Identifying Organizational Knowledge Paths through Social Network Lens: Synthesis of Multi-Industry Case Studies

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Abstract

Unlike the common belief that knowledge flows mainly along the formal organizational hierarchy, recent research has pointed out an informal social network among organizational members as a more potent source of organizational knowledge paths. Most of the previous studies examining the organizational knowledge flows, however, have been conducted in a single organization or industry setting, thus limiting the generalizability of their findings. Through the use of social network lens, this paper identifies organizational knowledge flow paths, examines knowledge flow network structures, and analyzes the knowledge flow patterns based on individual case studies from six organizations in different industries. Based on these findings, seven propositions are derived for future research. In addition, it suggests implications for KM practitioners and scholars interested in finding, nurturing, and utilizing knowledge flow networks embedded in organizations.

1. Introduction

As research accumulates and practices mature on organizational knowledge management (KM), the focal point of KM seems to have moved from "collecting and sharing through knowledge repositories" to "finding and transferring through knowledge networks" [6, 20]. It is no longer the case of "what you know" that matters. Increasingly, it is the "who you know" that has become more crucial to problem solving. Since knowledge flows along existing pathways in organizations [3], if we are interested in creating and disseminating organizational knowledge, we need to discover and understand the knowledge paths within an organization.

Traditionally, most managers presuppose that knowledge (and information) flows mainly along the formal organizational hierarchy as evidenced by the reporting lines of their organizational charts [21]. However, recent research has indicated that an informal social network among organizational members is a more potent source of organizational knowledge (especially tacit knowledge) paths [5, 16]. Over the past decade, the social network paradigm has been adopted in various KM studies, examining the typical network patterns in isolated cases or validating the links between structural/relational features of a social network and organizational or team/group performance. These studies have contributed greatly in identifying the existence of knowledge exchanging social network relationships within organizations or in verifying the effects on parts of a social network as they relate to the knowledge transfer between individuals or organizational units. However, most of the studies have been conducted in a single organization or industry setting, thus limiting the generalizability of their findings across different organizational or industry contexts.

In this paper, we report on the results of multiple case studies on six organizations in different industries. First, we identify the knowledge flow paths among individuals and business units by using a social network analysis (SNA) tool, NetMiner3 [10] developed by the authors of this study, to come up with a knowledge flow network of the participating organizations. Second, we examine the general structure and features of each organization's knowledge flow network (average geodesic distance, giant component percentage, clustering coefficient, network density, and degree of concentration) as well as the role-specific node features (knowledge owner, knowledge provider, and knowledge broker). Third,

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perhaps for the first time, we analyze each organization's knowledge flow patterns according to its intra/inter business units and five management levels to reveal general knowledge flow patterns common to the six organizations from different industries. Lastly, based on an in-depth understanding of the case organizations' knowledge flow paths and patterns, we derive seven propositions for future knowledge network research and suggest implications for KM practitioners and scholars interested in finding, nurturing, and utilizing knowledge networks embedded in their organizations.

The followings are the specific research questions we will look into: (1) questions regarding knowledge flow aspects (a. how does knowledge flow along different (personal, business, expertise) types of paths?, b. how does knowledge flow within or between business units?, c. how does knowledge flow across different management levels?) and (2) questions pertaining to knowledge node aspects (a. what are the distribution patterns of knowledge owner, knowledge provider, and knowledge broker?, b. do such patterns differ across different management levels?).

2. Social network perspective on knowledge flow research

Rather than utilizing impersonal sources such as the organization's knowledge repositories, the Internet, or individuals from the formal organizational structure, people rely more on their informal relationship network to obtain (tacit) knowledge and assistance in resolving their problems [4, 5]. As a result, SNA is adopted as a powerful tool to understand how knowledge flows in an organization [21]. Recently, a growing body of literature has been addressing the topic of knowledge flow in organizations, both theoretically and practically, through a social network approach.

In terms of research methodology, there have been two streams of study on how social networks lead to active knowledge transfer within organizations: (1) theory-testing survey studies and (2) case studies. Plenty of the literature has focused on empirically validating the relationship between structural (e.g., structural holes, density, centrality) or relational (e.g., trust, closeness, strength of tie) characteristics of social network and knowledge flow (e.g., sharing, transfer, creation) at the individual [1, 7], team or group [15, 24], and organizational [25] levels. However, these studies, despite their theoretical contribution, seem to lack the concrete and practical guidelines for organizational managers.

In order to overcome such inadequacy, a series of social network case studies have ensued. Cross et al. [5] introduced scenarios, wherein SNA would likely yield sufficient benefits and developed the generalized insights into analyses that were informative and actionable for practitioners. In addition, Cross and Prusak [6] defined four knowledge network role-players (central connector, boundary spanner, information broker, and peripheral specialist) whose existence are critical to the performance of their organization. In other case-based studies, SNA is combined with measures of organizational culture [19] or communities of practice [8]. Since most of these case studies, however, have focused mainly on developing managerial insights based on a single company or industry context, they lack information in deriving general patterns or propositions for building theories. Consequently, we adopt the theory building approach based on multiple case studies [12, 29] to address those issues.

3. Research method

In order to explore the existence and patterns of various organizational knowledge paths in different industry settings, we conducted a comparative case study with a theory-building purpose. Among the 50+ member firms of the university-affiliated KM consortium in Korea, six organizations from six industries (*Alpha*: oil refinery, *Beta*: automobile part, *Gamma*: industrial machine, *Delta*: construction, *Epsilon*: government/public, *Zeta*: food manufacturing) participated. From the six organizations, a total of 2,098 business people at five management levels (employee, assistant manager, manager, associate general manager, general manager) initially agreed to participate in the study, ranging from 237 (*Zeta*) to 407 (*Delta*) participants. Among those, 1,833 (response rate of 87.1%) finally answered the network survey from June 21 to July 27, 2007. Adopting the principles of theory building based on multiple case studies [12, 29], we first conducted the within-case analysis of the six firms, followed by the cross-case analysis for both the comparison across different organizations/industries and the synthesis of commonly observed knowledge flow network patterns. Based on these analyses, we suggest propositions for future research.

3.1. Data collection

Data was collected through a "multiple name generator" type questionnaire, which is one of the

widely used SNA methods [2, 22]. This survey method directly measures the various relationships among all members where each organizational member is expected to nominate all individuals with specific relationships such as personal, business, expertise, and others. Furthermore, this method is deemed appropriate in diagnosing a social network among individuals who belong to the same organization and maintain continuing relationships with one another [22]. The actual survey was conducted on-line by using e-OrgXray [9], developed by the authors of this study, and consisted of five network questions (knowledge give relationship, knowledge receive relationship, knowledge owner (expert), business relationship, and personal relationship). Based on the respondents' answers to these network questions, each organization's knowledge flow network map was constructed and the individuals' network roles/locations (knowledge owner, provider, and broker) were derived for further analysis. Figure 1 shows the overview of the variables used and the analyses conducted in this study.

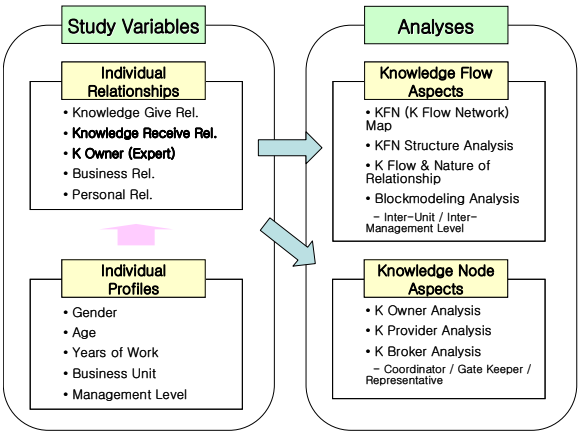

Figure 1. Overview of the study variables and analyses

The data collection procedures consisted of the following four steps: (1) participating firms' KM managers send the participant list to the researchers; (2) researchers prepare the data setting for the on-line survey system; (3) researchers send each participant a survey authorization number through e-mail; (4) participants log on to the on-line survey site using their authorization numbers and complete surveys. Table 1 shows, for each participant firm, the survey response rate and the average number of nominations made for each network question.

Table 1. Participating firms' response data

Participating Firms	Response Rate (% - Answered / Agreed to Participate)	Average # of Nominations (People)
Alpha	82.7 (329 / 398)	1.38
Beta	92.1 (374 / 406)	2.08
Gamma	90.8 (228 / 251)	1.57
Delta	96.8 (394 / 407)	1.50
Epsilon	79.4 (317 / 399)	1.44
Zeta	80.6 (191 /237)	1.06
Mean	87.4 (1,833 / 2,098)	1.50

4. Within-case analysis

For each of the six participant firms, an in-depth analysis of their organizational knowledge flow networks and specific node roles are conducted. In this section, the case of *Alpha*, an oil refinery, will be introduced as an exemplary within-case analysis, while the results of analyses for the rest five firms are summarized in the Cross-case comparisons section. Since *Alpha* came closer to average organization-wide measures on important characteristics such as response data and structural indices, this company was chosen as the most representative one among six participants. *Alpha* is a Korean subsidiary of a large multi-national oil refinery. Out of the 398 initial participants, 329 (82.7%) completed the on-line network survey. Among the given five network questions, they nominated an average of 1.38 persons, which is a little lower than the overall mean value, 1.50.

4.1. Knowledge flow aspects

Based on the collected data about individual relationships from the participants in *Alpha*, we identify the knowledge flow paths among individuals by drawing a knowledge flow network map and further examine the general structure and features of *Alpha*'s knowledge flow network. In addition, to answer the inquiry on "how does knowledge flow along different types of path?", the relationship between knowledge flow and the three types of relationship (personal, business, and expertise) is investigated. Furthermore, we also conduct the inter-unit and inter-management level analysis, called blockmodeling analysis [11, 26] by aggregating individual level data to the business unit or management level. In doing so, we can understand knowledge flows in organizations in a more comprehensive and generalized way [11].

4.1.1. Knowledge flow network map. Figure 2 shows *Alpha*'s organizational knowledge flow

network map, which is drawn using NetMiner 3 [10]. It is constructed based on the knowledge receive relationship question ("please, enter the names of your colleagues (up to 7 people) who provided you with useful knowledge for your work in the past six months"). In the map, circles are people who participated in the survey and triangles are people who initially were listed as participants but did not participate (still, they could be nominated by others as knowledge providers). The five symbol colors represent the five business units of the firm and the size of a symbol increases in proportion to a person's management level. People on the periphery of the map without any linked arrows (39, about 10%) are the "loners" who do not have anyone to exchange knowledge with. Further inside from the "loner" group are isolated small clusters (called components) of people (about 10%) who belong to some local components but are disconnected from the main knowledge flow network of their firm. Judging from the clustering of nodes of the same color, knowledge flows between people in the same business unit seem to be more dominant than the inter-unit knowledge flows. Centrally-located large symbols suggest that, in *Alpha*, high-level managers are more actively involved in the organizational knowledge transfer.

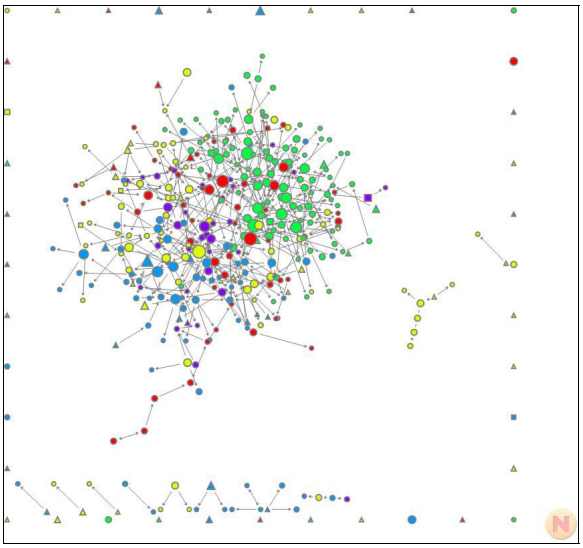

Figure 2. *Alpha*'s organizational knowledge flow network map

4.1.2. Knowledge flow network structure analysis. In order to detect the structural features from *Alpha*'s organizational knowledge flow network, we calculate the following five social network indices by using NetMiner 3 [10]: (1) average geodesic distance; (2) giant component percentage; (3) clustering coefficient; (4) network density; and (5) degree of concentration. The definitions and *Alpha*'s values of these indices with quoted references are described in Table 2.

First, average geodesic distance is the mean number of links any two members of the network have to traverse to be connected [23]. The shorter the distance, the faster and easier the knowledge transfer. *Alpha*'s average geodesic distance is 4.19, which means the employee in *Alpha* needs to go through more than three people before meeting the target person. Second, a giant component of an organization is the largest, main connected subset of any organization's knowledge flow network [23]. It suggests that the higher the giant component percentage is, the lower the portion of the isolated "island" or "loner" nodes in an organization will be. Table 2 shows that about 20 percent of people are not connected to *Alpha*'s main knowledge cluster, subjecting themselves to "knowledge disadvantage". Third, clustering coefficient measures the probability (ranging from zero to one) that two people connected to a common person are also connected with each other [26]. High clustering coefficient signals that local nodes (within a department or team) are tightly connected with one another. Fourth, network density measures how densely or sparsely a network is organized, calculated by the ratio of actual existing links among every connectable link of the network, ranging from zero to one. [26]. Lastly, degree of concentration reveals whether the provision of knowledge in an organization is spread out through the organization or most knowledge is provided by a small number of experts [17]. Zero corresponds to perfect equality (everyone providing exactly the same knowledge) and one corresponds to perfect inequality (where one person provides all the knowledge in an organization, while everyone else does not). The values of clustering coefficient, network density, and degree of concentration of *Alpha* are 0.11, 0.35, and 0.601, respectively. The detailed discussion including comparisons among six companies in different industries will be handled in the Cross-case comparisons section.

Table 2. *Alpha*'s structural indices of knowledge flow network

Structural Index [References]	Definitions	*Alpha*
Average geodesic distance [23]	The mean shortest path-length between any pair of nodes in a network.	4.19
Giant component percentage [23]	The percentage of the largest, main connected subset in a network.	81.9 %
Clustering coefficient [26, 27]	How close the vertex and its neighbors are from being a clique (complete graph). The likelihood that neighbor associates connected to a node (common person) are also associates themselves (connected with one another).	0.11
Network density [26]	How densely or sparsely a network is organized, calculated by the ratio of actual existing links among every connectable link of a network.	0.35
Degree of concentration [17]	Whether link in a network is equally spread out through the network or owned by a small number of nodes, which is calculated by the Gini coefficient.	0.601

4.1.3. Knowledge flow and nature of relationship. "When you need knowledge for your work, whom do you turn to mostly? To the one with the most expertise in the field, to a colleague you work with in business, or to a person whom you have a personal relationship (e.g., friendship, alumni, etc.)?" In order to answer such questions, we analyze the relationships between knowledge flow and the three types of relationship (personal, business, and expertise), using an index called network correlation coefficient. Network correlation coefficient indicates the portion of the links overlapping in two relationships of interest [14].

For instance, if there are many parings of people who have both their knowledge flow (A→B; B receives knowledge from A) and personal (A→B; A is a personal friend of B) relationship in *Alpha*, the network correlation coefficient between knowledge flow and personal relationship is high. In other words, people in *Alpha* are inclined to turn to their friends for knowledge. Table 3 shows the network correlation coefficient for *Alpha*. We find that, in *Alpha*, knowledge flow relationship overlaps most highly with professional (expertise) relationship (0.282), followed by business relationship (0.178), and personal relationship (0.105). That is, *Alpha* employees seek knowledge for their work more from the experts with professional knowledge (they perceive) than from people doing business with them or their personal acquaintances.

Table 3. Network correlation coefficient in *Alpha*

Relationship type	Personal	Business	Expertise	K. flow
Personal	1	-	-	-
Business	0.132	1	-	-
Expertise	0.122	0.168	1	-
Knowledge flow	0.105	0.178	**0.282**	1

4.1.4. Blockmodeling analysis. This study examines knowledge flow paths between individuals based on individual-level data. However, if we aggregate these data to the business unit level or management level, we can analyze the inter-unit or inter-management level analysis, called blockmodeling analysis [11, 26]. Table 4 shows *Alpha*'s standardized (considering unit size, mean, and standard deviation) result of blockmodeling analysis arranged by the business unit. In this table, we can differentiate and compare the volume of knowledge flows between business units as well as within a business unit. In the same way, we can prepare a standardized result of blockmodeling analysis arranged by the management level (Table 5) where we can analyze the different types of knowledge flows (upward, horizontal, and downward) between management levels and identify the management levels with active (or passive) knowledge flows between them.

According to the blockmodeling analysis on unit-level knowledge flows in *Alpha*, the within-unit knowledge flows (the diagonal of Table 4) are dominant over the inter-unit knowledge flows (the off-diagonal). However, the ranges among the within-unit knowledge flows are diverse from 0.41 (BU3) to 33.40 (BU4) as are those among inter-unit knowledge flows from -5.64 (BU3 → BU1) to 4.84 (BU5 → BU4). Additionally, blockmodeling analysis at the management level in *Alpha* shows that the within-level (horizontal) and the inter-level (downward and upward) knowledge flows are quite diverse depending on management levels. More specifically, the downward knowledge flows (the upper diagonal of Table 5) are dominant over the horizontal (the diagonal) and the upward (the lower diagonal) knowledge flows. Since active knowledge flows within/between units and management levels do not always imply the ideal type of KM in organizations [15], managers in *Alpha* may want to plan a goal for nurturing knowledge flows based on

these blockmodeling results after carefully considering the factors such as organizational or unit/management-level strategy and characteristics.

Table 4. *Alpha*'s standardized result of business unit blockmodeling analysis

From \ To	BU1	BU2	BU3	BU4	BU5
BU1	16.22	-3.57	-4.01	-2.33	-3.06
BU2	-4.70	3.68	-3.78	-0.67	-3.11
BU3	**-5.64**	-4.50	0.41	-0.93	-2.40
BU4	-3.69	-1.56	-0.04	**33.40**	-0.79
BU5	-2.86	-2.66	-2.62	4.84	15.68

* BU1: Production, BU2: Supply & Trading, BU3: Process innovation, BU4: Sales & Marketing, BU5: Management support

Table 5. *Alpha*'s standardized result of management level blockmodeling analysis

From \ To	ML1	ML2	ML3	ML4	ML5
ML1	1.8	0.16	0.3	-1.07	-0.98
ML2	-0.58	**4.38**	1.15	2.8	-0.91
ML3	1.96	1.15	-0.53	1.48	1.43
ML4	-0.48	-0.19	-0.57	1.36	0.94
ML5	-2.8	-2.81	**-3.85**	-2.43	-2.02

* ML1: General manager, ML2: Associate general manager, ML3: Manager, ML4: Assistant manager, ML5: Employee

4.2. Knowledge node aspects

In a typical organization's knowledge flow network, knowledge flows from a source node (knowledge provider) to a recipient node (knowledge receiver) [28]. To promote active knowledge transfer within organizations, it is critical to motivate knowledge owners to become active knowledge providers. Likewise, knowledge receivers should be encouraged to play the role of knowledge brokers to facilitate the knowledge spread to the rest of an organization. Thus, in this section, we analyze the roles of knowledge owner, knowledge provider, and knowledge broker in terms of their distribution patterns.

4.2.1. Knowledge owner analysis. Knowledge owners are people who possess expertise in certain business fields or tasks [18]. They are identified in this study through their colleagues' nominations. Expertise points indicate the frequency of their nomination as internal experts. As shown in Figure 3, *Alpha*'s expertise points have an "L-shaped" distribution, wherein only a small number of people have high points while more than half of the population has 0 or 1 point. Figure 4 shows the expertise points distribution along five management levels in *Alpha*. While the average expertise point increases as the management level goes up, it is interesting to note that they peak at the associate general manager level, and not at the general manager level itself. It might be interpreted in two ways. First, *Alpha* general managers tend to focus on managing their subordinates and, over time, are likely to become insulated from actual functional tasks. Or, since general managers, in *Alpha*, are less available and busy most of the time, their expertise may not be easily understood or accessible to their subordinates.

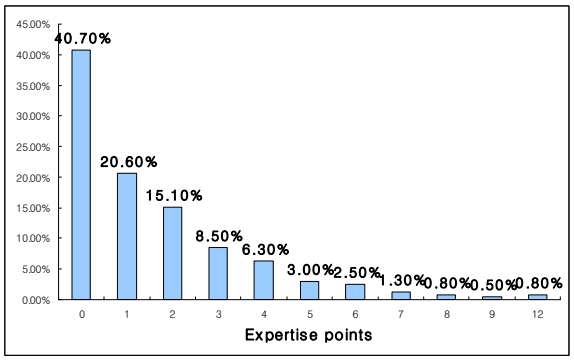

Figure 3. The knowledge owner distribution in *Alpha*

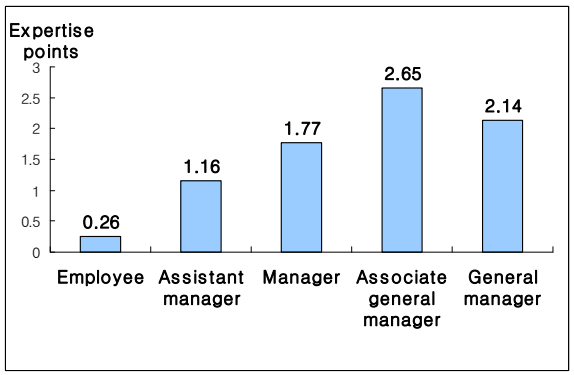

Figure 4. The expertise point distribution aggregated by five management level in *Alpha*

4.2.2. Knowledge provider analysis. Knowledge providers are people who help other people through the use of their knowledge [18], identified by other people's nominations through the "knowledge receive relationship question". In *Alpha*, knowledge providers have very similar distribution patterns to those of knowledge owners (e.g., L-shape, peaking at the associate general manager level, etc.). Here, a more interesting observation is made regarding the gap between the expertise and knowledge provision points at the respective management levels. At the

employee and assistant manager levels, as seen in Figure 5, knowledge provision points are higher than expertise points (that is, while they do not have much knowledge, they are still willing to help others with their knowledge). However, at the manager level, expertise points become slightly higher than the knowledge provision points and, moreover, at the associate general manager and general manager levels, such gap significantly widens, signaling the need to motivate the higher-level managers to contribute their knowledge more actively.

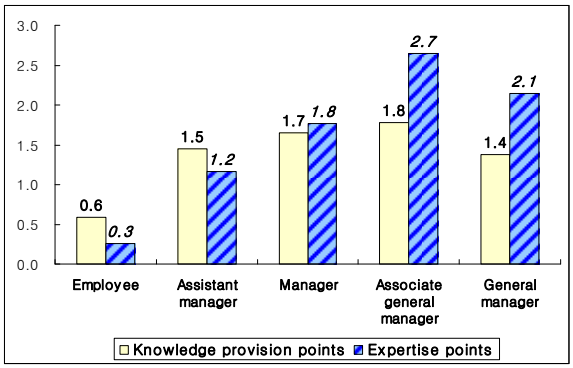

Figure 5. The comparison between the expertise and the provision points along with five different management levels in *Alpha*

4.2.3. Knowledge broker analysis. Knowledge brokers are people who play the role of intermediary between knowledge owners/providers and those in need of knowledge [13, 18]. The fact that one is a knowledge owner or a knowledge provider does not necessarily make the person a knowledge broker. Knowledge brokers should not only receive knowledge from various sources but also spread such knowledge to the rest of the organization. Thus, it is the knowledge broker's role that is instrumental in promoting active knowledge transfer within an organization. Three types of knowledge brokers, adopted in this study, are coordinator, gatekeeper, and representative based on Gould and Fernandez's [13] structurally identified types of brokerage. First, a coordinator intermediates the knowledge transfer within the business unit (all three actors - source, recipient, and broker - belong to the same group). Second, both gatekeeper and representative play the "boundary spanner" role [6], the one which intermediates between different business units. A gatekeeper imports knowledge from other business units and spread it within his/her own unit. In contrast, a representative exports knowledge from his/her business unit to the rest of the organization.

In *Alpha*'s case, these knowledge brokering roles seem to be mostly conducted by a small number of people in the organization. About 90% of the coordinating role is concentrated in the top 20% of the company's population, while, for the gatekeeper and representative roles, such concentration becomes even more extreme with approximately a 90/10 distribution as described in Table 6. Going back to *Alpha*, a typical broker (coordinator, gatekeeper, representative) is either a general manager or an associate general manager and is prominently found in the process innovation business unit right under the CEO's office. These findings suggest that *Alpha* seems to have a fairly conservative and centralized knowledge transfer culture where, within business units, knowledge gets spread by the higher rankers and, across the organization, the CEO's brain unit (the process innovation business unit) plays the most important inter-unit knowledge brokering roles (gatekeepers, representatives).

Table 6. The knoweldge brokering points distribution in *Alpha*

Top	Coordinator	Gatekeeper	Representative
1%	19.23%	27.07%	28.15%
5%	51.05%	63.91%	63.70%
10%	72.73%	88.72%	85.93%
15%	85.66%	100.00%	100.00%
20%	92.66%	100.00%	100.00%

5. Cross-case comparisons

In the Within-case analysis section, we look into the knowledge flow network as well as knowledge node roles of a single company *Alpha*. While it exposes meaningful, otherwise hidden, patterns, it will be more convincing if we synthesize and derive more generalized patterns through the cross-case comparisons. We will discuss the six participating organizations' knowledge flow networks by summarizing the results of structural, correlated relationship, and blockmodeling analysis conducted within each case study. Then, we will also interpret the summarized results on each knowledge node role (knowledge owners, providers, and brokers) analysis.

5.1. Knowledge flow aspects

The results of the knowledge flow network structure analysis on five social network indices are summarized in Table 7. First, the average geodesic distance of the entire six firms is 5.25, suggesting that the organization, to some extent, has a sticky process of promulgating critical knowledge to its members. While *Epsilon* and *Zeta*, which have a small number of local manufacturing sites, have relatively short

distances (3.10 and 2.97, respectively), *Beta* and *Delta*, which operate multiple overseas plants and construction sites, show rather high distances (9.84 and 6.80, respectively). This confirms that despite the widespread installations of corporate groupware and intranet, physical proximity still plays a critical role in shortening the average geodesic distance of a firm's knowledge flow network, suggesting a need to complement IT-oriented communication with more face-to-face offline interactions. Second, an overall giant component percentage is about 90%, which means that one out of ten in an organization is not connected to the main knowledge cluster, thus, subjecting him/herself to "knowledge disadvantage". Identifying and helping such personnel get connected with the rest of the organization will be an important task beneficial to both the individuals and the organization. Third, all organizations in this study, except *Alpha*, appear to have a clustering coefficient of around 0.2. It is suggested that *Alpha* examine why its employees are not tightly connected with others locally. Fourth, while most of the organizations have a network density of around 0.44 (mean), *Gamma* has 0.63. Follow-up interviews with *Gamma's* employees reveal that the firm has developed a very strong camaraderie among its colleagues ever since it went on the verge of bankruptcy in 1998 and was sold to an overseas investment firm. Furthermore, the employees believe their strong collegiality and closeness to one another will help them greatly as they expand overseas in the near future. Finally, while we expect to observe a fair level of variance across organizations (since all of them belong to different industries), the degree of concentration seems to average around 0.6 without significant variance among them. That is, an abnormal concentration of knowledge flows is not present in any of the six participating firms.

Table 7 also shows each participating company's most associated relationship between knowledge flow and the three types of relationship (personal, business, and expertise) examined in this study. All knowledge flows among the six organizations overlap most highly with expertise relationship, followed by business and personal relationship. That is, people in each company seek knowledge for their work more from the experts (they perceive) with professional knowledge than from people doing business with them or their personal acquaintances. This also confirms prior research showing that knowing an informal social network rather than formal business relationship is more important to understand actual knowledge paths within an organization [21]. The blockmodeling analysis on both within and inter-unit knowledge flows show that six organizations' within-unit knowledge flow portion ranges from 59% (*Delta*) to 82% (*Beta*) with an average of 71%. Thus, within-unit vs. inter-unit knowledge flow ratio seems to be roughly 7:3. Additionally, blockmodeling analysis on inter-management level shows that the portions of downward, horizontal, and upward knowledge flows between management levels are 47%, 32%, and 21%, respectively, roughly suggesting a 5:3:2 ratio except for *Epsilon*. Follow-up interviews with *Epsilon*'s KM manager and executives reveal that the company has a different KM culture, being a government/public company compared to the private enterprises. They often perceive people in their management level to be experts and depend on them in problem solving. This is partly due to the stricter role separation among each management level.

Table 7. The summarized results of analyses on knowledge flow aspects in six case companies

Company	KFN structure analysis					CRA	BMA at BU level		BMA at MGT level		
	AGD	GCP	CC	ND	DC	Highest NCC with KF	Within-unit	Inter-unit	Down-ward	Hori-zontal	Up-ward
Alpha	4.19	81.9%	0.11	0.35	0.60	0.282 (Expertise)	69%	31%	45%	25%	30%
Beta	9.84	95.6%	0.23	0.51	0.50	0.300 (E)	82%	18%	48%	27%	25%
Gamma	4.59	92.8%	0.20	0.63	0.56	0.332 (E)	77%	23%	51%	28%	21%
Delta	6.80	93.4%	0.18	0.37	0.68	0.330 (E)	59%	41%	54%	30%	16%
Epsilon	3.10	84.7%	0.18	0.36	0.59	0.300 (E)	68%	32%	31%	48%	21%
Zeta	2.97	78.9%	0.18	0.45	0.67	0.312 (E)	72%	28%	52%	34%	14%
Total	5.25	88.3%	0.18	0.44	0.60	0.320 (E)	71%	29%	47%	32%	21%

* KFN: Knowledge flow network, CRA: Correlated relationship analysis, BMA: Blockmodeling analysis, BU: Business unit, MGT: Management, AGD: Average geodesic distance, GCP: Giant component percentage, CC: Clustering coefficient, ND: Network density, DC: Degree of concentration, NCC: Network correlation coefficient, KF: Knowledge flow

Table 8. The summarized results of analyses on knowledge node aspects in six case companies

Company	KOA		KPA		Gap (EP - KPP)	KBA					
						Coordinator		Gatekeeper		Representative	
	Top 20%	Peak	Top 20%	Peak	Peak	Top 20%	Peak	Top 20%	Peak	Top 20%	Peak
Alpha	61.7%	AG	59.2%	AG	AG	92.7%	GM	100%	AG	100%	AG
Beta	62.2%	GM	50.9%	GM	GM	79.7%	AG	100%	AG	100%	GM
Gamma	59.9%	GM	53.9%	GM	GM	85.2%	GM	100%	GM	100%	AG
Delta	75.1%	GM	67.0%	AG	GM	100%	AG	100%	AG	100%	AG
Epsilon	62.4%	GM	59.3%	AG	GM	94.4%	GM	100%	AG	100%	GM
Zeta	72.6%	GM	65.3%	GM	GM	100%	MG	100%	AM	100%	AM
Total	65.7%	GM	59.3%	AG	GM	92.0%	GM	100%	AG	100%	AG

* KOA: Knowledge owner analysis, KPA: Knowledge provider analysis, KBA: Knowledge broker analysis, EP: Expertise point, KPP: Knowledge provision point, AM: Assistant manager, MG: Manager, AG: Associate general manager, GM: General manager

5.2. Knowledge node aspects

Both knowledge owners and providers in each of the six case companies seem to have very similar distribution patterns (e.g., L-shape, increasing as management level goes up, etc.). However, while knowledge owners, as shown in Table 8, usually peak at the general manager level, knowledge providers seem to peak at the associate general manager level. Interestingly, the gap between knowledge owning and providing is significantly expanding as management level increases. It further suggests the need to motivate the high rankers (especially general managers) to contribute their knowledge more actively.

Table 8 also shows that the top 20% people in an organization dominate over 90% of brokerage activities while only about 60% of knowledge owning and providing activities are explained. These results imply that identifying and motivating knowledge brokers (rather than owners or providers) are more critical for an effective organizational knowledge transfer. Among the knowledge brokers, more specifically, the case comparison results imply that focusing inter-unit knowledge transfer by motivating boundary spanners' (gatekeeper or representative) role (100/20) is more likely to be effective than paying attention to a coordinators' role (90/20).

6. Propositions for future research

Based on major findings and discussions from the within case analysis and cross-case comparisons, we derive the following seven propositions for future organizational knowledge flow research as shown in Table 9. Due to space limitations, we skip the specific rationales for propositions development.

Table 9. Propositions derived from multi-industry case studies

	Proposition
P1	*The knowledge flow in an organization is more likely to be related to the professional relationship than other relationships such as personal and business relationships.*
P2	*The within-unit knowledge flow is likely to be dominant over inter-unit knowledge flow in an organization.*
P3	*The downward knowledge flow is likely to be dominant over upward or horizontal knowledge flow in an organization.*
P4	*The knowledge nodes (knowledge owners, providers, and brokers) in an organization are likely to have L-shaped distribution patterns.*
P5	*The gap between knowledge owning and knowledge providing is likely to become wider as the management level goes up.*
P6	*The knowledge broker's distribution patterns are more likely to be extreme than other knowledge nodes such as knowledge owners and providers.*
P7	*While the role of coordinator is likely to be dominant at general manager level, boundary spanning role of knowledge brokerage (gatekeeper or representative) is likely to be dominant at associate general manager level.*

7. Conclusion

Identifying organizational knowledge paths is of great importance to organizations trying to create and sustain their competitive advantage. This study, based on the multiple case studies, can provide some practical implications. First, managers should have a solid grasp about knowledge flows and knowledge node roles in an organization in order to facilitate an

activate knowledge transfer. Second, from a deep understanding of organizational knowledge paths, more specific KM strategies (e.g., suited approaches for a specific unit or management level) could be identified and implemented successfully. For academicians, this study could be a stepping stone to further empirical research by providing synthesized and generalized knowledge flow patterns and propositions.

Despite the above implications, there are several limitations to this study, requiring further examination. First, we derived seven propositions only from six companies. Second, because data collection was limited to Korean organizations, cultural difference issue might arise. Lastly, more considerations on types of knowledge in the future study would produce more interesting findings.

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