Share or send and receive? The impact of team knowledge outflow/inflow with IT support on performance

Article *in* Journal of Knowledge Management · October 2019

DOI: 10.1108/JKM-11-2018-0705

CITATIONS
0

READS
61

5 authors, including:

Junyeong Lee
Korea University of Technology and Education
19 PUBLICATIONS **83** CITATIONS
SEE PROFILE

Jinyoung Min
Chosun University
17 PUBLICATIONS **334** CITATIONS
SEE PROFILE

Chanhee Kwak
Korea Advanced Institute of Science and Technology
11 PUBLICATIONS **15** CITATIONS
SEE PROFILE

Lg Pee
Nanyang Technological University
58 PUBLICATIONS **780** CITATIONS
SEE PROFILE

Share or send and receive? The impact of team knowledge outflow/inflow with IT support on performance

Junyeong Lee, Jinyoung Min, Chanhee Kwak, L.G. Pee and Heeseok Lee

Abstract

Purpose – *An organization can be understood as a knowledge network in which teams send and receive knowledge. Many studies have explored knowledge sharing across teams but did not consider the direction of knowledge flows (KF), specifically how the knowledge inflow (KIF) and knowledge outflow (KOF) can be induced and influence team activities differently. To fill this gap, this paper distinguishes between KIF and KOF, examines their antecedents and consequences and considers how KIF and KOF within a team moderate the relationship between antecedents and KF of a team.*

Design/methodology/approach – *This study used structural equation model analysis of a sample of 341 individuals within 73 teams from four companies.*

Findings – *The results suggest that IT support is essential because it influences both KIF and KOF. However, only KOF has a significant effect on team performance suggesting that ambidexterity is not always necessary. In promoting KOF, increasing task interdependency is also effective. The effect of IT support varies with the level of KIF diversity.*

Originality/value – *The findings emphasize the importance of distinguishing KOF from KIF in a team's knowledge network under the theoretical lens of ambidexterity. Identifying how IT support influences KF and how these flows separately affect team performance can provide useful insights into managing and facilitating KF in an organization.*

Keywords *Team management, Empirical study, IT support, Knowledge inflow, Knowledge outflow, Team diversity in knowledge flow, Ambidexterity*

Paper type *Research paper*

1. Introduction

Companies have turned to team-based organization for its high information processing capability (Shin *et al.*, 2012). Organizational knowledge resides in teams and is sent and received between teams in various magnitudes and directions (Gupta and Govindarajan, 1994). However, becoming a knowledge sender does not necessarily mean becoming a knowledge recipient. Differences in the value of the knowledge and the motivations and channels of its transmission can make teams active in either or both sending and receiving (Gupta and Govindarajan, 2000; Stenius *et al.*, 2016; Wang and Hou, 2015), resulting in different roles for teams within an organization (Gupta and Govindarajan, 1991). Consequently, a team that is highly engaged in both sending and receiving can enhance both the circulation and recombination of existing knowledge (Eisenhardt and Galunic, 2000). A team that shows high level of activity in either of them can become a pure knowledge provider or an exploiter (Villasalero, 2017). By contrast, a team that is neither sending nor receiving knowledge can suffer from isolation (Villasalero, 2013). Therefore, it is essential to view knowledge flows (KF) in a knowledge network not as a combined form of

sending and receiving but as separate forms that distinguish between knowledge inflow (KIF) and knowledge outflow (KOF).

In this sense, following the work of Gupta and Govindarajan (1991), studies have focused on the two types of KF: KIF and KOF. However, only a limited number of studies has investigated them separately, their effects on performance and what influences these flows. For instance, some studies separated KIF and KOF but most targeted multinational companies with parent–subsidiary relationships (Harzing and Noorderhaven, 2006; Monteiro *et al.*, 2008). As the linguistic and cultural distances across units of multinational companies can differ significantly from those of teams that exist in close proximity, the KF of multinational companies cannot properly represent KF at the team level. Moreover, some of these studies focused only on either KIF (Mahnke *et al.*, 2005; Mom *et al.*, 2007; Tippmann *et al.*, 2014) or KOF (Björkman *et al.*, 2004), making it difficult to see how these operate together. Although some considered KIF and KOF simultaneously (Gupta and Govindarajan, 2000; Villasalero, 2017), their findings were limited. There has been no consensus on the effects of KOF, as both beneficial (Lai *et al.*, 2016; Schulz, 2003) and detrimental effects (Droege *et al.*, 2003; Schulz and Jobe, 2001) have been reported on a unit's performance. Additionally, conflicting effects of team KIF were observed. KIF can trigger team learning and enhance a team's knowledge reservoir (Chang *et al.*, 2012; Jaw *et al.*, 2006) but can also trigger potentially harmful influences due to inaccurate learning (Yang, 2012) and strong reliance on external resources (Villasalero, 2017).

To understand further how certain flows operate, this study investigates the KIF and KOF of teams separately in terms of the context characteristics that affect those flows, their effects on team performance, and how a team's degree of ambidexterity in terms of KIF and KOF affects its performance.

For this purpose, we consult ambidexterity theory (Duncan, 1976), which suggests an organizational unit can be ambidextrous by successfully pursuing two disparate activities at the same time. More specifically, by using a cross-sectional survey on 73 teams composed of 341 individuals from four companies, this study answers the following questions: How does the information technology (IT) support, which is represented as the context characteristic, influence a team's level of KIF and KOF? How does each knowledge flow affect team performance? How does the diversity of KF within a team influence the way IT support affects a team's KF? How do teams differ based on their ambidexterity of KF?

2. Theoretical framework and literature review

2.1 Theoretical framework: organizational ambidexterity

Organizational ambidexterity is an organization's ability to pursue two disparate things simultaneously (Duncan, 1976). The literature suggests that, in task environments, demands in an organizational unit are usually in conflict to some degree and reconciling these conflicting demands and being ambidextrous can enhance work performance (Gibson and Birkinshaw, 2004). These conflicting demands have been identified in different terms, such as exploitation and exploration (Luger *et al.*, 2018); alignment and adaptation (Gibson and Birkinshaw, 2004); and efficiency and flexibility (Adler *et al.*, 1999).

In the sense that ambidexterity theory focuses on a team's disparate activities, the concept of ambidexterity can be applied to analyzing a team's KF: KIF and KOF are disparate but simultaneous activities (Gupta and Govindarajan, 1991; Harzing and Noorderhaven, 2006). This study focuses on expanding our comprehension of KF from the perspective of ambidexterity by investigating the interplays of the two flows in a team setting.

Additionally, a key issue in organizational ambidexterity is how it can be achieved (Raisch *et al.*, 2009). A stream of research suggests that organizational ambidexterity can be accomplished by allocating different roles to each unit such that a single unit is not

ambidextrous by itself but the set of business units as a whole is. This concept is structural ambidexterity, which assumes that it is difficult for a unit to be good at two different things, so ambidexterity can be achieved not by a single unit but by a structural organization of these units. By contrast, contextual ambidexterity suggests that a unit can be ambidextrous depending on the context (Gibson and Birkinshaw, 2004). In this study, we address this issue by studying the context characteristics affecting a team's KF.

2.2 Ambivalent knowledge flows: knowledge inflow and knowledge outflow

The sharing of organizational knowledge is a critical activity that can enhance the accessibility and dissemination of knowledge created and used by a specific unit in an organization (Schulz, 2003). This unit-specific knowledge can lead to knowledge expansion and innovation (Tsai, 2001). Moreover, as it can benefit other teams (Lai *et al.*, 2016), its flow can enhance team capabilities (Nickerson and Zenger, 2004) and, by improving the mobility of core competencies, can increase team performance (Tsai, 2001).

An important feature of KF is bidirectionality (Chen and Hung, 2010; Gupta and Govindarajan, 2000; Van Wijk *et al.*, 2008). There are two roles in a KF relationship: those of the receiver and the sender. From a knowledge receiver's perspective, a team acquires knowledge created by other teams, a process also known as KIF (Gupta and Govindarajan, 1991; Jaw *et al.*, 2006). KIF suggests the increased availability of knowledge assets. With knowledge from other teams, a team can fill knowledge gaps and find novel combinations of knowledge (Phene and Almeida, 2008). Additionally, an expanded knowledge reservoir presents a team with greater opportunities and encourages creativity (Fey and Birkinshaw, 2005). However, studies have reported the detrimental effects of KIF on a team's performance; a team can gain inaccurate or inefficient knowledge (Yang, 2012) and a team with a high level of KIF can be hugely dependent on external knowledge, which can hinder its performance (Villasalero, 2017) suggesting that the effects of KIF on team performance remain unclear.

A team can also send out knowledge to help other teams through KOF (Jaw *et al.*, 2006). This team can be a resource pool that teaches its own knowledge to other teams, leading to enhanced knowledge application by other teams (Schulz, 2001) or the focal team itself (Lai *et al.*, 2016). Since teams have different expertise, offering one's knowledge can benefit other teams (Eisenhardt and Martin, 2000). However, the effect of KOF on an organizational unit is unclear. KOF can create additional burden for a team by requiring extra effort to transfer its knowledge, including preparing and codifying knowledge and managing communications with other units (Choi and Lee, 2003). Moreover, it may not pay off, due to opportunistic behaviors of receiving teams (Droege *et al.*, 2003). In such cases, although organizational performance could be improved (Yang, 2012), a focal team's performance might not necessarily improve. Meanwhile, KOF is also a self-learning process (Lai *et al.*, 2016) reorganizing sometimes uncertain and vague knowledge. By clarifying it, a team can manage this knowledge more efficiently and effectively and, in the process, understand previously unknown knowledge gaps (Lippman and Rumelt, 1982). A feedback loop is another benefit of KOF. When a knowledge receiving team applies that knowledge in different settings and conditions, feedback can be provided to the team that sent the knowledge improving the sending team's understanding of that knowledge (Markides and Williamson, 1994). Additionally, a focal team can gain information on knowledge adaptation and application (Chatterjee, 1990). Lastly, a team that actively engages with KOF signals a rich knowledge base and thus can be considered a desirable partner for cooperation by other teams (Villasalero, 2014; Villasalero, 2017).

2.3 How knowledge inflow and knowledge outflow are achieved: diversity within a team

When investigating the characteristics of a team, its composition cannot be ignored as an aggregated measure, which only depicts the centrality of its characteristics, and is not

sufficient to draw a detailed picture of a group (Cooke *et al.*, 2000). Therefore, many researchers have adopted the concept of diversity (or compositional variance). Taking into account a team's diversity, which refers to differences among its members (Van Knippenberg *et al.*, 2013), enables one to capture its compositional information (Harrison and Klein, 2007), and such an expanded understanding of a team facilitates detailed investigations of group dynamics and contexts. For instances, decision-making processes can be greatly influenced by diversity, which is linked to the intensity of a team's consensus (Rao and Tilt, 2016). In addition, team diversity can impact a team's innovation and creativity, as it represents the team's functional and knowledge mix (Lee *et al.*, 2015).

A traditional subject of diversification is surface-level diversity, reflecting physical and biological features (Harrison *et al.*, 1998) such as age, gender, race, ethnicity and tenure. Generally, these are immediately observable, easily measurable and remain unchanged. However, an in-depth look at diversity can reveal differences in attitudes, beliefs, knowledge and skills that can be mutable and subject to construal (Harrison *et al.*, 1998; Tekleab *et al.*, 2016), enabling the collection of much deeper and richer information on individual behavior than available from surface-level diversity.

Knowledge transfer can also be influenced by this deep-level diversity (Pinjani and Palvia, 2013). A team's behavioral composition can have a significant influence on its members' knowledge sharing behavior (Cummings, 2004; Srivastava *et al.*, 2006). In terms of KF, a team member can think of how diversely his or her teammates engage in KF as an important behavioral cue (Park and Kim, 2018); a team's high KF diversity can be seen as an absence of team standards regarding KF, providing no motivation for team members to actively engage in KF (Huang *et al.*, 2013). Nevertheless, studies considering the impact of team behavioral diversity in KIF and KOF are limited. Therefore, an investigation on the effects of diversity in terms of knowledge behavior is important to enhance team knowledge management (KM).

2.4 Context for achieving knowledge flows

According to organizational ambidexterity theory, context can determine whether structural or contextual ambidexterity is achieved; depending on the context in which KIF and KOF occur, either one or both types of flows are facilitated within a team.

In a work context, KF among teams occur through their interactions, such as coordination, and collaboration (Liyanage *et al.*, 2009). As their interactions are associated with task-related operations and processes, such task-related teams interact with one another and knowledge flows between them (Lee *et al.*, 2017). Therefore, task characteristics are an essential contextual factor that can influence KF across teams (Argote and Ingram, 2000; Becerra-Fernandez and Sabherwal, 2001). However, these interactions are affected by other supplementary contextual factors that are not necessarily task related. Among them, technology is the most foundational and all-encompassing, as it links individuals, codifies the knowledge, and promotes collaboration and information sharing (Barua *et al.*, 1995; Dewett and Jones, 2001). In particular, technology enables KF without temporal or spatial limitations with efficient knowledge integration (Bélanger and Allport, 2008). Therefore, we investigate task and technology characteristics as the two contextual factors that affect the achievement of KF.

2.4.1 Task interdependency as a task-dependent context characteristic for achieving knowledge flows. We describe the task-dependent context by using task interdependency, which is defined as "the intensity and direction of a workflow relationship between two teams" (Gerwin and Moffat, 1997, p. 301). Task interdependency is closely related to KF across teams because it determines how team members rely on other teams' knowledge to achieve their own tasks (Goodman, 1986). Given highly interdependent tasks, teams are more likely to engage in sharing knowledge, since communication and cooperation across

related individuals and teams are required (Wageman, 1995). Accordingly, it is well known that the positive relationship between task interdependency and knowledge activities (Cabrera and Cabrera, 2005; Janz *et al.*, 1997) thus rather obvious. Therefore, this study uses task interdependency as a control variable and focuses on examining the effects of IT support on KF in the presence of task interdependency.

2.4.2 Information technology support as a technological context characteristic for achieving knowledge flows. IT support has become increasingly important in its KM activities, handling complex team knowledge. IT support refers to how well IT assists in collaborative work, communications, and searching, accessing, and storing information (Lee and Choi, 2003). IT support affects team knowledge activities by reducing information-processing costs and enhancing information availability (Clemons *et al.*, 1993). For instance, IT support the search for knowledge and collaboration with others (Alavi and Leidner, 2001; Zigurs and Kozar, 1994) and identify KF processes through communication channels (Yeh *et al.*, 2006), especially through KM systems. IT systems play a substantial role in supporting KM activities (Alavi *et al.*, 2006) and are thus highly related to the way knowledge flows within an organization. Moreover, since today's businesses are highly diverse and fragmented, IT support is important to link, store, apply and integrate information and knowledge (Malhotra and Majchrzak, 2004; Pan and Leidner, 2003). IT support becomes effective in KF in two ways with both co-located and distributed teams: through codification and personalization (Haas and Hansen, 2007). Teams use IT to share codified knowledge through databases in a person-to-document manner, as well as to build personalized networks to share knowledge on a person-to-person basis (Gupta *et al.*, 2009). Malhotra and Majchrzak (2004) also suggested the usefulness of IT support in far-flung teams in terms of task coordination, external connectivity, distributed cognition, and interactivity; all these dimensions are highly related to the flow of knowledge. Therefore, in this study, IT support is considered an important context characteristic for achieving KF.

3. Hypothesis development

3.1 Contexts of knowledge inflow and knowledge outflow: information technology support

IT enables individuals to communicate quickly and create networks, thus reducing teams' communication costs (Schultze and Orlikowski, 2004). IT also facilitates information exchange among teams and increases the accuracy of and expedites information flow by providing a set of governance arrangements and applications (Argyres, 1999). For example, by using visualization and accessing information as supported by IT (Kautz and Thaysen, 2001), teams in a dyadic relationship can realize the benefits of information exchange by identifying the knowledge they already have versus what they still need to acquire. IT also supports the exchange of knowledge to gain an external perspective and a clearer view of the tasks at hand (Malhotra and Majchrzak, 2004). Additionally, IT assists in enhancing the identification and linkage of relevant content (Zack, 1999), improving access to communication channels for identifying KF processes (Yeh *et al.*, 2006), and minimizing the barriers of KF across units in an organization (Lee and Choi, 2003). These examples demonstrate that KF increase with IT support. Thus, we hypothesize the following.

H1. IT support has a positive effect on a team's knowledge inflow.

H2. IT support has a positive effect on a team's knowledge outflow.

3.2 Contexts of knowledge inflow and knowledge outflow: knowledge inflow and knowledge outflow diversities

As previously mentioned, IT support can facilitate KF between people. However, the influence of this support varies depending on a team's composition. Since individuals have different capabilities in handling KF and processes (Griffith *et al.*, 2003; Jackson *et al.*, 1995), the

diversity of KF among team members can moderate the relationship between IT support and both KF of a team.

High KIF diversity within a team implies differences in team members' capabilities in using IT to identify the knowledge they have and need and to search required knowledge (Pan and Leidner, 2003). Additionally, the diversity of KIF within a team is high when only some of the team members manage KIF while the rest depend on them. In such a situation, team members who actively participate in KIF are less likely to share acquired knowledge with other members (Wang *et al.*, 2007; Yu *et al.*, 2013), and the team thus has difficulty acquiring a shared understanding of knowledge. Additionally, high KIF diversity can be associated with less intra-team communication and information exchange and can lead to redundant or unnecessary KIF for a team, which makes it difficult to achieve a shared understanding of KIF at the team level. Consequently, the impact of IT support in identifying and searching relevant external knowledge for a team and making it team knowledge (i.e. a team's KIF) can be diminished. Hence, we hypothesize the following.

H3. Knowledge inflow diversity within a team weakens the relationship between IT support and a team's knowledge inflow.

Diverse KOF within a team can be viewed as a lack of understanding of team-level KM resulting from low intra-team shared memory and a low level of knowledge boundary management (Lee *et al.*, 2017). High KOF diversity occurs when some team members are highly engaged in KOF activities while others are not. Consequently, members of this team signal other teams that they are not consistent in controlling cooperation with other teams (Ancona and Caldwell, 1992; Bass, 1982; Villasalero, 2013). Other teams thus find it difficult to trust the communications and the communication channel with that team (Jarvenpaa and Leidner, 1999; Riegelsberger *et al.*, 2003). Therefore, through a decrease in the effectiveness of the communication channel created by IT support, the effect of IT support on a team's KOF can be diminished in teams with a highly diverse KOF. Hence, we hypothesize the following.

H4. Knowledge outflow diversity within a team weakens the relationship between IT support and the team's knowledge outflow.

3.3 Effects of knowledge outflow and c on performance

The literature on KM has shown that knowledge acquisition has a positive effect on team performance (Zellmer-Bruhn, 2003). As knowledge is the most critical and competitive assets, the acquisition of external knowledge contributes strongly to a team's performance (Grant, 1996). Combining existing knowledge with imported knowledge, a team can increase its performance (Jaw *et al.*, 2006). Hence, we hypothesize the following.

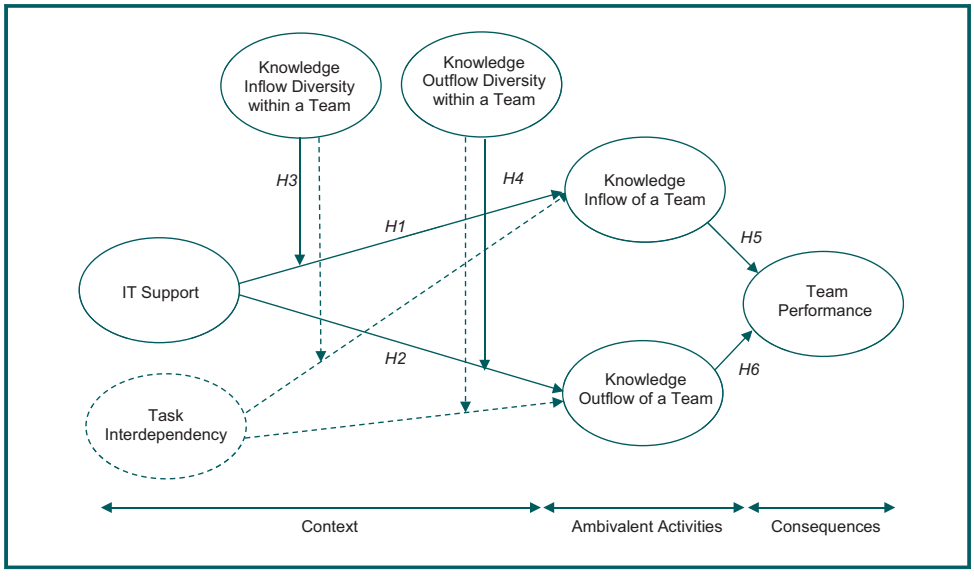
H5. A team's knowledge inflow has a positive effect on team performance.

Previous studies have investigated the importance of intra-firm KF and their contribution to performance (Monteiro *et al.*, 2008). Researchers suggested that positive performance is expected from a knowledge sender, as this KOF signals a rich resource base and also utilizes interdivisional learning (Jaw *et al.*, 2006; Villasalero, 2013). Furthermore, a team's high KOF can be the result of the team's relatively high capabilities compared to other teams with lower KOF (Harzing and Noorderhaven, 2006). In contrast, a team with low KOF could suffer from deficient resources (Gupta and Govindarajan, 2000; Villasalero, 2017). Hence, we hypothesize the following.

H6. A team's knowledge outflow has a positive effect on team performance.

This study's research model is illustrated in Figure 1. As task interdependency is a control variable of the research model, the dotted lines represent paths that are not hypothesized but which will be examined to check the effect of task interdependency.

Figure 1 Research model



4. Research method

4.1 Measurement

We adopted questionnaires from previous literature and modified the wordings to reflect the context of this study. Regarding a team's KIF/KOF and KIF/KOF diversity within a team, this study revised the Bock *et al.* (2005)'s intention to share knowledge to measure the behavior rather than intention and to reflect the direction of sharing.

Although all the variables in the model are team-level variables, responses were collected differently, depending on what the corresponding measure captures. IT support, task interdependency, and a team's KIF/KOF are team characteristics; therefore, a single representative response can be legitimate when sought from a team leader. However, in the case of team performance, since a team leader's desire to show his/her own competence in leading a team could distort the answers (Podsakoff, 2003), all the team members (including the leader) were asked to avoid potential common method bias and the responses were then aggregated. To generate KIF and KOF diversity within a team, the team members were asked about their own KIF and KOF activities rather than about the team's. Then, for each item, the coefficient of variation (standard deviation divided by the mean) was calculated (Allison, 1978; Bedeian and Mossholder, 2000).

All variables were measured using a Likert seven-point scale ranging from "strongly disagree" to "strongly agree" (see Appendix).

4.2 Data collection

The data was gathered from four companies (belonging to the construction, airport management, construction management and cable production industries), with approximately 240, 800, 720 and 4,500 employees respectively.

The KM teams assisted in distributing the survey link to 899 individuals (199 teams) and 587 individuals (194 teams) responded. As team performance was used as an aggregate measure, inter-rater reliability (r_{wg}) was computed to check whether team members agreed on their team performance level. To do so, at least three respondents were required (James *et al.*, 1984); 96 teams (146 individuals) in which fewer than three members responded were

thus eliminated. The results of the inter-rater reliability test also suggested removing 25 teams (100 individuals) whose members did not agree on their team's performances. All the other teams indicated a value higher than 0.741 for r_{wg} on team performance, validating the aggregation of individual responses into team level. Consequently, 73 teams (341 individuals) were used for the main analysis. Table I shows the respondents and their teams' profile.

5. Results

5.1 Test of the measurement model

To determine the validity of the measurement model, Cronbach's alphas and loadings and cross-loadings for each item of the constructs were tested. As shown in Table II, all factor loading scores are greater than 0.777 and the loadings of all items on their own constructs are higher than those of other constructs, indicating a sufficient level of convergent and discriminant validity for the measurement model (Hair *et al.*, 2006).

The average variance extracted (AVE) was then calculated and whether the square roots of the AVEs were greater than the correlations among the constructs was checked. The correlation matrix (Table III) shows this is satisfactory in all cases and all AVEs are higher than 0.5, suggesting convergent and discriminant validity (Fornell and Larcker, 1981).

Two different tests were conducted to check for the presence of common method bias. First, the Chi-square values of three models (Song and Zahedi, 2005) were compared. The first model, the null model (MM0), presumes no common factors underlying any of the measures; the second model (MM1) assumes that a single underlying factor explains all the measures; and the third model (MM2) is the measurement model used in this study. The Chi-square (χ^2) of the test results for MM0, MM1, and MM2 were 2519.119 (*d.f.* = 435), 1842.920 (*d.f.* = 405) and 611.408 (*d.f.* = 384), respectively. Delta ($[\chi^2_{MMO} - \chi^2_{MMi}]/\chi^2_{MMO}$) of MM2 explains 75.7 per cent of the total variance among measures and that the difference between Chi-square values of MM1 and MM2 (1903.711 (*d.f.* = 21)) is also significant ($p < 0.001$), suggesting that the measurement model fits the data better than a single common method factor model (Straub *et al.*, 1995).

Second, a confirmatory factor model was used with a common method latent variable (Liang *et al.*, 2007). This method explicitly decomposes the total variance into variance explained by constructs and the common method factor. The results show that the substantive factor loadings are from 0.764 to 0.982 (all are significant at $p < 0.001$) and the average substantively explained variance of the indicators are 0.791. The method factor loadings are from −0.180 from 0.188 (only one is significant at $p < 0.001$) and the average

Table I The characteristics of teams in the sample

Team characteristics	*Category*	*Frequency*	*(%)*
The number of members responded within a team	3-4	40	54.8
	5-6	21	28.8
	7-8	12	16.4
The number of teams of company	Construction	30	41.1
	Airport management	10	13.7
	Construction management	20	27.4
	Cable production	13	17.8
The average team tenures of team members responded (years)	<1	10	13.7
	1-3	36	49.3
	3-5	19	26.0
	5>=	8	11.0

Table II The results of confirmatory factor analysis

	IT support (ITS)	*Task interdependency (TID)*	*Knowledge inflow (KIF)*	*Knowledge inflow diversity (KIFD)*	*Knowledge outflow (KOF)*	*Knowledge outflow diversity (KOFD)*	*Team performance (TMP)*
ITS	0.916	0.165	0.430	−0.096	0.377	0.082	0.374
	0.955	0.157	0.443	−0.029	0.489	0.073	0.367
	0.886	0.198	0.414	−0.148	0.389	−0.031	0.391
	0.936	0.261	0.405	−0.098	0.472	0.096	0.382
TID	0.192	0.980	0.222	−0.075	0.398	−0.055	0.195
	0.221	0.984	0.271	−0.014	0.452	−0.003	0.208
KIF	0.372	0.306	0.820	−0.209	0.539	−0.176	0.285
	0.422	0.332	0.915	−0.148	0.613	−0.138	0.321
	0.452	0.147	0.880	−0.224	0.502	−0.101	0.347
	0.342	0.159	0.858	−0.244	0.547	−0.182	0.326
	0.408	0.155	0.909	−0.154	0.610	−0.114	0.322
KIFD	−0.070	−0.044	−0.192	0.777	0.044	0.450	−0.307
	0.015	0.069	−0.062	0.876	0.118	0.519	−0.282
	−0.082	−0.043	−0.207	0.926	−0.113	0.631	−0.416
	−0.142	−0.074	−0.246	0.823	−0.139	0.470	−0.479
	−0.092	−0.051	−0.179	0.864	−0.072	0.482	−0.303
KOF	0.343	0.344	0.455	0.050	0.808	−0.069	0.319
	0.345	0.469	0.515	−0.077	0.874	−0.193	0.427
	0.446	0.282	0.470	−0.086	0.796	−0.119	0.451
	0.438	0.349	0.643	−0.051	0.842	−0.056	0.348
	0.398	0.375	0.609	−0.075	0.880	−0.083	0.372
KOFD	0.057	−0.154	−0.074	0.505	−0.112	0.831	−0.422
	0.013	0.039	−0.219	0.537	−0.146	0.909	−0.532
	0.125	−0.020	−0.073	0.519	−0.067	0.871	−0.311
	0.064	0.033	−0.153	0.472	−0.109	0.849	−0.505
	0.028	−0.039	−0.137	0.571	−0.095	0.860	−0.414
TMP	0.392	0.212	0.403	−0.424	0.395	−0.463	0.920
	0.329	0.209	0.283	−0.446	0.408	−0.514	0.954
	0.397	0.206	0.335	−0.383	0.446	−0.472	0.964
	0.429	0.157	0.365	−0.412	0.486	−0.517	0.949

Table III Descriptive statistics and the correlation matrix

Construct	*Mean*	*SD*	*Cronbach's alphas*	*ITS*	*TID*	*KIF*	*KIFD*	*KOF*	*KOFD*	*TMP*
ITS	5.603	1.037	0.943	*0.924*						
TID	5.568	1.347	0.963	0.211	*0.982*					
KIF	5.044	1.171	0.925	0.457	0.252	*0.877*				
KIFD	0.181	0.111	0.909	−0.107	−0.054	−0.237	*0.853*			
KOF	5.532	1.064	0.896	0.471	0.434	0.640	−0.072	*0.841*		
KOFD	0.150	0.094	0.916	0.057	−0.028	−0.165	0.599	−0.129	*0.863*	
TMP	5.574	0.732	0.962	0.410	0.205	0.367	−0.443	0.461	−0.523	*0.947*

Note: The numbers of the diagonal are the square root of the variance shared between the constructs and their measures

method-based variance is 0.003. Given the results of these two tests together, the effect of common method bias is deemed minimal.

5.2 Test of knowledge flow ambivalence

First, we tested if KF can be indeed separated into KIF and KOF by using a paired *t*-test. If this does not hold true, a team's level of KIF will be indifferent to its level of KOF. Paired

t-test results confirmed the difference between KIF and KOF (t = 4.365, $p < 0.001$) suggesting that teams indeed engage in two separate ambivalent KF.

5.3 Test of the structural model

The partial least squares (PLS) method was used to test the research model of the study. PLS method is a structural equation modeling method and has an advantage in testing small sample sizes (Chin, 1998). Although there were 341 individual respondents, the number of teams to which they belonged was relatively small, 73 teams; therefore, PLS is an appropriate method to test the research model. A summary of our hypothesis testing is provided in Table IV.

IT support affects both KIF and KOF, supporting *H1* and *H2*. The relationship between IT support and a team's KIF is negatively moderated by its KIF diversity; *H3* is supported. However, a team's KOF diversity does not influence the relationship between IT support and the team's KOF; therefore, *H4* is not supported. A team's KOF affects team performance, whereas its KIF does not, supporting *H6* but not *H5*.

5.4 Test of team ambidexterity

A series of analyses were performed to investigate details concerning the ambidexterity of teams and their characteristics. First, teams were classified into four types as described in Table V, depending on whether their KOF and KIF scores were at least equal to or less than the medians of each kind of KF: ambidextrous (high outflow/high inflow), teaching (high outflow/low inflow), learning (low outflow/high inflow), and stagnant (low outflow/low inflow).

Table IV The results of structural model testing

Independent variables	*Dependent variables (estimate (t-value))* KIF	KOF	Performance
Research model			
IT support	0.346*** (3.288)	0.476*** (4.473)	
KIF diversity	−0.178 (n.s.) (1.326)		
IT support × KIF diversity	−0.314* (2.094)		
KOF diversity		−0.177 (n.s.) (1.438)	
IT support × KOF diversity		0.288 (n.s.) (1.158)	
KIF			0.074 (n.s.) (0.120)
KOF			0.525*** (4.316)
Interaction between KF			
KIF x KOF			0.352 (n.s.) (1.013)
Controls			
Task interdependency	0.179 (n.s.) (1.492)	0.306** (3.103)	
Task interdependency × KIF diversity	0.296 (n.s.) (1.499)		
Task interdependency × KOF diversity		0.012 (n.s.) (0.108)	
R-square	0.360	0.437	0.331

Notes: n.s.: not significant, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table V the Classification of teams and performance comparison (mean (SD))

Type (team)	*KOF*	*KIF*	*Performance*
Ambidextrous (n = 29)	6.352 (0.436)	6.055 (0.532)	5.881 (0.732)
Teaching (n = 10)	6.140 (0.353)	4.200 (0.854)	5.701 (0.699)
Learning (n = 10)	5.200 (0.667)	5.660 (0.366)	5.533 (0.414)
Stagnant (n = 24)	4.425 (0.867)	3.917 (0.720)	5.166 (0.683)

Note: Median of the average of KOF and KIF items are 5.800 and 5.200 respectively

Figure 2 illustrates how these teams are scattered on their KF scores.

Second, analysis of variance (ANOVA) was conducted to see whether the performance of the teams differed depending on the team type. The results in Table V show differences between the types of teams in terms of performance ($F = 5.016$, $p < 0.01$). However, the post hoc analysis suggests that this performance difference is only statistically significant between ambidextrous and stagnant teams.

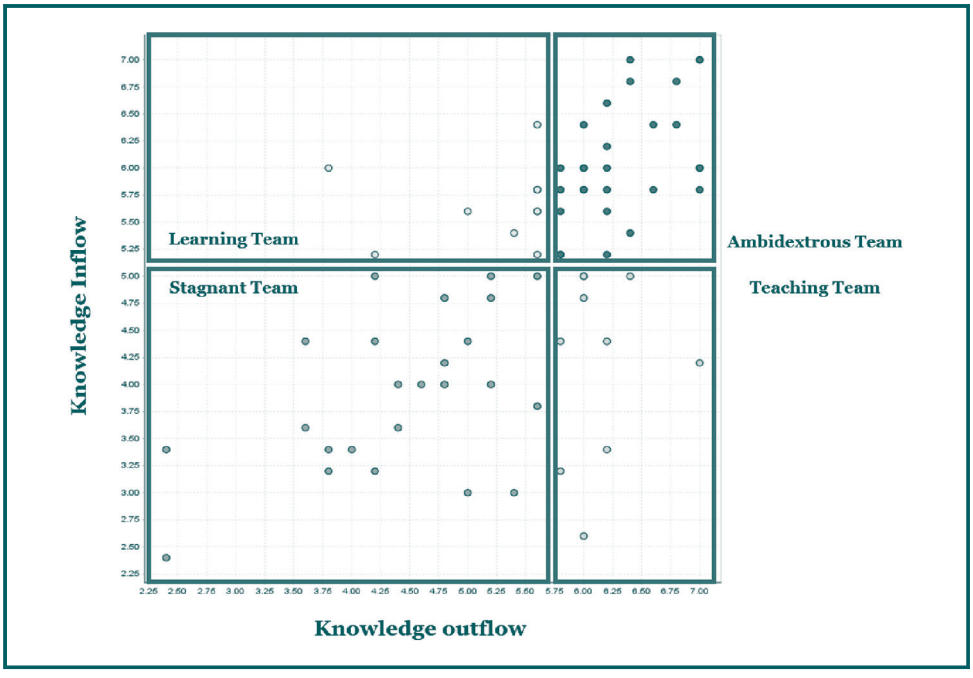
6. Discussion

This study examined how the work context characteristics represented by IT support, task interdependency, and KF diversity within a team affect ambivalent knowledge activities, specifically a team's KIF and KOF, and how these flows subsequently affect team performance. Here, we discuss more about the specific relationships that are suggested in the model but turned out to be statistically nonsignificant.

First, task interdependency affects KOF but not KIF. This can be attributed to a team's ability to control the knowledge it exports but not the knowledge it imports. The increased KOF reflects a team's awareness of the need to provide more knowledge so that other teams can continue their tasks. Recognizing task interdependency, the team can respond proactively to the other teams' need for more knowledge by creating more detailed reports, documentations and so on. This implies that although the loss of competitive edge is usually a concern when providing knowledge (Fey and Birkinshaw, 2005), knowledge can be provided by fulfilling tasks and by expecting mutual cooperation in an interdependent task situation. Regarding KIF, however, teams can be reluctant to bring in outside knowledge that is not deemed beneficial to the team (Lee *et al.*, 2017). Therefore, task interdependency alone without the means of coordinating KF across teams, such as IT support, cannot guarantee the seamless sharing of knowledge within an organization.

It is also notable that the two diversities within a team do not moderate any of the relationships between task interdependency and KF. This suggests that, in an

Figure 2 KIF and KOF scores of teams



interdependent task situation, a team's KF is determined by task characteristics and easiness of controllability and not by how individual members perform differently in their KF activities.

Second, the results indicate that, if the degree of individual KIF activities varies significantly within a team, the positive effect of IT support on the team's KIF will be diminished. This result can be attributed to the effort necessary for KIF. Unlike KOF through IT support that can be easily accomplished by codifying knowledge, KIF through IT support is associated with not only searching for relevant knowledge but also evaluating and determining the value of outside knowledge, which requires relevant capabilities. In this activity, the differences in team member capabilities accentuate the varying degrees of KF (Alavi and Leidner, 2001): those with low KIF activities may rely on members with high KIF activities for their skills and experiences in evaluating the value of outside knowledge other than relying on IT support. Therefore, the positive effect of IT support on the team's KIF is limited.

7. Implications and future studies

7.1 Implications for research and theory development

First, with regard to antecedents, we found that, while IT support facilitates both KIF and KOF, as found in prior studies, task interdependency affects them differently: increasing the level of task interdependency increases KOF to other teams while the amount of KIF remains unaffected. For further research, this finding suggests that, although the universal effect of IT support is confirmed, the effect of task interdependency on knowledge sharing must be further examined by considering KIF and KOF separately.

Second, with regard to the effects of KF, we found that a team's KIF does not significantly affect team performance, as KOF does. A plausible explanation for this is that KIF must be effectively applied or adapted before it can affect a team's output. This differential effect highlights the need to distinguish between KIF and KOF when modeling the effects of KF on team performance.

We also further tested the interaction effect between KIF and KOF, that is, whether the effect of KOF on team performance is strengthened by the amount of KIF. The results indicated no significant interaction. This suggests that KF ambidexterity does not significantly elevate performance. The effect of ambidextrous KF should be further tested before it is adopted full scale in practice, considering that ambidexterity is often challenging, confusing, and costly to maintain.

Third, we found that, while the diversity of team members' KIF behavior weakens the effect of IT support on KIF, the diversity of KOF behavior does not have such a significant weakening effect indicating that IT support facilitates KOF, regardless of whether the members are involved in outflow activities at varying levels. This further strengthens the importance of offering IT support to promote KF, as it is effective even in teams where only some members engage actively in outflow activities.

Fourth, this is one of the earliest studies to consider both a team's KIF and KOF and team members' behavioral diversity in KF activities. We show that these are conceptually distinct yet related factors, in that diversity in members' behavior can influence KF at the team level. It could therefore be fruitful to look beyond team-level KF to examine the specific activities and people driving the flow.

Lastly, while some studies attempted to understand KIF and KOF, they lacked a theoretical foundation. This study applied the theory of ambidexterity to understand them and suggested an additional theoretical perspective to explain and interpret previous findings. By doing so, two different KF across teams can be viewed from the perspective of how the teams deal with ambivalent activities and how being good at each type of knowledge activity is linked to performance.

7.2 Implications for practice

Our findings influence the management of knowledge-intensive teams in several ways. First, to improve team performance, KOF should be supported and promoted. Team members can be encouraged to provide more detailed work reports and documentations, as well as proactively offer to share their experiences, know-how, knowledge-where, and know-whom with other teams. Our findings also indicate that offering IT support and increasing the level of task interdependency help. In particular, IT for collaborative work, communication, information search and knowledge storage can enhance the accessibility of knowledge such that it is available wherever and whenever needed (Lee and Choi, 2003). Communicating task interdependency to team members is also useful in raising their awareness of how their work and the knowledge embedded in their team's output will be needed by others and to prompt them to consider knowledge transfer as it is generated.

Second, our findings suggest that, despite its conceptual appeal, ambidextrous KF does not always lead to better team performance. Considering the challenges and costs of ambidexterity, it could be more practical to take a gradual, temporal approach if ambidexterity is deemed necessary. Our findings suggest that teams should begin with promoting KOF, since it is significantly related to team performance. When KOF is well established, support for KIF can be gradually increased to allow members to adapt and learn the very different skill sets needed.

Third, team leaders need to consider the diversity of members' KF activities, especially when KIF is necessary. We found that the effectiveness of offering IT support is significantly weaker when members engage in KF activities differently (i.e. highly diverse). It is desirable for all members to exploit the IT support to fully realize its value in improving the team's KIF. This reflects the compositional and complementary nature of team members, whose knowledge is integrated to develop an output; all members – and not only specific members – are required to be actively involved in acquiring knowledge for the team's success.

7.3 Limitations and future study

Although this study provides significant contributions, it has several limitations that call for future research. First, the sample size of team is relatively small. Increasing the sample size is recommended for future studies.

A reinforcing relationship can exist between KF and team performance over time: more knowledge flowing in and out of a team will make the team perform better and a team that learns about the helpfulness of KF will send and receive more knowledge. For example, certain types of knowledge, such as best practices or lessons learned, will be more available as the result of the KOF of successful teams. We focused on the cross section in which KF affect team performance in this potentially circular relationship. Future research can conduct a longitudinal study and not only confirm but also extend our findings by delving into how KF and performance reinforce each other over time.

Additionally, future studies could focus on other context characteristics. Related to the diversity of KF, this study did not explicitly show which specific capabilities cause the differences between members. Since there can be several capabilities to consider regarding KF, such as culture, structure, human behavior and technical capabilities (Yang and Chen, 2007), future research examining the influence of specific capabilities on diversities within a team can provide more detailed insights.

Lastly, this study showed which context characteristics can influence the operation of KF but is limited in revealing the reasons these two flows operate differently on performance. Therefore, future studies that investigate these reasons can provide deeper insight.

8. Conclusion

This study attempted to examine the distinct roles of KIF and KOF for team performance, how they are influenced by context characteristics and the way flows are established within a team by addressing four specific research questions: How does the IT support influence a team's level of KIF and KOF? How does each knowledge flow affect team performance? How does the diversity of KF within a team influence the way IT support affects a team's KF? How do teams differ based on their ambidexterity of KF? We found that IT support is essential because it influences both KF. However, only KOF has a significant effect on team performance. We also found that, when the levels of KIF activities vary, IT support is less effective in promoting the team's KIF. The findings also show that a team that is good at one type of flow can achieve similar performance results to teams that are good at both flows, which suggests that ambidexterity is not always necessary. This study, therefore, expands understanding of KF under the framework of ambidexterity theory by showing that KIF and KOF of a team are distinct processes that operate differently and that KF ambidexterity is to be pursued considering the challenge and cost of being ambidextrous, thus emphasizing the need to study and execute these flows separately and investigate various circumstances that each knowledge flow can be facilitated and enriched.

References

Adler, P.S., Goldoftas, B. and Levine, D.I. (1999), "Flexibility versus efficiency? A case study of model changeovers in the toyota production system", *Organization Science*, Vol. 10 No. 1, pp. 43-68.

Alavi, M. and Leidner, D.E. (2001), "Review: knowledge management and knowledge management systems: conceptual foundations and research issues", *MIS Quarterly*, Vol. 25 No. 1, pp. 107-136.

Alavi, M., Kayworth, T.R. and Leidner, D.E. (2006), "An empirical examination of the influence of organizational culture on knowledge management practices", *Journal of Management Information Systems*, Vol. 22 No. 3, pp. 191-224.

Allison, P.D. (1978), "Measures of inequality", *American Sociological Review*, Vol. 42 No. 6, pp. 865-880.

Ancona, D.G. and Caldwell, D.F. (1992), "Demography and design: predictors of new product team performance", *Organization Science*, Vol. 3 No. 3, pp. 321-341.

Argote, L. and Ingram, P. (2000), "Knowledge transfer: a basis for competitive advantage in firms", *Organizational Behavior and Human Decision Processes*, Vol. 82 No. 1, pp. 150-169.

Argyres, N.S. (1999), "The impact of information technology on coordination: evidence from the B-2 'stealth' bomber", *Organization Science*, Vol. 10 No. 2, pp. 162-180.

Barua, A., Lee, C.-H.S. and Whinston, A.B. (1995), "Incentives and computing systems for team-based organizations", *Organization Science*, Vol. 6 No. 4, pp. 487-504.

Bass, B. (1982), "Individual capability, team performance, and team productivity", in *Human Performance and Productivity: Human Capability Assessment*, Lawrence Erlbraum Associates, Hillsdale, pp. 179-232.

Becerra-Fernandez, I. and Sabherwal, R. (2001), "Organizational knowledge management: a contingency perspective", *Journal of Management Information Systems*, Vol. 18 No. 1, pp. 23-55.

Bedeian, A.G. and Mossholder, K.W. (2000), "On the use of the coefficient of variation as a measure of diversity", *Organizational Research Methods*, Vol. 3 No. 3, pp. 285-297.

Bélanger, F. and Allport, C.D. (2008), "Collaborative technologies in knowledge telework: an exploratory study", *Information Systems Journal*, Vol. 18 No. 1, pp. 101-121.

Björkman, I., Barner-Rasmussen, W. and Li, L. (2004), "Managing knowledge transfer in MNCs: the impact of headquarters control mechanisms", *Journal of International Business Studies*, Vol. 35 No. 5, pp. 443-455.

Bock, G.-W., Zmud, R.W., Kim, Y.-G. and Lee, J.-N. (2005), "Behavioral intention formation in knowledge sharing: examining the roles of extrinsic motivators, social-psychological forces, and organizational climate", *MIS Quarterly*, Vol. 29 No. 1, pp. 87-111.

Cabrera, E.F. and Cabrera, A. (2005), "Fostering knowledge sharing through people management practices", *The International Journal of Human Resource Management*, Vol. 16 No. 5, pp. 720-735.

Chang, Y.-Y., Gong, Y. and Peng, M.W. (2012), "Expatriate knowledge transfer, subsidiary absorptive capacity, and subsidiary performance", *Academy of Management Journal*, Vol. 55 No. 4, pp. 927-948.

Chatterjee, S. (1990), "Excess resources, utilization costs, and mode of entry", *Academy of Management Journal*, Vol. 33 No. 4, pp. 780-800.

Chen, C.-J. and Hung, S.-W. (2010), "To give or to receive? Factors influencing members' knowledge sharing and community promotion in professional virtual communities", *Information & Management*, Vol. 47 No. 4, pp. 226-236.

Chin, W.W. (1998), "The partial least squares Ap- proach for structural equation modeling", in *Modern Methods for Business Research*, Lawrence Erlbaum Associates, New York, NY, pp. 295-336.

Choi, B. and Lee, H. (2003), "An empirical investigation of KM styles and their effect on corporate performance", *Information & Management*, Vol. 40 No. 5, pp. 403-417.

Clemons, E.K., Reddi, S.P. and Row, M.C. (1993), "The impact of information technology on the organization of economic activity: the 'move to the middle' hypothesis", *Journal of Management Information Systems*, Vol. 10 No. 2, pp. 9-35.

Cooke, N.J., Salas, E., Cannon-Bowers, J.A. and Stout, R.J. (2000), "Measuring team knowledge", *Human Factors*, Vol. 42 No. 1, pp. 151-173.

Cummings, J.N. (2004), "Work groups, structural diversity, and knowledge sharing in a global organization", *Management Science*, Vol. 50 No. 3, pp. 352-364.

Dewett, T. and Jones, G.R. (2001), "The role of information technology in the organization: a review, model, and assessment", *Journal of Management*, Vol. 27 No. 3, pp. 313-346.

Droege, S.B., Anderson, J.R. and Bowler, M. (2003), "Trust and organizational information flow", *Journal of Business and Management*, Vol. 9 No. 1, pp. 45-59.

Duncan, R.B. (1976), "The ambidextrous organization: designing dual structures for innovation", *In the Management of Organization*, North-Holland, New York, NY, pp. 167-188.

Eisenhardt, K. and Galunic, D. (2000), "Coevolving", *Harvard Business Review*, Vol. 78 No. 1, pp. 91-101.

Eisenhardt, K.M. and Martin, J.A. (2000), "Dynamic capabilities: what are they?", *Strategic Management Journal*, Vol. 21 Nos No. 10-11, pp. 1105-1121.

Fey, C.F. and Birkinshaw, J. (2005), "External sources of knowledge, governance mode, and R&D performance", *Journal of Management*, Vol. 31 No. 4, pp. 597-621.

Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50.

Gerwin, D. and Moffat, L. (1997), "Authorizing processes changing team autonomy during new product development", *Journal of Engineering and Technology Management*, Vol. 14 Nos 3/4, pp. 291-313.

Gibson, C.B. and Birkinshaw, J. (2004), "The antecedents, consequences, and mediating role of organizational ambidexterity", *Academy of Management Journal*, Vol. 47 No. 2, pp. 209-226.

Goodhue, D.L. and Thompson, R.L. (1995), "Task-technology fit and individual performance", *MIS Quarterly*, Vol. 19 No. 2, pp. 213-236.

Goodman, P.S. (1986), "Impact of task and technology on group performance", in *Designing Effective Work Groups*, Jossey-Bas, San Francisco, pp. 120-167.

Grant, R.M. (1996), "Toward a knowledge-based theory of the firm", *Strategic Management Journal*, Vol. 17 No. S2, pp. 109-122.

Griffith, T.L., Sawyer, J.E. and Neale, M.A. (2003), "Virtualness and knowledge in teams: managing the love triangle of organizations, individuals, and information technology", *MIS Quarterly*, Vol. 27 No. 2, pp. 265-287.

Gupta, A., Mattarelli, E., Seshasai, S. and Broschak, J. (2009), "Use of collaborative technologies and knowledge sharing in co-located and distributed teams: towards the 24-h knowledge factory", *The Journal of Strategic Information Systems*, Vol. 18 No. 3, pp. 147-161.

Gupta, A.K. and Govindarajan, V. (1991), "Knowledge flows and the structure of control within multinational corporations", *Academy of Management Review*, Vol. 16 No. 4, pp. 768-792.

Gupta, A.K. and Govindarajan, V. (1994), "Organizing for knowledge flows within MNCs", *International Business Review*, Vol. 3 No. 4, pp. 443-457.

Gupta, A.K. and Govindarajan, V. (2000), "Knowledge flows within multinational corporations", *Strategic Management Journal*, Vol. 21 No. 4, pp. 473-496.

Haas, M.R. and Hansen, M.T. (2007), "Different knowledge, different benefits: toward a productivity perspective on knowledge sharing in organizations", *Strategic Management Journal*, Vol. 28 No. 11, pp. 1133-1153.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. and Tatham, R.L. (2006), *Multivariate Data Analysis*, Prentice Hall Englewood Cliffs, NJ.

Harrison, D.A. and Klein, K.J. (2007), "What's the difference? Diversity constructs as separation, variety, or disparity in organizations", *Academy of Management Review*, Vol. 32 No. 4, pp. 1199-1228.

Harrison, D.A., Price, K.H. and Bell, M.P. (1998), "Beyond relational demography: time and the effects of surface- and deep-level diversity on work group cohesion", *Academy of Management Journal*, Vol. 41 No. 1, pp. 96-107.

Harzing, A.-W. and Noorderhaven, N. (2006), "Knowledge flows in MNCs: an empirical test and extension of Gupta and Govindarajan's typology of subsidiary roles", *International Business Review*, Vol. 15 No. 3, pp. 195-214.

Hoegl, M., Weinkauf, K. and Gemuenden, H.G. (2004), "Interteam coordination, project commitment, and teamwork in multiteam R&D projects: a longitudinal study", *Organization Science*, Vol. 15 No. 1, pp. 38-55.

Huang, M.-C., Chiu, Y.-P. and Lu, T.-C. (2013), "Knowledge governance mechanisms and repatriate's knowledge sharing: the mediating roles of motivation and opportunity", *Journal of Knowledge Management*, Vol. 17 No. 5, pp. 677-694.

Jackson, S.E., May, K.E. and Whitney, K. (1995), "Understanding the dynamics of diversity in decision-making teams", in *Team Effectiveness and Decision Making in Organizations*, Jossey-Bass, San Francisco, pp. 204-261.

James, L.R., Demaree, R.G. and Wolf, G. (1984), "Estimating within-group interrater reliability with and without response bias", *Journal of Applied Psychology*, Vol. 69 No. 1, pp. 85-98.

Janz, B.D., Colquitt, J.A. and Noe, R.A. (1997), "Knowledge worker team effectiveness: the role of autonomy, interdependence, team development, and contextual support variables", *Personnel Psychology*, Vol. 50 No. 4, pp. 877-904.

Jarvenpaa, S.L. and Leidner, D.E. (1999), "Communication and trust in global virtual teams", *Organization Science*, Vol. 10 No. 6, pp. 791-815.

Jaw, B.-S., Wang, C.Y.P. and Chen, Y.-H. (2006), "Knowledge flows and performance of multinational subsidiaries: the perspective of human capital", *The International Journal of Human Resource Management*, Vol. 17 No. 2, pp. 225-244.

Kautz, K. and Thaysen, K. (2001), "Knowledge, learning and IT support in a small software company", *Journal of Knowledge Management*, Vol. 5 No. 4, pp. 349-357.

Lai, J., Lui, S.S. and Tsang, E.W. (2016), "Intrafirm knowledge transfer and employee innovative behavior: the role of total and balanced knowledge flows", *Journal of Product Innovation Management*, Vol. 33 No. 1, pp. 90-103.

Lee, D.S., Lee, K.C. and Seo, Y.W. (2015), "An analysis of shared leadership, diversity, and team creativity in an e-learning environment", *Computers in Human Behavior*, Vol. 42, pp. 47-56.

Lee, H. and Choi, B. (2003), "Knowledge management enablers, processes, and organizational performance: an integrative view and empirical examination", *Journal of Management Information Systems*, Vol. 20 No. 1, pp. 179-228.

Lee, J., Min, J. and Lee, H. (2017), "Setting a knowledge boundary across teams: knowledge protection regulation for inter-team coordination and team performance", *Journal of Knowledge Management*, Vol. 21 No. 2, pp. 254-274.

Liang, H., Saraf, N., Hu, Q. and Xue, Y. (2007), "Assimilation of enterprise systems: the effects of institutional pressures and the mediating role of top management", *MIS Quarterly*, Vol. 31 No. 1, pp. 59-88.

Lippman, S.A. and Rumelt, R.P. (1982), "Uncertain imitability: an analysis of interfirm differences in efficiency under competition", *The Bell Journal of Economics*, Vol. 13 No. 2, pp. 418-438.

Liyanage, C., Elhag, T., Ballal, T. and Li, Q. (2009), "Knowledge communication and translation–a knowledge transfer model", *Journal of Knowledge Management*, Vol. 13 No. 3, pp. 118-131.

Luger, J., Raisch, S. and Schimmer, M. (2018), "Dynamic balancing of exploration and exploitation: the contingent benefits of ambidexterity", *Organization Science*, Vol. 29 No. 3, pp. 449-470.

Mahnke, V., Pedersen, T. and Venzin, M. (2005), "The impact of knowledge management on MNC subsidiary performance: the role of absorptive capacity", *Management International Review*, pp. 101-119.

Malhotra, A. and Majchrzak, A. (2004), "Enabling knowledge creation in far-flung teams: best practices for IT support and knowledge sharing", *Journal of Knowledge Management*, Vol. 8 No. 4, pp. 75-88.

Markides, C.C. and Williamson, P.J. (1994), "Related diversification, core competences and corporate performance", *Strategic Management Journal*, Vol. 15 No. S2, pp. 149-165.

Mom, T.J., Van Den Bosch, F.A. and Volberda, H.W. (2007), "Investigating managers' exploration and exploitation activities: the influence of topdown, bottomup, and horizontal knowledge inflows", *Journal of Management Studies*, Vol. 44 No. 6, pp. 910-931.

Monteiro, L.F., Arvidsson, N. and Birkinshaw, J. (2008), "Knowledge flows within multinational corporations: explaining subsidiary isolation and its performance implications", *Organization Science*, Vol. 19 No. 1, pp. 90-107.

Nickerson, J.A. and Zenger, T.R. (2004), "A knowledge-based theory of the firm – the problem-solving perspective", *Organization Science*, Vol. 15 No. 6, pp. 617-632.

Pan, S.L. and Leidner, D.E. (2003), "Bridging communities of practice with information technology in pursuit of global knowledge sharing", *The Journal of Strategic Information Systems*, Vol. 12 No. 1, pp. 71-88.

Park, S. and Kim, E.-J. (2018), "Fostering organizational learning through leadership and knowledge sharing", *Journal of Knowledge Management*, Vol. 22 No. 6, pp. 1408-1423.

Phene, A. and Almeida, P. (2008), "Innovation in multinational subsidiaries: the role of knowledge assimilation and subsidiary capabilities", *Journal of International Business Studies*, Vol. 39 No. 5, pp. 901-919.

Pinjani, P. and Palvia, P. (2013), "Trust and knowledge sharing in diverse global virtual teams", *Information & Management*, Vol. 50 No. 4, pp. 144-153.

Podsakoff, N. (2003), "Common method biases in behavioral research: a critical review of the literature and recommended remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, pp. 879-903.

Raisch, S., Birkinshaw, J., Probst, G. and Tushman, M.L. (2009), "Organizational ambidexterity: balancing exploitation and exploration for sustained performance", *Organization Science*, Vol. 20 No. 4, pp. 685-695.

Rao, K. and Tilt, C. (2016), "Board composition and corporate social responsibility: the role of diversity, gender, strategy and decision making", *Journal of Business Ethics*, Vol. 138 No. 2, pp. 327-347.

Riegelsberger, J., Sasse, M.A. and McCarthy, J.D. (2003), "The researcher's dilemma: evaluating trust in computer-mediated communication", *International Journal of Human-Computer Studies*, Vol. 58 No. 6, pp. 759-781.

Schultze, U. and Orlikowski, W.J. (2004), "A practice perspective on technology-mediated network relations: the use of internet-based self-serve technologies", *Information Systems Research*, Vol. 15 No. 1, pp. 87-106.

Schulz, M. (2001), "The uncertain relevance of newness: organizational learning and knowledge flows", *Academy of Management Journal*, Vol. 44 No. 4, pp. 661-681.

Schulz, M. (2003), "Pathways of relevance: exploring inflows of knowledge into subunits of multinational corporations", *Organization Science*, Vol. 14 No. 4, pp. 440-459.

Schulz, M. and Jobe, L.A. (2001), "Codification and tacitness as knowledge management strategies: an empirical exploration", *The Journal of High Technology Management Research*, Vol. 12 No. 1, pp. 139-165.

Shin, S.J., Kim, T.-Y., Lee, J.-Y. and Bian, L. (2012), "Cognitive team diversity and individual team member creativity: a cross-level interaction", *Academy of Management Journal*, Vol. 55 No. 1, pp. 197-212.

Song, J. and Zahedi, F.M. (2005), "A theoretical approach to web design in e-commerce: a belief reinforcement model", *Management Science*, Vol. 51 No. 8, pp. 1219-1235.

Srivastava, A., Bartol, K.M. and Locke, E.A. (2006), "Empowering leadership in management teams: effects on knowledge sharing, efficacy, and performance", *Academy of Management Journal*, Vol. 49 No. 6, pp. 1239-1251.

Stenius, M., Hankonen, N., Ravaja, N. and Haukkala, A. (2016), "Why share expertise? A closer look at the quality of motivation to share or withhold knowledge", *Journal of Knowledge Management*, Vol. 20 No. 2, pp. 181-198.

Straub, D., Limayem, M. and Karahanna-Evaristo, E. (1995), "Measuring system usage: implications for IS theory testing", *Management Science*, Vol. 41 No. 8, pp. 1328-1342.

Tekleab, A.G., Karaca, A., Quigley, N.R. and Tsang, E.W. (2016), "Re-examining the functional diversity–performance relationship: the roles of behavioral integration, team cohesion, and team learning", *Journal of Business Research*, Vol. 69 No. 9, pp. 3500-3507.

Tippmann, E., Scott, P.S. and Mangematin, V. (2014), "Subsidiary managers' knowledge mobilizations: unpacking emergent knowledge flows", *Journal of World Business*, Vol. 49 No. 3, pp. 431-443.

Tsai, W. (2001), "Knowledge transfer in intraorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance", *Academy of Management Journal*, Vol. 44 No. 5, pp. 996-1004.

Van Knippenberg, D., van Ginkel, W.P. and Homan, A.C. (2013), "Diversity mindsets and the performance of diverse teams", *Organizational Behavior and Human Decision Processes*, Vol. 121 No. 2, pp. 183-193.

Van Wijk, R., Jansen, J.J. and Lyles, M.A. (2008), "Inter-and intra-organizational knowledge transfer: a Meta-analytic review and assessment of its antecedents and consequences", *Journal of Management Studies*, Vol. 45 No. 4, pp. 830-853.

Villasalero, M. (2013), "Signaling, spillover and learning effects of knowledge flows on division performance within related diversified firms", *Journal of Knowledge Management*, Vol. 17 No. 6, pp. 928-942.

Villasalero, M. (2014), "Intra-network knowledge roles and division performance in multi-business firms", *Journal of Knowledge Management*, Vol. 18 No. 6, pp. 1165-1183.

Villasalero, M. (2017), "A resource-based analysis of realized knowledge relatedness in diversified firms", *Journal of Business Research*, Vol. 71, pp. 114-124.

Wageman, R. (1995), "Interdependence and group effectiveness", *Administrative Science Quarterly*, Vol. 40 No. 1, pp. 145-180.

Wang, E., Klein, G. and Jiang, J.J. (2007), "IT support in manufacturing firms for a knowledge management dynamic capability link to performance", *International Journal of Production Research*, Vol. 45 No. 11, pp. 2419-2434.

Wang, W.-T. and Hou, Y.-P. (2015), "Motivations of employees' knowledge sharing behaviors: a self-determination perspective", *Information & Organization*, Vol. 25 No. 1, pp. 1-26.

Yang, C. and Chen, L.-C. (2007), "Can organizational knowledge capabilities affect knowledge sharing behavior?", *Journal of Information Science*, Vol. 33 No. 1, pp. 95-109.

Yang, Y. (2012), "Bilateral inter-organizational learning in corporate venture capital activity: governance characteristics, knowledge transfer, and performance", *Management Research Review*, Vol. 35 No. 5, pp. 352-378.

Yeh, Y.-J., Lai, S.-Q. and Ho, C.-T. (2006), "Knowledge management enablers: a case study", *Industrial Management & Data Systems*, Vol. 106 No. 6, pp. 793-810.

Yu, Y., Hao, J.-X., Dong, X.-Y. and Khalifa, M. (2013), "A multilevel model for effects of social capital and knowledge sharing in knowledge-intensive work teams", *International Journal of Information Management*, Vol. 33 No. 5, pp. 780-790.

Zack, M.H. (1999), "Developing a knowledge strategy", *California Management Review*, Vol. 41 No. 3, pp. 125-145.

Zellmer-Bruhn, M.E. (2003), "Interruptive events and team knowledge acquisition", *Management Science*, Vol. 49 No. 4, pp. 514-528.

Zigurs, I. and Kozar, K.A. (1994), "An exploratory study of roles in computer-supported groups", *MIS Quarterly*, Vol. 18 No. 3, pp. 277-297.

Appendix

Table AI Questionnaire items

Construct	*Questionnaire*	*Source*
ITS	Our team is provided with IT support for collaborative works regardless of time and place	Lee and Choi (2003)
	Our team is provided with IT support for communication among team members	
	Our team is provided with IT support for searching for and accessing necessary information	
	Our team is provided with IT support for systematic storing	
TID	The business problems that our team deals with frequently involve more than one team	Goodhue and Thompson (1995)
	The problems that our team deals with frequently involve more than one team	
KIF/KFID	___ receives our work reports and official documents with members of other teams	Bock *et al.* (2005)
	___ always receives our manuals, methodologies and models for members of other teams	
	___ receives our experience or know-how from work with other team members frequently	
	___ team always receives our know-where or know-whom at the request of other team members	
	___ try to receives our expertise from our education or training with other team members in a more effective way	
KOF/KOFD	___ provides our work reports and official documents with members of other teams	
	___ always provides our manuals, methodologies and models for members of other teams	
	___ provides our experience or know-how from work with other team members frequently	
	___ always provides our know-where or know-whom at the request of other team members	
	___ tries to provide our expertise from our education or training with other team members in a more effective way	
TMP	Going by the current status, this team can be regarded as successful	Hoegl *et al.* (2004)
	So far, all team goals have been achieved	
	The team's output so far is of high quality	
	The team is satisfied with its performance to this point	

Notes: ___ is filled with "Our team" for KIF and KOF and filled with "I" for KIFD and KOFD. Regarding KFID and KOFD within a team, each sentence is also revised to ask about their own KIF and KOF activities rather than about the team's

About the authors

Junyeong Lee is an Assistant Professor in the School of Industrial Management at the Korea University of Technology and Education (KoreaTech). He received his PhD in Management Engineering at the Korea Advanced Institute of Science and Technology (KAIST). His research interests include collective dynamics and human behavior in information systems. His work has been published in academic journals including *International Journal of Information Management, Computers in Human Behavior, Journal of Knowledge Management* and *Communications of the ACM.*

Jinyoung Min is an Associate Professor of College of Business at Chosun University, South Korea. She received her PhD in management engineering from Korea Advanced Institute of Science and Technology. Her research interests include social media, knowledge management and human computer interaction. Her research articles have been published in *Computers in Human Behavior*, *Journal of the Association for Information Science and Technology*, *International Journal of Information Management*, *Journal of Knowledge Management*, etc. Jinyoung Min is the corresponding author and can be contacted at: saharamin@chosun.ac.kr

Chanhee Kwak is a PhD candidate in School of Management Engineering at Korea Advanced Institute of Science and Technology (KAIST). His research interests include information privacy and dynamics of IT in organizational contexts.

L.G. Pee received her PhD in Information Systems and Bachelor of Computing from the National University of Singapore. Her research focuses on social informatics of knowledge in organizations and online communities. She has studied and published journal articles on topics such as artificial intelligence in health care, smart manufacturing systems, smart

mobility solutions and big data analytics for the grand challenges of air pollution, animal conservation and spread of infectious diseases. These studies used different, often mixed, research methods and tools, including survey, interpretive case study, social network analysis, text mining, design science and action research. She received the Best Paper Award of Pacific Asia Conference on Information Systems (PACIS 2010) and the science award by NTT Docomo's Mobile Communication Fund in 2013. LG also serves on the editorial board of several international journals and program committee of several international conferences. She was a program chair of PACIS 2018. As a principal investigator, LG has received more than SG$700,000 in research funding.

Heeseok Lee is a Professor of Strategy and IT in the College of Business at the Korea Advanced Institute of Science and Technology (KAIST). He received his PhD in Business Administration from the University of Arizona and was a previous faculty member at the University of Nebraska at Omaha. His research interests include strategy and IT. His work has been published in academic journals including *Journal of Computer Information Systems*, *International Journal of Information Management*, *Journal of Management Information Systems*, *Information Systems*, *European Journal of Operational Research*, *Annals of Operations Research*, *Information and Management* and *MIS Quarterly*.