*전문영역 1*] 대한 본인과 동료들의 지식과 전문성은 얼마나 되는지 표시해 주세요.

전문 영역 1	1 매우 낮음	2 낮음	3 보통	4 높음	5 매우 높음
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					
나 (Myself)					

[*전문영역 2*] 대한 본인과 동료들의 지식과 전문성은 얼마나 되는지 표시해 주세요.

전문 영역 2	1 매우 낮음	2 낮음	3 보통	4 높음	5 매우 높음
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					
나 (Myself)					

[*전문영역 3*] 대한 본인과 동료들의 지식과 전문성은 얼마나 되는지 표시해 주세요.

전문 영역 3	1 매우 낮음	2 낮음	3 보통	4 높음	5 매우 높음
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					
나 (Myself)					

Tie strength

당신은 각 동료들과 얼마나 가까운 관계입니까?

	1 안면만 있음	2 다소 거리감 있음	3 가까운 직장 동료	4 직장동료 이상의 좋은 관계	5 직장동료 이상의 매우 가까운 관계
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					

당신은 각각의 동료들과 보통 얼마나 자주 대화하는 편입니까?

	1 거의 하지 않음	2 많이 하지 않음	3 보통	4 자주 대화함	5 매우 자주 대화함
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					

Task interdependency at dyadic level

당신은 당신의 업무를 수행하는데 필요한 자료, 도구, 정보 등에 대해 아래의 동료들에게 얼마나 의존적입니까?

	1 의존적이지 않음	2 다소간 의존적임	3 보통	4 어느정도 의존적임	5 전적으로 의존적임
동료 1					
동료 2					
동료 3					
동료 4					
동료 5					

Psychological empowerment

13. 내가 하는 업무는 나에게 매우 중요하다.
14. 나의 업무 활동은 개인적으로 의미있는 일이다.
15. 내가 하는 업무는 나에게 의미가 있다.
16. 나는 내가 하는 업무를 처리할 수 있는 능력이 있다고 확신한다.
17. 나는 나의 업무활동들을 실행하기위한 나의 역량에 대해 확신한다.
18. 나는 나의 업무에 필요한 기술들을 습득해왔다.
19. 나는 나의 업무를 어떻게 할 것인지에 대한 충분한 자율권이 있다.
20. 나는 나의 업무를 어떻게 진행할 것지 스스로 결정할 수 있다.
21. 나는 나의 업무를 하는데 있어서 충분한 독립성과 자율성을 보장받고 있다.
22. 나의 부서에서 일어나는 일들에 대한 나의 영향력은 크다.
23. 나는 나의 부서에서 일어나는 일들에 대한 상당한 통제능력이 있다.
24. 나는 나의 부서에서 일어나는 일들에대한 충분한 영향력이 있다.

Need for cognition

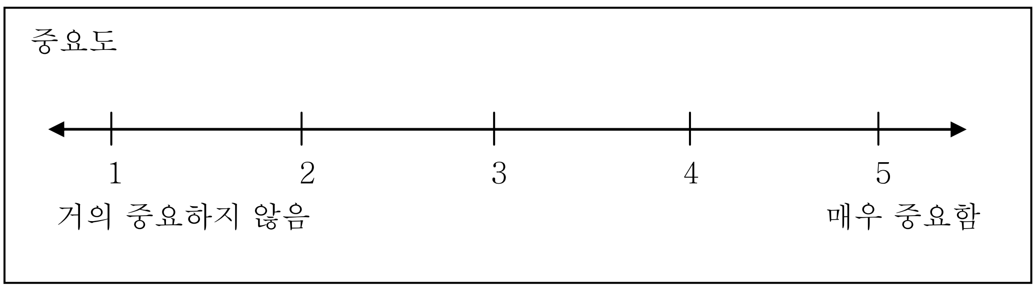
19. 나는 단순한 문제보다 복잡한 문제를 선호한다.
20. 나는 많은 생각을 요하는 상황을 다루는 일을 맡아하기를 좋아한다.
21. 나는 생각하는 것을 즐겨하지 않는다.
22. 나는 나의 사고력을 많이 요하는 일보다 조금 요하는 일을 좋아한다.
23. 나는 무언가에 대해 깊이 생각하는 상황을 예상하고 피하려고 노력한다.
24. 나는 깊고 오랫동안 고민하는 것에 만족감을 찾는다.
25. 나는 오직 고민해야 할 경우만 그렇게 한다.
26. 나는 장기적인 관점의 것 보다는 작고 하루하루의 일만 생각하길 좋아한다.
27. 나는 일단 배우고 나면 조금의 사고를 요하는 일을 좋아한다.
28. 나는 최선의 방법을 만들기 위해 숙고하는 것이 좋다.
29. 나는 문제에 새로운 해답을 제시하는 업무를 하는 것을 즐긴다.
30. 새롭게 사고하는 법을 배우는 것은 좀처럼 흥미를 유발하지 않는다.
31. 나는 내가 반드시 풀어야 하는 퍼즐로 가득찬 삶을 선호한다.
32. 추상적으로 생각한다는 개념은 나에게 매력적이다.
33. 나는 다소 중요하지만 많은 생각을 요구하지 않는 일 보다는 지적이고, 어렵고, 중요한 업무를 더 선호한다.
34. 나는 많은 정신적 노력을 요구하는 일을 마친 후에는 만족감보다는 안도감을 느낀다.
35. 나는 업무가 끝났다는 사실이면 충분하다; 나는 업무가 왜/어떻게 진행되는지는 상관하지 않는다.
36. 나는 보통 어떤 사안에 대해 나에게 미치는 영향이 없을지라도 깊이 고민하게 된다.

Survey Questionnaires for team level variables evaluated by project leaders

List of expertise areas

당신의 회사내에 각각의 팀들은 모두 다른 분야에서 다양한 업무와 프로젝트를 진행하고 있습니다. 그리고 각 팀의 성격과 프로젝트의 특성에 따라 필요로 하는 전문기술 지식 (expert area)이 있습니다.

현재 당신이 이끌고 있는 팀의 업무성과를 효율적으로 달성하기 위해 팀에 필요한 전문기술 영역은무엇입니까? 팀의 업무를 성공적으로 수행하기 위해 필요한 **구체적인 기술영역** 중 가장 중요한 영역을 나열해 주세요.



팀 업무에 필요한 지식 영역	중요도

*전문영역의 개수는 팀별 업무 성격에 따라 달라질 수 있습니다.

Team task interdependence

7. 나의 팀원들은 업무수행에 있어 서로를 필요로 한다.
8. 팀 멤버들의 업무는 모든 팀원들이 각자의 역할을 다 할 때까지는 완수할 수 없다.
9. 내가 이끄는 팀의 멤버들은 업무를 수행하기 위해 자료나 생각을 교환해야만 한다.
10. 내가 이끄는 팀원들은 많은 양의 공동작업을 한다.
11. 내가 이끄는 멤버들은 각각 독립적인 업무를 수행하지 않는다.
12. 팀원들은 업무를 잘 수행하기 위해 동료들과 의사소통을 해야만 한다.

Time pressure for team project

4. 나의 팀은 과도한 시간 압박 아래서 일한다고 느낀다.
5. 더 많은 시간이 주어진다면, 우리 팀은 보다 정밀한 프로젝트를 진행 할 수 있을 것이다.
6. 우리는 만족할만한 수준의 업무를 완성할 수 있는 충분한 시간이 있다.

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