협력 네트워크 패턴에 관한 연구 : MIS Quarterly 공저자 분석을 중심으로

Patterns of Collaboration Networks : Co-authorship Analysis of MIS Quarterly from 1996 to 2004

황명호(MingHao Huang)*, 안중호(JoongHo Ahn)**, 장정주(JungJoo Jahng)***

초 록

본 연구는 정보 시스템 분야에서 최고 학술지 중 하나인 MIS Quarterly를 중심으로 공저자 관계를 설명하고 논문을 게재한 연구자들의 협력 네트워크 패턴을 살펴보고자 하였다. 1996년부터 2004년까지 MIS Quarterly에 게재된 242편의 논문 공저자 네트워크에 대한 사회연결망분석을 통해 그 해답을 찾고자 하였다. 공저자 자료에 대한 사회연결망분석 결과 이 기간 MIS Quarterly 전체 불 완전 네트워크는 낮은 밀도를 나타내고 있다. 따라서, 세 개의 서브네트워크들을 대상으로 분석을 진행하고 그 서브네트워크에서 중요 역할을 하는 저자가 누구인지를 분석하였다. 다음으로, 키워드 분류 스키마에 따라 분류된 논문에서 관련된 데이터를 수집 및 코딩을 하여 MIS Quarterly 커뮤니티에 세 개의 중요한 협력 패턴이 존재함을 분석 및 확인하였다. 마지막으로 각 서브네트워크의 중심에 있는 연구 키워드들에 근거하여 협력 네트워크 패턴을 제시하고 시사점들을 논의하였다.

ABSTRACT

The study investigates the co-authorship networks of MIS Quarterly as one of the leading journals in IS field and examines patterns of collaboration networks of the intellectuals. These issues are addressed through a systematic Social Network Analysis (SNA) of 242 articles published from 1996 to 2004 in MIS Quarterly. Results of co-authorship network analysis indicate that the whole incomplete network has a low degree of density. Thus, we analyzed three biggest sub-networks to find out who the key players of each sub-network are. Then, following the keyword classification scheme, relevant data from the articles were collected and coded to analyze three major co- authorship networks of MIS Quarterly community. Some implications are drawn from different research keywords of each sub-network.

키워드 : MIS Quarterly, 사회 연결망 분석, 공저자 분석, 협력 네트워크
MIS Quarterly, Social Network Analysis, Co-authorship Analysis, Collaboration Network

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* Ph. D Candidate, Coll. of Business Administration, Seoul National University
** Corresponding Author, Professor, Coll. of Business Administration, Seoul National University
*** Associate Professor, Coll. of Business Administration, Seoul National University

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1. INTRODUCTION

"Know thyself" was the motto that Socrates learned from the oracle at Delphi[3]. To know yourself is to consider the nature of the rational soul. To know yourself is to struggle against ignorance. Ignorance of self is the greatest enemy of any entity. It is an ancient wisdom, but true today to IS Community. Such a reflection in research creates a firm foundation for future research and knowledge. It also accelerates the theory development, helps us not to do redundant research, and discovers areas where intense researches are needed[26].

This study provides, based on the analysis of the still evolving journal of MIS Quarterly, an opportunity to have a reflection upon both what has been done by past efforts and what needs to be accomplished in the future. Since academic journals are a major platform of the formal communication system for knowledge sharing and creation, they themselves become objects of interests and researches[11]. For instance, analysis has been conducted on a regular basis to rank IS journals. Since MIS Quarterly ranked first in most of analyses, there are some studies to investigate MIS Quarterly[12, 18, 23, 27] further. Among them, Ron Weber has reviewed the MIS Quarterly's review processes from 1995 to 2001[25]. Katerattanakul and Hong[13] have used citation analysis to describe the quality and knowledge contributions of MIS Quarterly.

Another network which is different from citation network, co-authorship network is formed by collaboration between two or more authors who have coauthored one or more papers. Co-authorship of articles in academic journals provides a window on patterns of collaboration within the academic community, and the structure of such networks turns out to reveal many interesting features of academic communities[20].

The primary objective of the study is to analyze the almost a decade-long co-authorship network of MIS Quarterly through a Social Network Analysis of a sample of articles published in the 1996~2004 in MIS Quarterly. The study aims at investigating who are the central players in MISQ Community by examining degree centrality of the networks, as well as at analyzing co-authorship patterns by classifying articles according to the keyword classification scheme suggested in information systems literature[4]. This establishes a benchmark for tracking the status of MIS Quarterly and its evolution, while suggesting areas which need more future researches.

2. METHODOLOGY

MIS Quarterly is selected for this study.

Since MIS Quarterly ranks first in most of journal ranking studies in different periods [12, 18, 23, 27], it is assumed in this study that MIS Quarterly represents the mainstream of MIS work.

The articles published from 1996 to 2004 in MIS Quarterly are collected and analyzed. All the articles are included in the raw data except those written by anonymous authors, and they are 242 articles. To analyze co-authorship networks, we then create a set of data by including the papers only written by co-authors. To analyze two-mode networks, we also classify all the articles according to the keyword classification scheme for IS research literature and make a two-mode network data, in which all the authors are included. Barki, Rivard and Talbot[4] update the classification scheme of IS keywords, and it provides a much needed common vocabulary among researchers in a rapidly changing domain such as IS. Since MIS Quarterly stops the classification works from the edition of Sept 2003, a two-mode network data in this paper only includes the papers published from March 1996 to June 2003.

MIS Quarterly is published in the United States and has been in publication since 1977. As a result, the data we collected covers almost one third of the time of its life. With the fact that most of the papers doing such an analysis never used the data over a decade, we carefully make a conclusion that the period(1996~2004) is long enough to find the collaboration patterns. However, we acknowledge that it is necessary to cover all the time to make a complete co-authorship network of MIS Quarterly.

3. SNA and NETWORK INDICES

Mitchell[17] defines social networks as a specific set of linkages among a defined set of persons, and suggests that the characteristics of these linkages as a whole may be used to interpret the social behavior of the persons involved.

The nodes in this co-authorship network are authors, and the link between authors represents that they have coauthored one or more papers. In the two-mode network, nodes of keywords are added to measure ties between the authors in one data set and keywords in another data set. It is called dyadic two-mode networks, since these relations are functions of dyads in which authors and keywords in the dyad are from different data set[24].

With the increasing numbers of coauthored papers[7, 8, 28], co-authorship network is an important issue to arrange systems, such as grants in aid, for supporting research collaboration. For this issue, first of all, we need to grasp the present sit-

uation of research collaboration in MIS Quarterly. We analyze the products of collaborations, i.e., coauthored papers from 1996 to 2004 to measure the situation of research collaboration in MIS Quarterly community. As far as we survey, there has been many studies in other areas which try to analyze 'co-authorship networks' and to describe their patterns. For example, some studies propose indices for measuring the link strength between authors and analyze actual co-authorship networks using those indices[2, 14, 15, 18], and others apply statistical methods such as Factorial Correspondence Analysis(FCA) to the analysis of co-authorship networks[7, 19]. This study aims to draw a co-authorship network of Social Network Analysis i.e. a co-authorship network analysis is performed using the co-authorship network data of MIS Quarterly.

Tushman and Fombrun[22] demonstrate that social network analysis was originated from Sociology, Anthropology, and Role Theory, and they suggest a set of indices describing the structural characteristics of networks. Since the main purpose of our study is to find out who the key players of each sub-network are, we use the indices to examine which actors are at the "center" of network. The following conceptions illustrate the definitions of this centrality, which can also define the status of actor's prominence or importance. The key players are the actors with maximum degree centrality, betweenness centrality, and closeness centrality[21]. In this paper, we use the specific definitions and derivations defined by Evelien Otte and Ronald Rousseau[10].

4. STUDY RESULTS

4.1 Co-authorship Network

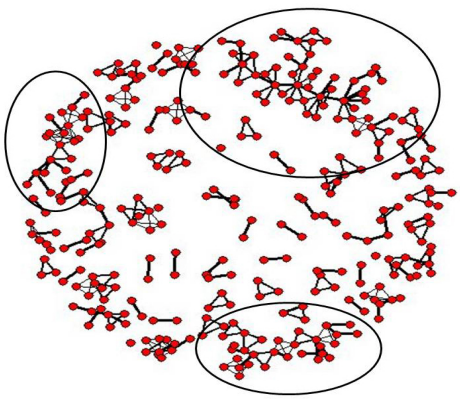
In this study, we find that in the 242 articles published in MIS Quarterly during the period, there are 328 authors occurring at least once. An undirected co-authorship graph of these 328 authors indicates a big connected component of 54 authors, one component of 21 authors, one component of 19 authors, five components of 7 authors, three components of 6 authors, four components of 5 authors, five components of 4 authors, eighteen components of 3 authors, and 36 components of 2 authors. These are summarized in <Table 1>.

The three central clusters will be focused on in this study. Most researchers who are active in MIS Quarterly community belong to one of these clusters. Network analysis is performed on the three biggest central clusters by using NetMiner 2.4. Another reason why we analyze those three subgroups is that the network of all authors who published papers in the period demon-

〈Table 1〉 Clusters and Authors

Cluster Name	No. of Component	No. of Authors of the Component	No. of Authors of Clusters
A	1	54	54
B	1	21	21
C	1	19	19
D	5	7	35
E	3	6	18
F	4	5	20
G	5	4	20
H	18	3	54
I	36	2	72
J	15	1	15

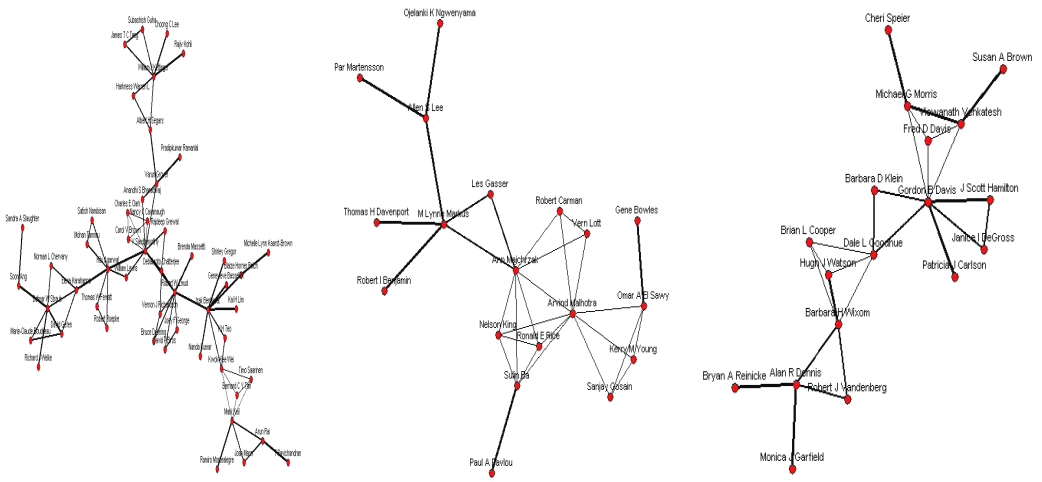
strates a loosely-connected network. In other words, its density is too low to figure out an interesting result when including all subgroups.



〈Figure 1〉 Co-authorship Data Network

To find out who the key players of each sub-network are, we look into the following network indices : density, degree centrality, closeness centrality and betweenness centrality.

- **Density** : The density is an indicator for the level of connectedness of a network. It is given as the number of lines in a graph divided by the maximum number of lines (the case where every author is connected to every other one). Hence it is a relative measure with values between 0 and 1. When the density of the whole network is quite a small number, we say that the network is in lack of social capital. <Figure 1> visually shows the result of a loosely connected network of MIS Quarterly community. However, we easily find three biggest clusters which are marked with oval shape in <Figure 1>, and the network may be in the process of knowledge collaboration buildup. <Figure 2> shows the extraction of three biggest clusters from the whole network. The density for the biggest cluster from

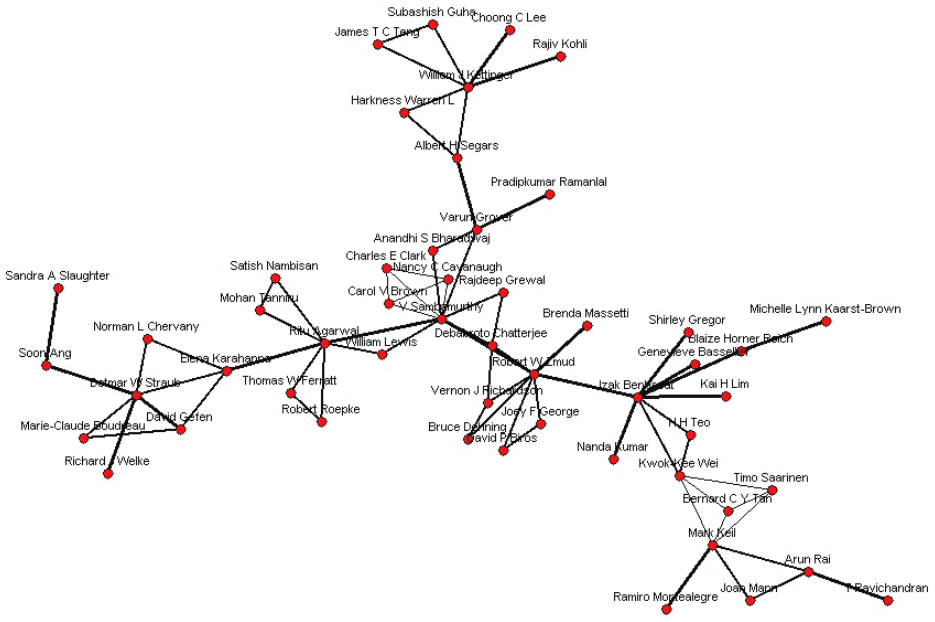


(A) (B) (C)

〈Figure 2〉 Three Biggest Clusters(A, B, C)

network analysis is 0.144, and we name the cluster as cluster A. We also name the left two clusters as cluster B and C whose densities are 0.318 and 0.336 respectively. These results indicate that these networks are clearly not dense, but rather loose.

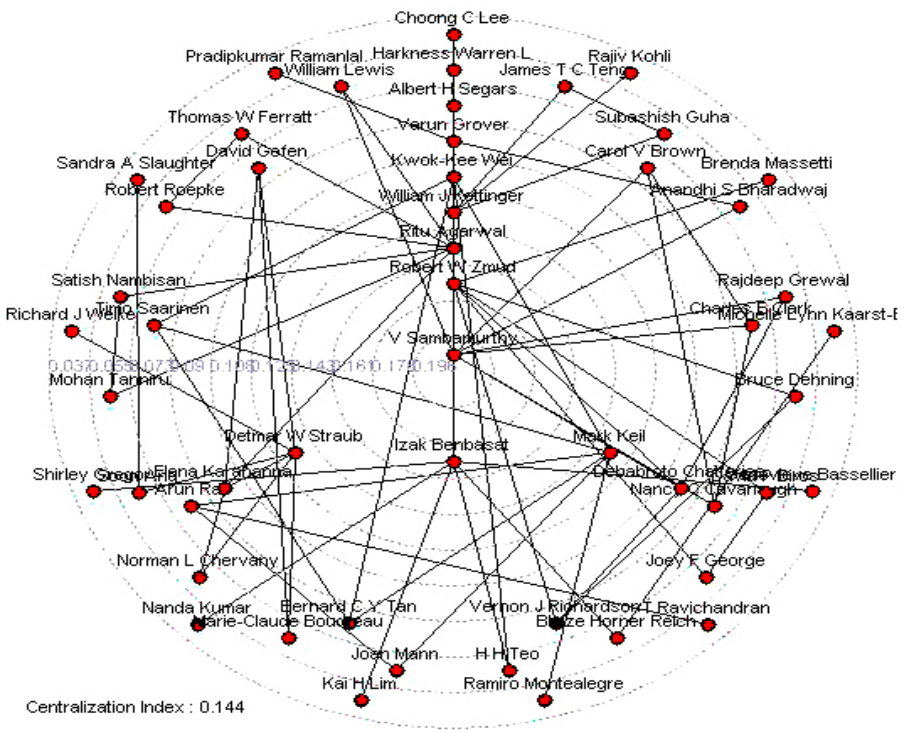
- **Degree Centrality** : Degree centrality is equal to the number of connections that an actor (a node) has with other actors. In this network being a central author means that this scientist has collaborated (in the sense of co-authoring) with many colleagues. In cluster A, the author with the highest degree centrality is V Sambamurthy, who has a degree centrality of 19. The degree centrality of the cluster A is 14.4%, indicating that many authors are not connected. <Figure 3> visually shows that V Sambamurthy has highest degree centrality in cluster A. In cluster B, the author with the highest degree centrality is Gordon B. Davis, who has a degree centrality of 15. The degree centrality of the cluster B is 31.8%, indicating that quite a few authors are connected. In cluster C, the author with the highest degree centrality is Arvind Malhotra, who has degree centrality of 9. The degree centrality of the cluster C is 31.8%, also indicating that many authors are connected.
- **Closeness** : Another way of studying centrality is using the closeness indicator. This indicator is more general than the previous one, because it takes the structural position of actors in the whole network into account. A high



〈Figure 3〉 Degree Centrality of Clusters A

closeness for an actor means that he or she is related to all others with quite a small number of paths. An author with higher closeness centrality can access information, position and the power of influence more easily. In cluster A, the author with the highest closeness centrality is V Sambamurthy and Robert W. Zmud, who have closeness centrality of 35.9% and 34.2% each. In cluster B, the author with the highest closeness centrality is Gordon B. Davis and Dale L. Goodhue with 53.1% and 51.5% each. In cluster C, Ann Majchrzak has the most powerful influence with the closeness centrality of 58.1%. This has the different result from above analysis.

- **Betweenness** : This measure is based on the number of shortest paths among actors. Actors with a high betweenness play the role of connecting different groups, as 'middlemen.' Again V Sambamurthy in cluster A and Gordon B. Davis in cluster B have the highest betweenness. As an example, <Figure 4> visually shows that V Sambamurthy has the highest betweenness centrality. But In cluster C, Ann Majchrzak has the highest betweenness. As a result, in cluster C, Ann Majchrzak has the higher betweenness centrality than Arvind Malhotra who has the highest degree cen-



〈Figure 4〉 Betweenness Centrality of Cluster A

trality. This indicates that the same cluster may have different key players according to different network-based indices. The betweennness of the cluster A, B, C is 65.4%, 68.3%. 52.9% respectively and it indicates that the actors of cluster B are connected with the smallest number of shortest paths.

4.2 Two-mode Network : Co-authors and Keyword Classification Scheme

Barki, Rivard and Talbot[4] made a keyword classification scheme, and it made it possible for IS research literature to be classified according to a common standard. In this study, we classified the articles from March 1996 to June 2003 to make a two-mode data. The following part describes the analysis of two-mode network data.

First, the two-mode data were transformed through overlap option in NetMiner 2.4, and then betweenness centrality analysis has been conducted. The result shows that some major keywords have appeared in the center of the map. They are organizational dynamics, research, IS management issues, types of information systems, management theory, organizational char-

acteristics, IS development methods and tools, and IS development strategies. We suggest that these keywords may represent the major research areas of MIS Quarterly in the period, and they also, to some degree, represent its identity. The degree of the authors from bipartite analysis indicates whether the author is a generalist or specialist in MIS Quarterly community to a certain degree. In cluster B, behavioral science, organizational dynamics, IS education, and research are major research keywords. We find that eight authors are connected through these keywords, and it can be concluded that these research topics have been researched and published more often in MIS Quarterly community.

From the bipartite analysis of the biggest cluster A, some major keywords also appeared which are similar to cluster B. They are IS management issues, research, organizational dynamics, IS evaluation, organizational characteristics, IS project management, management theory, users and behavioral science. Based on the more detailed keyword classification scheme, we find that organizational dynamics, here in cluster A, especially refers to organizational design, such as job design and business process re-engineering, while in cluster B it mainly refers to innovation. That's the difference between cluster B and A.

From the bipartite analysis of cluster C, some major keywords which are much different from those of cluster A and B appeared in the center. They are types of information systems, decision theory, IS development strategies, IS management issues, systems theory, organizational theory, management theory, and IS implementation. These are apparently different from the keywords of cluster A and B, and they form the third sub-network of MIS Quarterly community with the major research areas of telecommunication systems and internet communications which are revealed by examining the more detailed keyword classification scheme.

5. CONCLUSION

5.1 Discussion of Research Results

Social network analysis provides a new way of analyzing the network and collaboration patterns of a research community. Although IS discipline has such a short history, it has developed to make contributions to other disciplines. However, we are still in such a loosely connected research community that the identity crisis of IS discipline is still a critical issue among IS researchers[1, 5]. The crisis is real and threatens our ability to grow and thrive as a field. We need to find out IS journals' identity, as well as our own identity when we get involved in IS community.

This study attempted to identify different research groups and communities by using social network analysis. From the results of the analysis, we find that there are three major research groups in MIS Quarterly community based on the collaboration patterns. Keywords and major research issues are different among those groups which are not connected. Both researchers and keywords define the identity of each group. They altogether demonstrate the identity of MIS Quarterly in that period. In the same way, we can also examine identities of other IS journals if we use a common standard classification scheme.

Our research also tried to find out what kind of research areas are major topics of investigation of those times. Keywords which have been researched by many authors are surely popular areas and this will help us to identify some potential 'hot' topics in need of more research. All these information will be helpful for those whoever want to find "hot" topics or a blue ocean in IS research.

5.2 Implications

Social network-based indices for the authors included derived from the social network analysis in this study provide more credible measurement of indentifying the characteristics of IS journals. This methodology will play a key role in defining the identity of MIS Quarterly community, as well as the identity of IS community. What's more, it may contribute to the maturity of IS discipline.

In addition, the social network analysis in this study will also help all the scholars who have been involved in MIS Quarterly community to find out their own identity, role and position by measuring their specific network-based indices. For example, authors with the highest centrality could access information, position and the power of influence more easily. On the other hand, these three different clusters have different major research keywords, and we find out the main research areas of each author, as well as authors of each research area. Finally, different from other researches on co-authorship network analysis, this study conducted a two-mode network analysis to find out the collaboration patterns, which is necessary to indentify characteristics of a research community. Such a descriptive co-authorship network will help IS researchers to find a potential co-author who has both expertise and common research interests.

Social network analysis techniques of this study will also imply its potential capacity to solve the upfront organizational practical problems in this information age. They can be used to explore several ontological forms and patterns of structures and to further assess the structural efficiency and stability embedded in each identified

structure, such as information-processing network[16], firm-technology affiliation network, corporate elite network as human resource management[6], SNS(social network service) network, and chaebeol's network in S. Korea.

5.3 Limitations and Future Researches

By collecting and analyzing articles solely published in MIS Quarterly from 1996 to 2004, we have been able to draw an overall picture of co-authorship network of MIS Quarterly and their research keywords in that period.

In this study, we tried to define the MIS Quarterly community as the network of the authors who have published papers, of editors who have been involved in the affairs of MIS Quarterly and of their main research areas. Such a community is also a component of IS community, and such kind of efforts will surely contribute to the scientific maturity of IS discipline. Co-authorship networks provide a copious and meticulously documented record of the social and professional networks of scientists. The result reported here represents only a small portion of what could be done with these data.

Katerattanakul and Hong[13] suggest MIS Quarterly is a specialty business journal, but within the IS discipline, MIS Quarterly is considered to be a general IS journal. And they positioned MIS Quarterly's quality and contribution in between general business management journals and specialty business journals. The result from the analysis we have conducted here also shows that MIS Quarterly covers a broad areas in IS discipline.

Further investigations of MIS Quarterly community including papers from other periods are needed since the results of this study are from only a sample data of the papers. We felt it great necessary to include all the coauthored papers from 1977 to the present time. Only in this way, can we get a real whole view of complete network of MIS Quarterly. As for the classification scheme, IS discipline is still in great need of an authorized standard common classification scheme. It needs consistent and continuous efforts of researchers. Without such kind of a classification scheme, further investigation through the analysis of a two-mode network could not be possible.

As we have mentioned above, this study also need to collect the co-authorship network data of other major IS journals, such as Information Systems Research, Management Science, Journal of MIS etc. Such kind of research will surely give much more implications on IS community and identification of IS journals.

Since we are in lack of background knowledge of these authors, we only cre-

ated an un-directed link between authors. If we know more about detailed relationship between these authors, such as relationship of an advisor and a student, we can form a directed network. In this way, we can conduct much more analyses such as structural equivalence and block-model analysis. By adding other key attributes of authors, we can find out more interesting collaboration patterns.

Finally, we call for studies which can further develop the methodology of social network analysis so that the explored ontological forms and collaboration patterns in this study can further be related with some performance-based dependent variables.

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저 자 소 개

Ming Hao Huang	(E-mail : hmh625@snu.ac.kr)
2000	Peking University (PRC), Guanghua School of Management, (BA)
2003	Seoul National University, College of Business Admin. (MBA)
2005~Present	Seoul National University, College of Business Admin. (Ph. D Candidate)
Research Interests	IT Strategy, Dynamic Interaction of Organization and IT, IT Innovation, Social Network Analysis

Joong Ho Ahn	(E-mail : jahn@snu.ac.kr)
1975	Seoul National University, Department of Humanities (BA)
1980	Seoul National University, Graduate School of Public Admin. (MPA)
1987	New York University, Stern School of Business (M. Phil., Ph. D)
1999	President of Korea Society for MIS (KMIS)
1989~Present	College of Business Admin. and Graduate Scholl of Business, Professor President of Korea IT Governance Association
Research Interests	Technological Innovation and Business Transformation, IT Governance, IT Strategy, IT in Government and Public Sector

Jung Joo Jahng	(E-mail : jahngj@snu.ac.kr)
1989	Seoul National University, College of Business Admin. (BA)
1991	Seoul National University, College of Business Admin. (MBA)
2000	University of Wisconsin-Milwaukee, School of Business Admin. (Ph. D)
2000~2004	Rensselaer Polytechnic Institute (USA), Lally School of Management & Technology, Assistant Professor
2004~Present	College of Business Admin. and Graduate Scholl of Business, Associate Professor
Research Interests	Digital Management and Innovation Strategy, IT Related Industry Competitive Strategy