실행공동체 멤버 재구성을 통한 조직차원에서의 지식공유 활동 개선 방안 연구

A New Approach to Improve Knowledge Sharing Activities at the Organizational Level by Rearranging Members of Current CoPs

이 수 철 (Suchul Lee) 포스텍 산업경영공학과 박사과정

서 의 호 (Euiho Suh) 포스텍 산업경영공학과 교수

홍 대 근 (Daegeun Hong) 포스텍 산업경영공학과 박사과정, 교신저자

요 약

실행공동체는 특정 주제에 대해 관심을 가지고 있는 조직 구성원들이 자발적인 상호작용을 기반으로 학습을 수행하는 접근법으로, 성공적인 지식경영을 위한 혁신 인프라 요소 중 하나로 강조되고 있다. 최초의 실행공동체는 자발적이고 비공식적으로 운영되는 것을 전제로 하였으나, 실행공동체의 전략적 활용 가능성이 알려지면서 많은 기업들이 공식적인 관리와 지원을 하고 있다. 따라서 이러한 기업들은 실행공동체 구성원의 활발한 참여를 장려하는 방법을 모색하고 있다. 본 연구에서는 실행공동체 구성원 재구성을 통해 조직차원에서의 새로운 지식공유 활동 개선 방안을 제시하고자 한다. 실제적으로 지식공유활동을 활발히 하는 실행공동체 구성원들이 그들이 속한 실행공동체 전체의 지식공유활동을 이끌고 있으며, 따라서 이와 같은 활발한 구성원을 재배치함으로써 기업 조직차원에서 실행공동체 전체의 지식공유 활성화를 기대할 수 있다. 본 연구에서는 이러한 사항을 반영하여, 조직차원에서의 새로운 지식공유 활동 개선을 목적으로 실행공동체 구성원의 최적 재구성 방안을 찾기 위한 수리모델을 수립하였다. 수립된 수학모델은 비선형 해를 찾는 문제이므로 해당 문제를 차량경로문제로 전환하여 휴리스틱 알고리즘을 적용하여 풀고자 시도하였다. 실행공동체를 경로, 구성원을 노드, 구성원 유형의 중요도를 거리에 대응함으로써 문제 변환을 하였으며, 휴리스틱 알고리즘 중 다수이동방법을 적용하여 가능해를 도출하였다. 이와 같은 알고리즘을 적용하기 위한 솔루션 프로그램을 개발하였으며, 솔루션 프로그램의 적합성을 검증하기 위해 실제로 실행공동체를 전략적으로 활용하고 있는 기업 A의 자료를 이용하여 효과성을 검증하였다.

키워드 : 실행공동체, 사회연결망분석, 지식공유, 차량경로문제, 휴리스틱 알고리즘, 다수이동방법

Ⅰ. Introduction

Knowledge is one of the most valuable resources for business organizations (Zack, 1999). Companies can create and sustain a competitive advantage by applying collected knowledge to the production of goods and services (Grant, 1996). The purpose of Knowledge Management (KM) is to maximize the utilization of knowledge and to gain an advantage relative to other competitors. The KM process has four major components: capturing, storing, sharing and using knowledge. Of these four process components, knowledge sharing is the main issue in a KM system (Lee and Neff, 2001). Knowledge sharing activities provide a link between the knowledge of individual workers and the values of an organization (Hendriks, 1999), and it creates a learning environment that permits the recycling and creation of specialized knowledge (Kim *et al.*, 2010).

Communities of Practice (CoP) have been highlighted recently as one of the most effective methods means of building effective KM (Wenger and Snyder, 2000). As the importance of CoP activity increase, organizations align their CoP activity with organizational strategy and as a consequence, the need to assess the current status of CoP also increases (Wenger *et al.*, 2002). Several research groups have suggested general guidelines for CoPs (e.g., Lesser and Storck, 2001; Wenger and Snyder, 2000; Kim, 2005; Zhang and Watts, 2008). These guidelines were proposed without assessing the current status of a CoP and are only useful when determining an organization's KM or CoP philosophy. Other researchers have suggested a diagnosis framework. However, the proposed frameworks were usually based on subjective methods. Also, guidelines are hard to apply at the individual CoP level where most actual CoP activities are conducted since most of the research regarding CoP diagnosis was focused on the organization level.

Social Network Analysis (SNA) is a scientific method to identify a social network. It focuses on patterns of relationship between actors and examines the availability of resources and the exchange of resources between these actors (Scott, 1991; Wasserman and Faust, 1994; Wellman and Berkowitz, 1988). Kim *et al.* (2008) conducted SNA at individual and organization levels to present some basic indexes, such as link distance, maximum component percentage, clustering coefficient, network density and concentration coefficient. Cross *et al.* (2006) applied SNA to understand the current status of a CoP. They identified five network viewing points: central connectors, brokers, peripheral players, fragmentation points and external connectivity. By using SNA, CoP member types can be developed; balanced player, egoistic propagator, egoistic receiver and knowledge isolator (Kim *et al.*, 2010). These approaches are only focused on identifying the types of actors in the community.

Previous research about the diagnosis of knowledge sharing activities using SNA did not give a strategic direction for future knowledge sharing activities at the organizational level, and some research was not effective in collecting data even though some of the results of analysis were meaningful. In order to give some meaningful information for knowledge sharing activities, it is necessary to propose effective guidelines for linking CoP activities to an organization's performance. In addition, strategic guidelines can be applied to the individual CoP level and organizational levels.

This paper tries to overcome limitations of previous research by proposing an effective way of rearranging members among current CoPs and by suggesting a knowledge sharing strategy for linking CoP activities to an organization's performance. This strategy is based on individual activity using a balanced level score (BLS). This paper also presents a mathematical model to maximize total BLS of company A with several constraints and then a real world problem is converted to a popular problem, VRP, to solve this problem. Moreover, the solution program is developed to find a meaningful solution.

This paper is organized as follows. In section Ⅱ, we review previous research on knowledge sharing and CoP activities in organizations and present Social Network Analysis as the diagnosis method to be used in the paper. In section Ⅲ, we define the problem of a company A and describe our mathematical model to maximize BLS. In section Ⅳ, we describe a heuristic method to increase participation in CoP activities. In section Ⅴ, the final results of this study are discussed. Finally, we present our concluding remarks and suggest future research directions presented in section Ⅵ.

Ⅱ. Related work

2.1 Relationship between Knowledge Sharing and Organizational Performance

Knowledge, which is information whose validity has been established through tests of proof (Liebeskind, 1996), has emerged as a strategically significant resource for firms. Accordingly, knowledge management has become a key factor in gaining and sustaining a competitive advantage (Davenport and Prusak, 1998; Spender and Grant, 1996). Knowledge management is the process of capturing, storing, sharing, and using knowledge.

In this context, a major management issue is how to change individual into organizational knowledge, since organizational knowledge is created and resides with individuals by nature (Nonaka and Konno, 1998). Another issue is how to integrate and manage organizational knowledge so that it results in successful performance. Since organizational knowledge is usually distributed within an organization and organizational products or services generally require multiple-knowledge, organizations need to integrate knowledge to improve business performance (Brown and Duguid, 1998).

Organizational knowledge is not only created within an organization but can also be acquired externally. Therefore, recently, increasing attention has been paid to how organizations learn from their partners and develop new competencies through strategic alliances (Simonin, 1999). Many scholars have discussed the way forming alliances can help a company acquire new capabilities from partners through organizational learning (Hamel, 1991).

On the other hand, the fundamental question in the field of strategic management has been how organizations gain and sustain competitive advantages. With the increasing uncertainty and the dynamics of business environments, organizational resources and capabilities are key success factors for competitive advantage and sustainability (Barney, 1991). Accordingly, organizational capabilities depend on valuable resources that are inimitable, unsubstitutable, and durable; these capabilities depend on an organization's ability to acquire and use such resources for competitive advantage.

The research interest in organizational capabilities has been revitalized recently by knowledge-based theories (Grant, 1996; Kogut and Zander, 1992; Quinn *et al.*, 1997). These argue that organizational knowledge, such as operational routines, skills, or know-how, are the most valuable resources and its strategic management capability is a key factor in a dynamic and rapidly changing environment; i.e. from the knowledge-based perspective, organizational capability is considered a key source of competitive advantage. From this point of view, knowledge sharing is important not only at the organization level but also at the individual level.

2.2 Using CoPs to Cultivate Knowledge Sharing

CoPs have been highlighted recently as one of the most effective methods to build effective KM. A CoP is defined as an informal group of individuals that share a common work environment (Wenger, 2006). By working together, members of a CoP share their concerns, problems or passion about specific topics to cultivate their knowledge and expertise. CoP activities facilitate mutual trust among CoP members based on social capital: connections, relationships and common context. Consequently, knowledge sharing activities in a CoP create and sustain competitive advantages for an organization.

The functions of a CoP are to help drive strategy, to solve problems quickly, to transfer best practices, to develop professional skills and to help organizations to recruit (Wenger and Snyder, 2000). CoPs assist in innovation and knowledge creation across boundaries in an organization. And CoPs allow members to create and share knowledge, regardless of organizational boundaries (Plessis, 2008). CoPs enable individuals to share knowledge and practice and learn members' situated knowledge. CoPs can accumulate organizational knowledge and diffuse knowledge through sharing among organizations. Many organizations have used CoPs as a tool in their organizational knowledge management strategy (Soekijad *et al.*, 2004).

Some researchers have suggested general guidelines for CoPs by identifying current CoP issues, e.g proposing future directions for linking CoP activity to an organization's performance (Lesser and Storck, 2001), pinpointing executive level management issues (Wenger and Snyder, 2000), identifying the current key issues and proposing strategies (Wenger, 2004), providing direction to solve potential problems in a CoP (Kim, 2005) and suggesting guidelines for online CoPs (Zhang and Watts, 2008). However, these guidelines are based on the philosophy or general issues of CoPs and not the status of actual individual or organizational CoPs. From this point of view, some researchers have mentioned that a measurement of activity is needed (Lesser and Storck, 2001).

Some research has tried to connect a diagnosis framework with strategic guidelines. Bishop *et al.* (2008) identified the critical factors for CoPs based on factors suggested by Wenger *et al.* (2002), Vestal and Lopez (2004) and Lee and Neff (2004). They conducted interviews to extract which critical factors are suited to their CoP and the findings were as follows:

- Consider CoP member requirements
- Establish both short and long-term CoP objectives
- Establish regular CoP meetings and events
- Provide specific time allocations for CoPs
- Facilitate regular communication of CoP work
- Consider the use of supporting technology

However, the proposed diagnosis framework is not a systematic method and it is hard to conduct annually due to the long working time and high cost involved. In addition, strategic guidelines cannot be applied to individual levels because most research regarding CoP diagnosis was focused at the organization level.

2.3 Using SNA to Diagnose Individual Knowledge Sharing Activities in CoPs

A social network is a social structure of components and their connections. Some examples of components are individuals, business units and organizations. Social networks can be directed when the relationship between any two vertices is one way, or undirected when it is bidirectional. In addition, they can be weighted (with a numeric value) or unweighted. SNA is a scientific method to identify a social network. It focuses on patterns of relationship between actors and examines the availability of resources and the exchange of resources between these actors (Scott, 1991; Wasserman and Faust, 1994; Wellman and Berkowitz, 1988).

In knowledge sharing activities, SNA provides a view of the relationship network. An SNA view increases the social capital in an organization (Kim *et al.*, 2010). SNA gives insights into how the work is really conducted in an organization, how decisions are made and how effective the existing organizational structures are. Also, SNA identifies the specific individuals or groups who are most likely to have a strong influence across group borders and boundaries (Anklam, 2003; Cantner and Graf, 2006; de Laat *et al.*, 2007; Haythornthwaite, 1996). SNA has been employed to identify social network dynamics, such as supervisor-supervisee, and father-daughter (e.g., Howell, 1988; Lin and Bian, 1991), presence or participation in particular events (e.g., Scherzer, 1992; Latkin, 1995), co-membership (e.g., Mizruchi, 1992), citation and co-citation (e.g., White and McCann, 1988) and technical relationships (e.g., Mika, 2005).

Kim *et al.* (2008) conducted SNA at individual and organization levels. They presented some basic indexes, such as link distance, maximum component percentage, clustering coefficient, network density and concentration coefficient. Using these indexes, they identified current knowledge sharing activities, and also conducted an analysis of knowledge brokers. Based on the major findings from the analysis, they derived seven propositions for future research. However, they did not suggest any strategic direction for guiding knowledge sharing activities.

Cross *et al.* (2006) applied SNA to understand the current status of a CoP. They identified five network viewing points: central connectors, brokers, peripheral players, fragmentation points and external connectivity. Along with the above, they suggested an assessment method based on network objectives: improve information flow and knowledge reuse, develop a sense-and respond capability, drive planned and emergent innovation, nurture value-creating interactions and engage employees through CoP efforts. However, the purpose of using SNA in this research was mainly focused on visualizing the current action in a CoP, even though they did identify the types of actors in the community.

By using SNA, member types of a CoP can be developed: balanced player, egoistic propagator, egoistic receiver and knowledge isolator (Kim *et al.*, 2010). Two dimensions are needed to determine the types of members: existence of knowledge receiving and knowledge propagating. For active knowledge sharing in a CoP, the proportion of balanced players should be high. If the proportion of egoistic propagators or egoistic receivers is higher than that of balanced players, knowledge in that CoP will not be shared actively. Therefore, BLS can be used to score a CoP depending on the types of CoP members it contations (Kim *et al.*, 2010). However, the purpose of using SNA in this research was to derive knowledge sharing strategies based on the activities of an individual CoP.

Ⅲ. Problem

3.1 Problem Definition

Even though a CoP is an informal group to share knowledge and know-how, many companies have started managing and supporting formal company-wide CoPs because of their strategic usability. Therefore, the importance of motivating members to participate in CoP activities has become a key concern for a number of organizations. According to this situation, the problem can be formulated in the following way:

- Problem: "Maximize total BLS of CoPs in company A by rearranging the members of its CoPs"

3.2 Assumption

To solve this problem, we need to make several assumptions. These assumptions are based on discussions with the KM team leader of company A in order to reflect real situation there. These assumptions are as follows:

- The number of CoPs in which each member is involved cannot be changed.
  - The reason for this assumption is that someone involved in too many CoPs is not likely to be a sufficiently active member.
- The minimum number of members in one CoP is five.
  - This number of members is neede in order to maintain a viable CoP.
- Members can be moved only in their working domain.
  - Since the basic purpose of a CoP is to share work-related knowledge, members' working domain should be considered.
- A member who works in one city cannot be moved to a CoP in another city.
  - Although virtual (online) CoPs are used these days, face-to-face interaction is more effective than other ways of sharing knowledge.

3.3 Data

In this paper, real data related to company A's CoPs is used to address the problem of maximizing BLS by rearranging CoP members. Company A is very interested in CoPs activities. The purposes of its CoPs are to do Work-Innovation-Learning relational activities, to create core knowledge, to activate knowledge and know-how sharing, and to capitalize on its knowledge. Company A has around 1,600 CoPs and the number of participants is around 78,000. Among these CoPs, 43 representative CoPs were selected to solve the problem. Representative CoPs were selected by the results of SNA, especially Network Density (ND) and BLS. Around 100 CoPs which have a high level of ND or BLS were selected, and then the final CoPs, in which members could be moved easily between departments, were determined by discussion with the KM team leader. General statistics related to 43 representative CoPs are shown in <Table 1> and a sample of CoP data is shown in <Figure 1>.

〈Table 1〉 General Statistics of Representative CoPs

Number of CoPs	43
Number of members	4,537
Number of writings	12,822
Number of writings per person	3.62
Number of reading	227,502
Number of readings per person	63.09

3.4 Mathematical Model

A mathematical model can be developed based on the problem and assumptions discussed above. The mathematical model that we have developed is as follows:

CoP No.	Department	Region	# of members	# of writings	# of readings	# of balanced player	# of egoistic propagator	# of egoistic receiver	# of knowledge isolator	BLS
CoP#01	Iron and steel	Region A	68	268	6,765	47	1	19	1	0.481
CoP#02	Iron and steel	Region A	68	421	7,794	40	0	26	2	0.425
CoP#03	Iron and steel	Region B	119	1,268	39,006	87	5	8	19	0.491
CoP#04	Iron and steel	Region B	174	648	27,182	125	1	34	14	0.489
CoP#05	Iron and steel	Region A	56	67	1,045	30	2	18	6	0.394
CoP#06	Iron and steel	Region A	52	77	1,508	27	2	18	5	0.387
CoP#07	Iron and steel	Region B	59	303	5,058	33	1	17	8	0.402
CoP#08	Iron and steel	Region B	83	348	2,238	39	2	20	22	0.346
CoP#09	Iron and steel	Region A	35	30	400	18	2	6	9	0.372
CoP#10	Iron and steel	Region A	60	69	644	28	4	19	9	0.357
CoP#11	Iron and steel	Region B	20	25	187	6	8	6	0	0.308
CoP#12	Iron and steel	Region B	148	165	1,335	33	2	84	29	0.223
CoP#13	Maintenance	Region A	55	229	1563	29	12	10	4	0.406
CoP#14	Maintenance	Region A	103	172	1584	26	5	72	0	0.257
CoP#15	Maintenance	Region B	81	587	12023	64	2	9	6	0.528

⟨Figure 1⟩ Sample of CoP Data

$$Max \sum_{j=1}^{43} BLS_j$$

$$\sum_{j=1}^{43} \frac{0.641\sum_{i=1}^{2280} BP_{ij}A_{ij} + 0.198\sum_{i=1}^{2280} EP_{ij}A_{ij} + 0.123\sum_{i=1}^{2280} ER_{ij}A_{ij} + 0.038\sum_{i=1}^{2280} KI_{ij}A_{ij}}{\sum_{i=1}^{2280}(BP_{ij}+EP_{ij}+ER_{ij}+KI_{ij}) \times A_{ij}}$$

$$\sum_{j=1}^{43} A_{ij} \le 3, \ for \ all \ j$$

$$\sum_{i=1}^{2280} A_{ij} \le 5, \ for \ all \ j$$

$$A_{ij} \le D_{ij}, \ for \ all \ i, j$$

$$A_{ij} \le R_{ij}, \ for \ all \ i, j$$

i = index of all members

j = index of all CoPs

A_{ij} = *1, if member i is assigned to Cop j /0, otherwise*

D_{ij} = *1, if departments of i and j are same /0, otherwise*

R_{ij} = *1, if region (working place) of i and j are same /0, otherwise*

BP_{ij} = *1, if i in j is a Balanced Player /0, otherwise*

EP_{ij} = *1, if i in j is a Egoistic Propagator /0, otherwise*

ER_{ij} = *1, if i in j is a Egoistic Receiver /0, otherwise*

KI_{ij} = *1, if i in j is a Knowledge Isolator /0, otherwise*

Weights (relative priorities) of member types in the above mathematical model are from the pair-wise comparison matrix, <Table 2>. The pair-wise comparisons were conducted by two evaluators who have CoP evaluation experience. The geometric mean was employed for each member type.

Ⅳ. Solution Method

4.1 Problem Change

The mathematical model in Section 3.4 is non-linear and difficult to solve. It would also take a long time to build a model with many CoPs and members. In practical terms, a feasible solution of the model might be meaningful enough.

Therefore, the problem, "Maximize total BLS of CoPs in company A by rearranging the members of its CoPs", can be changed into a Vehicle Routing

〈Table 2〉 Pair-wise Comparison Matrix for Types of Members

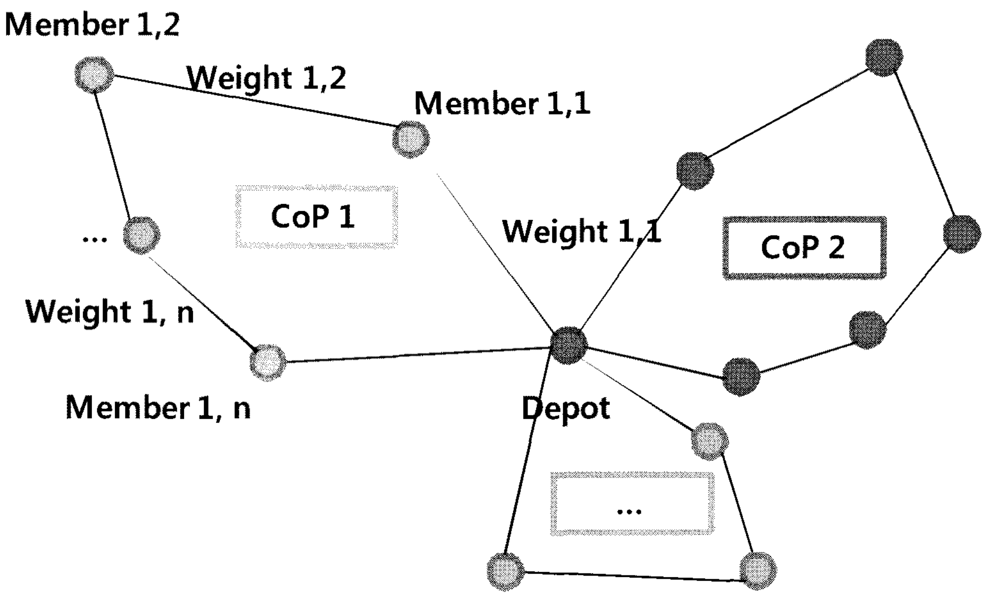
	Balanced Player(BP)	Egoistic Propagator(EP)	Egoistic Receiver(ER)	Knowledge Isolator(KI)	Weight
Balanced Player(BP)	1	5	6	9	0.641
Egoistic Propagator(EP)	1/5	1	2	7	0.198
Egoistic Receiver(ER)	1/6	1/2	1	5	0.123
Knowledge Isolator(KI)	1/9	1/7	1/5	1	0.038

Problem (VRP). A VRP is one of the popular optimization problems. A VRP is an important problem in the fields of transportation, distribution and logistics (Dantzig and Ramser, 1959). The general thrust of the problem is finding a way to deliver goods with the minimum cost form a central depot to the customers who have placed orders.

Assuming there is a dummy node as a depot, each CoP can be matched each route in a VRP problem. Moreover, each member can represent each node, and each weight (priority) can correspond to each distance in a VRP problem. Then, a distance of one route is the BLS of a CoP. The concept of the problem change is shown in <Figure 2>. In this case, however, the problem is to maximize BLS rather than minimize distance.

4.2 Method

In order to solve the problem of maximizing the



〈Figure 2〉 Concept of the Problem Change total BLS, the multi-move method is selected. There are several move methods to solve VRP; for example, one-move, 1-opt move, 2-opt move, 1-1 exchange, etc. Among these methods, the multi-move method is the most suitable in this case because of the definition of BLS. Since BLS is the average score of one member in a CoP, moving 1 or 2 members to another CoP does not make a meaningful change to the total BLS. Therefore, the multi-move method is selected to solve the problem in this paper. The concept of applying the multi-move method is shown in <Figure 3>.

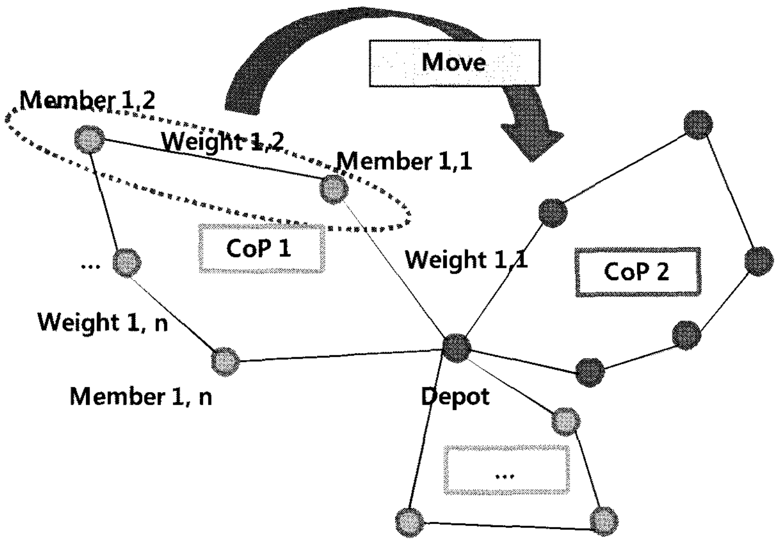
4.3 Method

<Table 3> shows a pseudo code of the multi-move algorithm to solve this problem.

First, to employ the multi-move method, two routes (CoPs) should be selected randomly: one is a from-route (from-CoP) and another is a to-route (to-CoP). After selecting these two routes, locations and department should be checked in terms of constraints described in the problem section. If from-CoP and to-CoP are in different locations or different departments, the next iteration starts after the current iteration has been stopped. Then the type of

〈Table 3〉 Pseudo Code

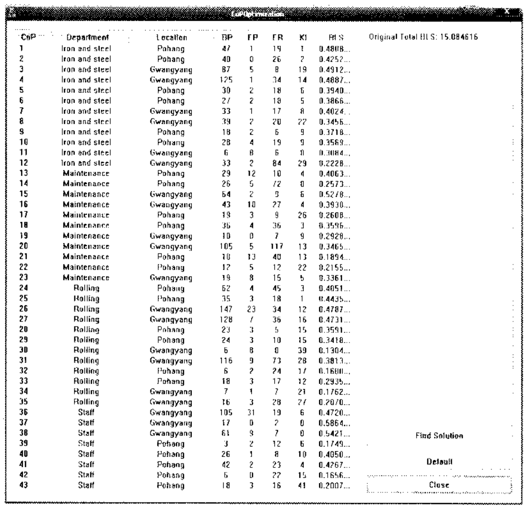
	Pseudo Code
1:	for (iteration)
2:	select two CoPs randomly (from-CoP, to-CoP)
3:	if (from-CoP and to-CoP are in different location)
4:	go to Line 1
5:	if (from-CoP and to-CoP are in different
6:	department)
7:	go to Line 1
8:	select type of members randomly
9:	select number of members to move move members
10:	if (number of from-CoP < 5)
11:	go to Line1
12:	if (number of to-CoP < 5)
13:	go to Line1
14:	calculate BLS
15:	if (improved) update total BLS
16:	else no change



〈Figure 3〉 Concept of Multi-move Method in the Problem member to be moved and the number of nodes (memebrs) to be moved are randomly selected. After selecting the from-node, to-node, type of members and number of nodes, the selected nodes are moved and the new total BLS is calculated. If the new total BLS improves, the changed status is saved; if not, the change is reversed.

4.4 Solution Program

The program which applies the multi-move algorithm was developed to solve the problem. A screen shot of the program is shown in <Figure 4>. The left side of the program shows the current status of member deployment, while the right side shows the results of its search for a solution.



CoP	Department	Location	BP	FP	FR	KI	BLS
1	Iron and steel	Pohang	47	1	19	1	0.4808...
2	Iron and steel	Pohang	40	0	26	2	0.4252...
3	Iron and steel	Gwangyang	87	5	8	19	0.4912...
4	Iron and steel	Gwangyang	125	1	34	14	0.4887...
5	Iron and steel	Pohang	30	2	18	6	0.3940...
6	Iron and steel	Pohang	27	2	18	5	0.3866...
7	Iron and steel	Gwangyang	33	1	17	8	0.4024...
8	Iron and steel	Gwangyang	39	2	20	22	0.3456...
9	Iron and steel	Pohang	18	2	6	9	0.3718...
10	Iron and steel	Pohang	28	4	19	9	0.3569...
11	Iron and steel	Gwangyang	6	8	6	0	0.3084...
12	Iron and steel	Gwangyang	33	2	84	29	0.2228...
13	Maintenance	Pohang	29	12	10	4	0.4063...
14	Maintenance	Pohang	26	5	72	0	0.2573...
15	Maintenance	Gwangyang	64	2	9	6	0.5278...
16	Maintenance	Gwangyang	43	10	27	4	0.3930...
17	Maintenance	Pohang	19	3	9	26	0.2608...
18	Maintenance	Pohang	36	4	36	3	0.3596...
19	Maintenance	Gwangyang	10	0	7	9	0.2928...
20	Maintenance	Gwangyang	105	5	117	13	0.3465...
21	Maintenance	Pohang	10	13	40	13	0.1894...
22	Maintenance	Pohang	12	5	12	22	0.2155...
23	Maintenance	Gwangyang	19	8	15	5	0.3361...
24	Rolling	Pohang	62	4	45	3	0.4051...
25	Rolling	Pohang	35	3	18	1	0.4435...
26	Rolling	Gwangyang	147	23	34	12	0.4787...
27	Rolling	Gwangyang	128	7	36	16	0.4731...
28	Rolling	Pohang	23	3	5	15	0.3591...
29	Rolling	Pohang	24	3	10	15	0.3418...
30	Rolling	Gwangyang	6	8	0	39	0.1304...
31	Rolling	Gwangyang	116	9	73	28	0.3813...
32	Rolling	Pohang	6	2	24	17	0.1600...
33	Rolling	Pohang	18	3	17	12	0.2935...
34	Rolling	Gwangyang	7	1	7	21	0.1762...
35	Rolling	Gwangyang	16	3	28	27	0.2070...
36	Staff	Gwangyang	105	31	19	6	0.4720...
37	Staff	Gwangyang	17	0	2	0	0.5864...
38	Staff	Gwangyang	61	9	7	0	0.5421...
39	Staff	Pohang	3	2	12	6	0.1749...
40	Staff	Pohang	26	1	8	10	0.4050...
41	Staff	Pohang	42	2	23	4	0.4267...
42	Staff	Pohang	6	0	22	15	0.1656...
43	Staff	Pohang	18	3	16	41	0.2007...

〈Figure 4〉 Screen Shot of the Solution Program

V. Experimental Results

Diverse iterations were run to find a meaningful solution using the solution program. Results of these iterations are shown in <Table 4>. Since the applied algorithm is based on random selection, using a large number of iterations guarantees a better solution. If more iterations are run, the amount of improvement will increase consecutively. Thus, when the program reaches a result which is meaningful enough, then no further iterations are necessary and the process can stop. In this case, the final result and meaningful solution was reached after 80,000. <Figure 5> shows the deployment of CoP members, which is given by the final result.

〈Table 4〉 Results of Diverse Iterations

Iteration	Result	Improvement
Original BLS	15.084616	-
1,000	15.146330	100.4%
3,000	15.192116	100.7%
5,000	15.206329	100.8%
10,000	15.496528	102.7%
20,000	16.630748	110.2%
30,000	17.267834	114.5%
40,000	18.280344	121.2%
50,000	18.845712	124.9%
60,000	19.782785	131.1%
70,000	20.306691	134.6%
80,000	20.813338	138.0%

VI. Conclusion

In terms of making CoPs more useful, this paper has proposed a way of increasing total CoP activities that involves rearranging CoP members. In practice, several active members might lead their CoPs. Therefore, rearranging members can, eventually, be one method to motivate other CoP members.

Taking all the above details into account, this paper's contributions are as follows:

CoP	Department	Location	BP	EP	ER	KI	BLS
1	Iron and steel	Pohang	47	1	19	1	0.4808...
2	Iron and steel	Pohang	40	0	26	2	0.4252...
3	Iron and steel	Gwangyang	87	5	8	19	0.4912...
4	Iron and steel	Gwangyang	125	1	34	14	0.4887...
5	Iron and steel	Pohang	30	2	18	6	0.3940...
6	Iron and steel	Pohang	27	2	18	5	0.3866...
7	Iron and steel	Gwangyang	33	1	17	8	0.4024...
8	Iron and steel	Gwangyang	39	2	20	22	0.3456...
9	Iron and steel	Pohang	18	2	6	9	0.3718...
10	Iron and steel	Pohang	28	4	19	9	0.3569...
11	Iron and steel	Gwangyang	6	8	6	0	0.3084...
12	Iron and steel	Gwangyang	33	2	84	29	0.2228...
13	Maintenance	Pohang	29	12	10	4	0.4063...
14	Maintenance	Pohang	26	5	72	0	0.2573...
15	Maintenance	Gwangyang	64	2	9	6	0.5278...
16	Maintenance	Gwangyang	43	10	27	4	0.3930...
17	Maintenance	Pohang	19	3	9	26	0.2608...
18	Maintenance	Pohang	36	4	36	3	0.3596...
19	Maintenance	Gwangyang	10	0	7	9	0.2928...
20	Maintenance	Gwangyang	105	5	117	13	0.3465...
21	Maintenance	Pohang	10	13	40	13	0.1894...
22	Maintenance	Pohang	12	5	12	22	0.2155...
23	Maintenance	Gwangyang	19	8	15	5	0.3361...
24	Rolling	Pohang	62	4	45	3	0.4051...
25	Rolling	Pohang	35	3	18	1	0.4435...
26	Rolling	Gwangyang	147	23	34	12	0.4787...
27	Rolling	Gwangyang	128	7	36	16	0.4731...
28	Rolling	Pohang	23	3	5	15	0.3591...
29	Rolling	Pohang	24	3	10	15	0.3418...
30	Rolling	Gwangyang	6	8	0	39	0.1304...
31	Rolling	Gwangyang	116	9	73	28	0.3813...
32	Rolling	Pohang	6	2	24	17	0.1600...
33	Rolling	Pohang	18	3	17	12	0.2935...
34	Rolling	Gwangyang	7	1	7	21	0.1762...
35	Rolling	Gwangyang	16	3	28	27	0.2070...
36	Staff	Gwangyang	105	31	19	6	0.4720...
37	Staff	Gwangyang	17	0	2	0	0.5864...
38	Staff	Gwangyang	61	9	7	0	0.5421...
39	Staff	Pohang	3	2	12	6	0.1749...
40	Staff	Pohang	26	1	8	10	0.4050...
41	Staff	Pohang	42	2	23	4	0.4267...
42	Staff	Pohang	6	0	22	15	0.1656...
43	Staff	Pohang	18	3	16	41	0.2007...

Total BLS: 15.084616

CoP	Department	Location	BP	EP	ER	KI	BLS
1	Iron and steel	Pohang	47	9	19	8	0.4162...
2	Iron and steel	Pohang	52	0	44	19	0.3431...
3	Iron and steel	Gwangyang	87	0	0	0	0.6410...
4	Iron and steel	Gwangyang	55	15	40	55	0.2741...
5	Iron and steel	Pohang	34	2	43	0	0.3478...
6	Iron and steel	Pohang	23	0	0	5	0.5333...
7	Iron and steel	Gwangyang	10	0	0	0	0.6410...
8	Iron and steel	Gwangyang	62	2	0	0	0.6271...
9	Iron and steel	Pohang	6	0	0	0	0.6410...
10	Iron and steel	Pohang	28	0	0	0	0.6410...
11	Iron and steel	Gwangyang	6	0	0	0	0.6410...
12	Iron and steel	Gwangyang	103	2	129	37	0.3088...
13	Maintenance	Pohang	29	0	10	0	0.5081...
14	Maintenance	Pohang	0	5	129	68	0.0962...
15	Maintenance	Gwangyang	48	12	0	15	0.4495...
16	Maintenance	Gwangyang	37	8	0	0	0.5622...
17	Maintenance	Pohang	19	3	0	0	0.5805...
18	Maintenance	Pohang	36	0	0	0	0.6410...
19	Maintenance	Gwangyang	6	0	0	0	0.6410...
20	Maintenance	Gwangyang	109	5	175	22	0.2997...
21	Maintenance	Pohang	36	34	40	0	0.3157...
22	Maintenance	Pohang	12	0	0	0	0.6410...
23	Maintenance	Gwangyang	41	0	0	0	0.6410...
24	Rolling	Pohang	17	10	90	21	0.1793...
25	Rolling	Pohang	53	3	0	0	0.6172...
26	Rolling	Gwangyang	33	3	0	0	0.6040...
27	Rolling	Gwangyang	242	0	36	0	0.5739...
28	Rolling	Pohang	23	3	29	42	0.2113...
29	Rolling	Pohang	6	0	0	0	0.6410...
30	Rolling	Gwangyang	10	47	34	110	0.1197...
31	Rolling	Gwangyang	112	1	73	0	0.4353...
32	Rolling	Pohang	6	2	0	0	0.5302...
33	Rolling	Pohang	63	0	0	0	0.6410...
34	Rolling	Gwangyang	8	0	0	0	0.6410...
35	Rolling	Gwangyang	15	0	35	33	0.1828...
36	Staff	Gwangyang	105	31	26	6	0.4575...
37	Staff	Gwangyang	17	0	2	0	0.5864...
38	Staff	Gwangyang	61	9	0	0	0.5840...
39	Staff	Pohang	6	0	0	0	0.6410...
40	Staff	Pohang	8	0	0	0	0.6410...
41	Staff	Pohang	17	2	0	0	0.5943...
42	Staff	Pohang	8	3	81	29	0.1387...
43	Staff	Pohang	56	3	0	47	0.3610...

Total BLS: 20.813338

⟨Figure 5⟩ Member Deployment of the Final Result

Firstly, we suggested a new approach in order to improve knowledge sharing activities at the organizational level. Many studies have tried to diagnose CoPs and suggest some strategies to make them more successful. However, this research proposes a new way to improve them by rearranging members of current CoPs. Secondly, we developed the mathematical model to maximize the total BLS of company A with several constraints. Then a real world problem was converted into a popular problem, VRP, to solve this problem. Actually, ideas like this are most important step to solve real world problems. Thirdly, the solution program was developed to find a meaningful solution. The multi-move algorithm was used in our mathematical model. Finally, a meaningful solution was found. The final result represented 138.0% improvement of total BLS (from 15.084616 to 20.813338).

However, since the multi-move method was used based on random selection, a result has high dependency on random selecting. In many cases, moreover, each CoP has its own leader. It is difficult to move such a leader to another CoP. Also the deployment of members in the final result led some impractical solutions. Therefore, these shortcomings should be considered in further research. Lastly, other heuristic methods need to be applied to solve the problem a more effectively and to find more accurate solution.

References

Abrams, L. C., R. Cross, E. Lesser, and D.Z. Levin, "Nurturing interpersonal trust in knowledge-shaving networks", *Academy of Management Executive*, Vol.17, No.4, 2003, pp. 64-77.

Anklam, P., "KM and the social network", *Knowledge Management Magazine*, 2003, pp. 24-28.

Barney, J., "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17, No.1, 1991, pp. 99-120.

Bishop J., I. Matsumoto, J. Stapleton, J. Glass, and D. Bouchlaghem, "Identifying the critical factors that determine the success of communities of practice within an engineering design consultancy", Proceedings of the CIB, 2008.

Brown, J. S. and P. Duguid, "Organizing knowledge", *California Management Review*, Vol.40, No.3, 1998, pp. 90-111.

Cantner, U. and H. Graf, "The network of innovators in Jena: An application of social network analysis", *Research Policy*, Vol.35, 2006, pp. 463-480.

Cross, R., T. Laseter, A. Parker, and G. Velasquez, "Using social network analysis to improve Communities of Practice", *California Management Review*, Vol.49, No.1, 2006, pp. 32-60.

Dantzig, G. B. and J. H. Ramser, "The Truck Dispatching Problem", *Management Science*, Vol. 61, 1959, pp. 80-91.

Davenport, T. H. and L. Prusak, Working Knowledge, Harvard Business School Press, Boston, MA, 1998.

de Laat, M., V. Lally, L. Lipponen, and R. J. Simons, "Investigating patterns of interaction in networked learning and computer-supported collaborative learning", *International Journal of Computer-Supported Collaborative Learning*, Vol.2, 2007, pp. 87-103.

Grant, R. M., "Toward a knowledge-based theory of the firm", *Academy of Management Executive*, Vol.17, 1996, pp. 109-122.

Hamel, G., "Competition for competence and inter-partner learning within international strategic alliances", *Strategic Management Journal*, Vol. 12, 1991, pp.83-103.

Hendriks, P., "Why share knowledge? The influence of ICT on the motivation for knowledge sharing", *Knowledge and Process Management*, Vol.6, No.2, 1999, pp. 91-100.

Haythornthwaite, C., "Social network analysis: An approach and technique for the study of information exchange", *Library and Information Science Research*, Vol.18, No.4, 1996, pp. 323-342.

Howell, N., Understanding simple social structure: Kinship units and ties, In Welhnan B., and Berkowitz S.D. (Eds.) Social structures: A network approach, Cambridge: Cambridge University Press, 1988, pp. 62-82.

Jones, G. R. and J. M. George, "The experience and evolution of trust: implications for cooperation and teamwork", *Academy of Management Review*, Vol.23, No.3, 1998, pp. 531-546.

Kim, S. J., E. H. Suh, J. H. Kim, S. C. Lee, and K. W. Lee, "A Diagnosis Framework for Identifying the Current Knowledge Sharing Activity Status in a Virtual Community of Practice", Proceedings of the 2010 APDIS, 2010.

Kim, S. W., "A theoretical analysis to cultivate Communities of Practice in organizations", *Journal of Knowledge Studies*, Vol.3, No.1, 2005, pp. 3-22.

Kim, Y., S. Yang, Y. Heo, J. Seo, and K. Kim, Identifying organizational knowledge paths through Social Network Lens: synthesis of multi-industry case studies, Proceedings of KMIS, 2008, pp. 42-51.

Kogut, B. and U. Zander, "Knowledge of the firm, combinative capabilities, and the replication of technology", *Organization Science*, Vol.3, No. 3, 1992, pp. 383-397.

Krackhardt, D., The strength of strong tie: the importance of philoss in organization. In N. Noharia and R. G. Eccles(Eds.), Networks and organizations: Structure, form, and action, Harvard School Press, 1992, pp. 216-239.

Latkin, C., W. Mandell, M. Oziemkowska, D. Celentano, D. Vlahov, M. Ensminger, and A. Knowlton, "Using social network analysis to study patterns of drug use among urban drug users at high risk for HIV/AIDS", *Drug and Alcoho Dependence*, Vol.38, 1995, pp. 1-9.

Lee, L. L. and M. Neff, "How information technologies can help build and sustain an organisation's CoP: spanning the socio-technical divide?", Knowledge networks: innovation through Communities of Practice, Hildreth, P., and Kimble, C. (Eds.), Idea Group Publishing, London, UK, 2004.

Lesser, E. L. and J. Storck, "Communities of Practice and Organizational Performance", *IBM Systems Journal*, Vol.40, No.4, 2001, pp. 831-841.

Liebeskind, J. P., "Knowledge, strategy, and the theory of the firm", *Strategic Management Journal*, Vol.17, 1996, pp. 93-107.

Lin, N. and Y. Bian, "Getting ahead in urban China", *American Journal of Sociology*, Vol.97, 1991, pp. 657-688.

Macneil, I. R., "Relational contacts: what we do and do not know", *Wisconsin Law Review*, Vol.45, 1985, pp. 483-535.

Mika, P., "Flink: Semantic Web technology for the extraction and analysis of social networks", *Journal of Web Semantics*, Vol.3, 2005, pp. 211-223.

Mizruchi, M. S., The structure of corporate political action: Interfirm relations and their consequences, Cambridge, MA: Harvard University Press, 1992.

Nonaka, I. and N. Konno, "The concept of 'Ba': building a foundation for knowledge creation", *California Management Review*, Vol.40, No.3, 1998, pp. 40-54.

Plessis, M. D., "The strategic drivers and objectives of communities of practice as vehicles for knowledge management in small and medium enterprises", *International Journal of Information Management*, Vol.28, No.1, 2008, pp. 61-67.

Quinn J. B., P. Anderson, and S. Finkelstein, "Leveraging intellect", *Academy of Management Executive*, Vol.10, No.3, 1997, pp. 7-27.

Rousseau, D. M. and J. M. Parks, "The contacts of individuals and organizations", In B. M. Staw and L. L. Cummings (Eds.) *Research in organizational behavior, Greenwich, CT: JAI Press*, Vol.15, 1993, pp. 1-43.

Scherzer, K. A., The unbounded community: Neighborhood life and social structure in New York City, Durham, *NC: Duke University Press*, 1992, pp. 1830-1875.

Scott, J., Social network analysis, A handbook, London: Sage, 1991.

Simonin, B. L., "Ambiguity and the process of knowledge transfer in strategic alliances", *Strategic Management Journal*, Vol.20, 1999, pp. 595-623.

Spender, J. C and R. M. Grant, "Knowledge and the firm", *Strategic Management Journal*, Vol. 17, 1996, pp. 5-9.

Vestal, W. C. and K. Lopez, "Best Practices: developing communities that provide business value, knowledge networks: innovation through Communities of Practice", Hildreth, P., and Kimble, C. (Eds.), Idea Group Publishing, London, UK, 2004.

Wasserman, S. and K. Faust, Social network analysis, Cambridge, MA: Cambridge University Press, 1994.

Wellman, B. and S. D. Berkowitz (Eds.), Social structures: A network approach, Cambridge: Cambridge University Pres, 1988.

Wenger, E. C., "Knowledge management as a doughnut: shaping your knowledge strategy through Communities of Practice", *Ivey Business Review*, Jan-Feb. 2004, pp. 1-8.

Wagner, E. C., "Breaking the Knowledge Acquisition Bottleneck through Conversational Knowledge Management", *Information Resources Management Journal*, Vol.19, No.1, 2006, pp. 70-83.

Wenger, E. C. and W. M. Snyder, "Communities of Practice: The Organizational Frontier", *Harvard Business Review*, Vol.78, January-February 2000, pp. 139-145.

Wenger, E. C., R. McDermott, and W. M. Snyder, Cultivating Communities of Practice, Harvard Business School Press, Boston, MA, 2002.

Zack, M. H., "Developing a knowledge strategy", *California management review*, Vol.41, No.3, 1999, pp. 125-145.

Zhang W. and S. Watts, "Online communities as communities of practice: a case study", *Journal of Knowledge Management*, Vol.12, No.4, 2008, pp. 55-71.

Information Systems Review
Volume 13 Number 2
August 2011

A New Approach to Improve Knowledge Sharing Activities at the Organizational Level by Rearranging Members of Current CoPs

Suchul Lee* · Euiho Suh* · Daegeun Hong*

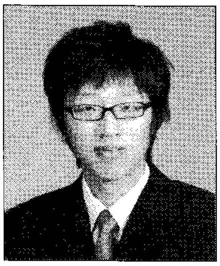
Abstract

Recently, many companies have started to manage and support CoPs formally at the organizational level because of strategic usability of CoP. These companies are also seeking ways to motivate CoP members to actively participate in their groups. Accordingly, this paper proposes one way of increasing CoP activities by rearranging CoP members. In practice, active CoP members often lead their groups. Therefore, rearranging members can, eventually, be one method to motivate more individuals to participate in CoP activities. This paper first suggests a new approach in order to improve knowledge sharing activities at the organizational level based on rearranging members of current CoPs. Second, a mathematical model is presented which maximizes total BLS (Balanced Level Score) of company A with several constraints. Then a real world problem is changed to a popular problem, VRP to solve this problem. Third, the solution program was developed to find a meaningful solution.

Keywords: Communities of Practice, Social Network Analysis, Knowledge Sharing, Vehicle Routing Problem, Multi-move method

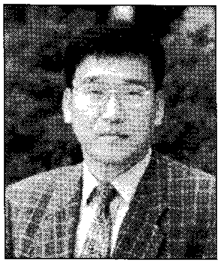
* POSTECH (Pohang University of Science and Technology)

◐ 저 자 소 개 ◑



이 수 철 (quito@postech.ac.kr)

포스텍(구, 포항공과대학교) 산업경영공학과에서 학사를 취득하였고, (주)삼성전자 무선사업부에서 품질관리를 담당하였다. 현재 포스텍 산업경영공학과에서 전략적 정보 및 기술경영 전공 석박사통합과정에 재학 중이다. 주요 관심분야는 지식경영 및 실행공동체, 정보전략 및 전략경영, 기술경영 및 R&D 등이다.



서 의 호 (ehsuh@postech.ac.kr)

서울대학교에서 자원공학 및 산업공학 공학사를, 한국과학기술원과 Stanford University에서 각각 공학석사를 수여 받았다. University of Illinois at Urbana Champaign에서 경영정보시스템을 전공하여 경영학 박사를 수여 받았으며, Tennessee Tech.과 Oklahoma State University에서 조교수를 역임하였다. 현재 포스텍(구, 포항공과대학교) 산업경영공학과 정교수로 재직 중이다. 2005년~2006년 경영정보학연구 편집위원장을 역임하였으며, 1997년 한국경영정보학회와 2002년~2003년 한국경영과학회 부회장을 역임하였다.
Decision Support Systems, International Journal of Information Management, IEEE Transactions on Engineering Management, Expert Systems with Applications, Journal of Knowledge Management, Knowledge and Process Management, Electronic Commerce Research and Applications, 경영정보학연구 등 국내외 유수 전문학술지에 다수의 논문을 게재하였다. 주요 관심분야는 정보전략 및 전략경영, 기술경영 및 e 비즈니스, 지식경영 및 실행공동체, 경영정보시스템 및 의사결정지원시스템 등이다.

홍 대 근 (dghong@postech.ac.kr)

중앙대학교에서 산업공학 학사를 수여 받았으며, 포스텍(구, 포항공과대학교) 정보통신대학원에서 경영정보시스템 전공 석사를 취득하였다. 현재 포스텍 산업경영공학과 전략적 정보 및 기술경영 전공 박사과정에 재학 중이다. Expert Systems with Applications, Information-An International Interdisciplinary Journal, Information Systems Review, 지식연구 등 국내외 유수 전문학술지에 논문을 게재하였다. 주요 관심분야는 지식경영 및 실행공동체, 정보전략 및 전략경영, 기술경영 및 R&D 등이다.

본 논문은 지난 2011 한국경영정보학회 춘계학술대회에서 우수논문상을 수상했으며 Information Systems Review 편집위원회에 의해 8월 12일 게재확정된 논문임을 알려드립니다.