

Semantic Network Analysis on the MIS Research Keywords: APJIS and MIS Quarterly 2005~2009

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This study compares and contrasts the intellectual development of the MIS field in Korea from 2005 to 2009 to that of international trends by using a keyword co-occurrence network analysis of the two flagship journals: APJIS and MIS Quarterly. From 316 research articles in these two journals, 132 unique and most frequently co-occurred keywords were put into analysis. The results of structural equivalence show a mild correlation between APJIS and MIS Quarterly. The e-commerce, trust, and technology adoption are the high frequency keywords in both journals. In Korea e-learning, purchasing, and recommendation systems turn out to be important keywords while outsourcing, research method, quantitative method, design research, information theory, and empirical research are in average international journals. This connotes that the Korean scholarship tends to focus more on practically oriented topics, but the clustering and relational mapping of research topics in each journal show a mild level of overlap with distinctive orientations due to intrinsic disparities depending on the concerned journals' geographical scopes, namely domestic or global.

Keywords : Reference Disciplines, Bibliometrics, Co-occurrence of Keywords, Network Analysis, MIS Discipline, Centrality, Clustering, Multidimensional Scaling

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I . Introduction

Thomas Kuhn [1962] claimed that scientific knowledge develops periodically as a result of interactions in the forms of consensus and conflicts on the 'truthfulness' of scientific findings in the academic community. His idea of 'paradigm' suggests that the growth of science revolves around many scientific communication channels, including journals, conferences, and academic and research institutions [Leydesdorff, 1998]. Scholars in any field of study may agree that these interactive processes through various communication channels are essential for building a sense of disciplinary identity.

As a relatively young discipline, the MIS programs were first introduced in the academic field in the 1960's and have grown fast ever since [Dickson, 1981]. Further, the MIS field has drawn on several other disciplines such as the computer science, industrial engineering, cognitive science, management and organizational behaviors [Alavi and Carlson, 1992]. Because of its multidisciplinary nature, there have been extensive discussions on its identity and validity, its dependence on other disciplines, and the value of its theoretical and methodological diversity [Landry and Banville, 1992].

Likewise, the MIS field in South Korea has been confronted with the same concerns especially over the last two decades since the foundation of the first academic association, the Korea Society of Management Information Systems, in 1989. Led by the Asia Pacific Journal of Information Systems, the flagship journal of the association published since 1991, many academic journals have served as fundamental channels for communication among scholars in

the MIS field. Entering the third decade, it may be timely for Korean MIS scholars and practitioners alike to review how this field is currently being structured through what types of communication links and academic interactions among scholars and whether Korea has its own distinctive local or regional identity as compared to the global community of MIS.

Yet, tracing how scientific knowledge and findings are being diffused and discussed within an academic circle has become an increasingly daunting task mainly due to IT advancement. First of all, sprawling online scientific communication channels have driven new ideas at an exponential rate, accelerating and intensifying interactions across multiple disciplines more than ever before. In addition, the emergence of numerous online scientific communication channels, such as online journal database and search engines (e.g., *Google Scholar*), facilitates scholarly interactions beyond geographical and time constraints. Without exceptions, the patterns of interaction in the scientific community are growing complicated.

In this context, a new alternative means of systematically examining the process of diffusion and development of scientific knowledge needs to be in place in any given discipline. Among a few, bibliometrics emerges as a promising solution. Academic journals have also played a key role in distributing ideas and findings among scholars across all fields. The formalized mode of communication in scholarly articles, all containing references and keyword information, facilitates the mapping of new findings and knowledge diffusion.

For this reason, citation and keyword analyses are a widely employed method for identi-

fyng how the scientific ideas and findings in an area of study are interlinked to each other [Garfield, 2006; Whittaker, 1989]. In particular, keywords are considered as highly formalized components containing core information of the research articles. Thus analyzing the relationships among them can shed light on the structure of scientific knowledge in the journal or in the field [Kim *et al.*, 2008]. In fact, keyword network analysis is an efficient method since the results are intuitively and succinctly interpretable [Callon *et al.*, 1986].

The primary goal of this study is, therefore, to examine the intellectual development of the Management Information System (MIS) field using keyword network analysis. The MIS field is characterized by diversity because it addresses broad areas of problems and employs theoretical frameworks derived from many different "reference disciplines" including management science, computer science, economics, and psychology, among others [Culnan, 1986; Nambisan, 2003]. Considerable discussions on the legitimacy of the field and its relationships to other disciplines exist in this regard [Baskerville and Myers, 2002; Keen, 1980]. The current research addresses some of these issues by identifying the current topical areas discussed in the MIS field in recent years. In other words, this study helps scholars in the MIS field reinforce their professional identity, role and position. Moreover, this empirical study can contribute to the field in that the mapping of intellectual associations and developments can be used not only as a guideline for future research but also as a reference for the history of MIS research.

This study attempts to compare and contrast

the intellectual development of the MIS field in South Korea to that of international trends. It is argued that the attributes of MIS research in different countries can be characterized in different ways [Kim *et al.*, 2009]. Given the country's world-leading IT infrastructure and fast adoption of innovative technologies, the MIS journals may also represent their distinct local communities by developing their own research agendas and mix of ideas. On the other hand, there is also a claim that Korean scholarship can be more easily blended with that of the West, especially with the emergence of online scientific communication channels and in the process of globalization [Chung *et al.*, 2009]. This study offers insights and empirical evidences on details of the current trend in Korean MIS research, comparing it to the global trends. It can also further deepen our understanding of where the Korean MIS research stands from the global perspectives.

II. Literature Review

2.1 Bibliometrics of MIS Field

To date, research communities have paid much attention to what have been studied in the field of MIS field and whether MIS field can be a reference discipline [Culnan, 1987; Swanson and Ramiller, 1993; Vessey *et al.*, 2002; Wade, 2006]. Those endeavors have mainly sought for academic journals in the field and utilized analytic methods of bibliometrics. For example, Culnan [1987] used a co-citation analysis to examine the intellectual structure of MIS from 1980 to 1985 and identified five major sub-specialties in MIS: foundations, indivi-

dual (micro) approaches to MIS design and use, organizational (macro) approaches to MIS design and use, MIS management, and MIS curriculum. Vessey *et al.* [2002] also evaluated the diversity of MIS field based on articles published in the top five journals in the field during 1995~1999 using five criteria: reference discipline, level of analysis, topics, and research approach and research method. They found that MIS field treats organizational issues as major topics, and survey method was the most frequently used as research methods

Another approaches to understanding MIS community have been relational examination of research topics and comparative analysis. Swanton and Ramiller [1993] examined research topics in articles published in *Information Systems Research* from 1987 to 1992. Out of classification of 37 categories, they extracted 9 themes: computer supported cooperative work, information and interface, decision support and knowledge-based systems, systems properties, evaluations and control, users, economics and strategies, introduction and impact, and IS research. Interestingly, they illustrated the relationship of categories in the mapping of links between themes. Wade *et al.* [2006] conducted a comparative citation analysis using 33 MIS and non-MIS journals to address whether MIS field is a reference discipline or not. They concluded that MIS field is not a reference discipline but has the potential to become one. Lee *et al.* [1999]'s comparative analysis on the themes and differences between academic journal and practical magazines is also noteworthy; they found that journals give prominence to generalized models while magazines give atten-

tion to specific applications.

The bibliometric analysis has been also adopted in MIS field in Korea. Baek and Park [1995] examined published articles in MIS related journals during 1974~1993 and found that the Korean MIS research focused on DSS/ES, IS evaluation, IS development and operations during that period. Kim *et al.* [2005] assessed diversity in MIS research by examining 357 articles published in Korean journals from 1991 to 2003. As in Vessey *et al.*'s [2002] framework, they evaluated diversity from four perspectives: research topic, research method, level of analysis, and reference discipline. Consistent with the results from Vessey *et al.*'s [2002] meta-analysis, the organizational concepts were the most widely discussed research topic followed by systems/software and problem domain-specific concepts.

In recent years MIS scholars witnessed serious transitions in the field. The IS industry has gone structural evolutions and faced newer trends such as Web 2.0 and clouding computing. As earlier mentioned, in academia the issue of identity crisis has been raised [Benbasat and Zmud, 2003; Hirschheim and Klein, 2003] and experienced transitions in many institutions and associations. Yet, not enough follow-up studies have been conducted on the issue of knowledge formation in the research community. Furthermore, a comparative examination on the local, regional, and global range is rare but needed. Thus, it is a timely contribution to the field when APJIS, a flagship journal of the major association in South Korea, seeks to advance knowledge distribution to regional and global reach.

2.2 Analytic Frameworks for Mapping the Structure of Scientific Knowledge

Scientific structure can be mapped by identifying specific interactional patterns in a research community in the field. The origin of intellectual inquiry about how scientific knowledge is developed, diffused, and structured comes from the seminal work of Thomas Kuhn's [1962] *The Structure of Scientific Revolution*. The conventional view of the growth of science holds that science is processed in such a way that new kinds of ideas and theories are continuously added and accumulated. He disagreed with this view and argued that science rather progresses through "paradigms," in which concepts enable the process of science to undergo periodic revolutions, not simply a linear accumulation of new knowledge. A paradigm constitutes a basic framework for the scientific structure, and is believed to be most "truthful" based on an achieved consensus by a majority of scholars during a given period. Of importance is that a paradigm is not ever-lasting, and can be substituted by another more powerful one. The major contribution of Kuhn's [1962] *The Structure of Scientific Revolution* to our understanding of "science" is that science is ever-changing in nature, and it should not be understood as a divine gate into a "truth" that transcends social contexts and time. Instead, Kuhn argues that science should be understood in relative (or interactive) terms such that it has the nature of "consensus" and is advanced through conflict and disproving within the scientific community of the fittest way to practice science.

Based on Kuhn's [1962] model of understanding science, Crane [1972] emphasized interactions in the process of scientific growth. She valued an information personal network, or "invisible colleges" in her terms. She argued that the members in "invisible colleges" are the key players in scientific growth, and the members of an "invisible colleges" study the same research, use the same laboratories, and have frequent, informal meetings to discuss progress. As membership increases, these groups become publicized and organize themselves into disciplines. Incidentally, the structure of science can be traced by identifying personal networks among these "invisible colleges." Kuhn [1962] and Crane [1972], therefore, proved that scientific growth is achieved through the process of interactions in a scientific community. In addition, they provided a basis for the theoretical framework that scientific structure can be mapped by identifying specific interactional (or relational) patterns in a scientific community [Lievrouw *et al.*, 1987].

The mapping of relational patterns in the research community can be created by social network methods. A social network analysis (SNA) is a research approach for identifying structural properties in systems or societies based on relations or interactional patterns among components or social entities. To describe the underlying structure, the network analysis not only examines node-level (i.e., individual) indicators, but also the patterns of relations among nodes by examining their clustering into subgroups [Wasserman and Faust, 1994].

The keyword network analysis is one type of an SNA to configure the structural properties of a scientific community. It is based on the

co-occurrence of keywords in the given texts as important relations. For example, if the two keywords "A" and "B" are used in the same article, then it is assumed that there is a relationship between these two keywords. In short, a keyword network analysis uses associational patterns of keywords as a means to clarify the patterns of scientific knowledge. According to Whittaker [1989], the rationale behind the usage of keyword network analysis for mapping scientific structure relies upon the following arguments: 1) authors of scientific articles choose their technical terms carefully; 2) when different terms are used in the same article, it is because the author is either recognizing or postulating some non-trivial relationship between their referents; and 3) if different authors appear to recognize the same relationship, then that relationship may be assumed to have some significance within the research field concerned.

There have been many studies done concerning the mapping of the structure of scientific knowledge based on keyword network analysis across many different disciplines, including chemistry, scientometrics, biotechnology and environmental science [Su and Lee, 2009]. However, only few studies in the MIS field actually use the network approach while comparative analysis of local and international journals is also needed. This study, therefore, investigates and compares the keyword networks of Korean and international journals in the MIS field.

2.3 Research Questions

We inquire about possible differences or si-

imilarities in the semantic structures of two journals with different geographic authorship/readership scopes. The starting question of this study centers on the possible discrepancy between a Korean journal with the local or regional scope and an international journal with the global scope. In fact, there has been a query about the lagged synchronicity trend between the local and the international research trend. Contrasting predictions exist: 1) A local academic community tends to catch up with global community in current research topics. Thus, research topics in the international journal may precede ones in the local journal; 2) The top-level international journals have a long review time span, from one to two years in average, while the local journals have relatively a short review process. Since there is only negligible delay in IT development and IS distribution among the developed countries, the local journals with newer topics published faster precede the research themes in the international journals. Thus, the first set of research questions can be stated as follows:

- Research Question 1-a: Is there a structural equivalence, or similarity in the pattern of keyword co-occurrence, between a local/regional journal in South Korea and an international journal in the MIS field?
- Research Question 1-b: Is there a time lag in the equivalence of keywords pattern between the local journal and the international journal? If so, does the local journal precede the international journal or vice versa?

Next question asks which keywords are more central than others in each journal and

whether there is a correlation in the hierarchy of keywords between the journals. The second set of questions can be stated as follows:

- Research Question 2-a: What are the prominent research topics, or the central keywords, in the local/regional journal and the international journal?
- Research Question 2-b: Is there a correlation in the rankings and scores of centrality between the two journals?

The last question is about the grouping of research topics. Grouping of co-occurred keywords represents the patterns of research agenda, and different combination of keywords generates distinct research themes in each journal. Those grouping pattern and relationship between those grouped topics can be identified by clustering and visual mapping of keywords. Thus, the last set of questions can be stated as follows:

- Research Question 3-a: What topical areas, or the research themes, have emerged within MIS research during 2005~2009 in the local/regional journal in South Korea and the international journal?
- Research Question 3-b: How are those research themes composed of closely tied keywords related with each other in each journal?

III. Methodology

3.1 Network Analysis: Key Measures

For the purposes of the current study, a net-

work analysis based on the co-occurrence of keywords is employed. A network analysis is a set of research methods which identifies structures in systems based on relations among the system's nodes [Rogers and Kincaid, 1981]. A *node* can be understood as different forms of a social actor including an individual human, an organization, and a country. A *system* is a defined set of nodes. It is representative of the whole entity influenced by all nodes examined. A *relation* is a central concept in network analysis. Relations, which can also be understood as "ties" or "linkages," can be defined as the nature of connections between nodes. They possess a number of important properties, including strength, symmetry, and transitivity [Monge and Contractor, 2003]. A social network system can be used for understanding how resources are exchanged among nodes, how nodes are positioned to influence resource exchange, and which resource exchange is more important than others [Su and Lee, 2009].

SNA researchers have also developed a number of metrics to calculate various structural properties of a network, from centrality to quadratic assignment procedures (QAP) [Wasserman and Faust, 1994]. The concepts of several important network-related measures used in this study require further explanation.

Quadratic assignment procedure (QAP) is an analytic tool examining the structural equivalence of two different networks in terms of correlation coefficients, as in the case of inferential statistics [Krackhardt, 1988]. QAP addresses the question of whether two networks are structurally different or similar in statistical terms.

Density is an indicator for the level of con-

nectedness of a network. *Centralization* is a measure of how unequal the individual node values are in the network level. That is, it is a measure of variability, dispersion and spread [Wasserman and Faust, 1994].

Centrality is a node level indicator of how well each node connects to the others. There are several forms of centralities, such as "degree," "betweenness," "closeness," and "eigenvector." *Degree centrality* is simply the number of direct links. *Betweenness centrality* refers to the frequency with which a node falls between pairs of other nodes in the network and represents the potential for control of communication like a broker or a middleman. *Closeness centrality* indicates that central nodes have minimum steps to all the other nodes, [Freeman *et al.*, 1991]. *Eigenvector centrality* captures the global structure among nodes, such that a node may be more central because of its relation to an even more central node [Bonacich, 1972].

Hierarchical clustering is used for identifying cohesive groups within the system. A bird's-eye view of the network structure can be achieved by the grouping, or clustering, of nodes or keywords in this study. It is a method for finding groups of similar entities in data and for identifying those groupings or clusters of nodes that best represent their measured relations [Johnson, 1987].

Multidimensional scaling (MDS) is a visualization tool used to uncover the spatial structure of a network. MDS takes a holistic approach to the representation of relational data. It helps capture the combined picture of centrality and cluster analysis for spatial network models. Centrality is defined as the position in space closest to the origin of the coordinate

system created from the patterns of interaction. Along with dimensional interpretation, a neighborhood approach can reveal patterns in the data based on how cluster members are represented in the plot [Scott, 1991].

3.2 Selection and Refinements of Keywords

The keywords, as the basic unit of keyword networks, were drawn from two representative journals in the field of MIS, *Asian Pacific Journal of Information System* (APJIS) and *Management Information System Quarterly* (MIS Quarterly), during the five-year period from 2005 to 2009. APJIS was chosen because it is the premier journal on MIS research in South Korea. MIS Quarterly is the one of the most popular international journals in the field of MIS. These two journals represent the local and global research trends in MIS field.

There were 716 keywords used in 153 articles in APJIS and 935 keywords in 163 articles in MIS Quarterly during the period of 5 years. That is, a total of 1,651 keywords in 316 research articles from these two journals were gathered. Then, 526 unique keywords were extracted from all keywords after checking for duplicate concepts. Finally, 132 keywords that appeared more than 10 times in both APJIS and MIS Quarterly were selected as the final dataset¹⁾. In terms of frequency, those selected

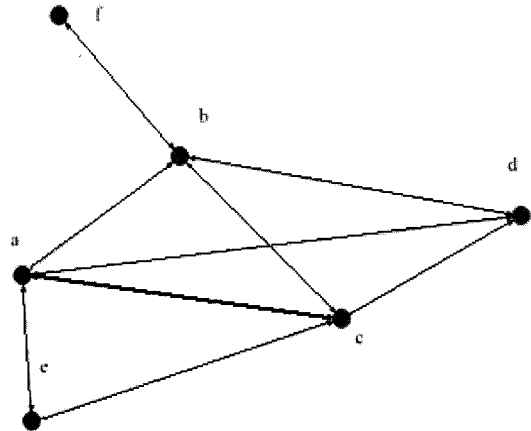
1) The reason that 132 keywords of the entire 526 keywords were used as the final dataset is to compare the APJIS keyword and the MIS Quarterly keyword network with more meaningful statistics. That is, the statistical relationships between two (526×526) networks may be attenuated simply because of the

Article	Keyword 1	Keyword 2	Keyword 3	Keyword 4
A	a	b	c	d
B	a	c	e	d
C	b	f		

(a) raw data

	a	b	c	d	e	f
a	-	1	2	1	1	0
b		-	1	1	0	1
c			-	1	1	0
d				-	0	0
e					-	0
f						-

(b) co-occurrence matrix



(c) co-occurrence network diagram

<Figure 1> A Matrix and Graphical Representation of a Sample Keyword Network from Three Articles

132 keywords represent 62% of all keywords in two journals. The whole list of 132 keywords used as the final dataset in the current study is shown in Appendix A.

3.3 Construction of Relations among Keywords

The basic dataset used in the social network analysis is an $(n \times n)$ Matrix S , where n indicates the number of nodes. A node represents each keyword used in APJIS and MIS Quarterly articles. Each cell S_{ij} in Matrix S contains the

relational strengths between nodes i and j . In the current study, it is the total co-occurrences of two keywords presented in the same article. For example, there are four keywords presented in the article A: "a," "b," "c," and "d." In this case, we can tap six pairs of co-occurrences: (a-b), (a-c), (a-d), (b-c), (b-d), and (c-d). If the article B contains keywords of "a," "c," and "e," the strength of relation, or the weight, is added to the (a-c) pair which contributes to the higher centrality of "a" and "c." As seen in the case of the article C, a new keyword of "f" is directly connected only to "b" which plays a bridge role for linking to other keywords and for forming a cluster.

Following this procedure, all relations among the 132 keywords were calculated based on frequencies of co-occurrence across all articles

network size (i.e., the network is too large and sparse). We tried to minimize the effect of network size on the relational statistics by comparing abridged networks (132x132).

from APJIS and MIS Quarterly, during the period from 2005 to 2009. This yielded two 132 by 132 keyword network matrices. Additionally, in order to verify yearly changes, an annual dataset for each year in each journal was created, and a set of 10 annual keyword networks, five keyword networks for APJIS [one for each year: 2005, 2006, 2007, 2008, 2009], and another five for MIS Quarterly were used for analysis.

IV. Results

4.1 Structural Equivalence of APJIS and MIS Quarterly

The QAP was employed to examine similarity and differences in terms of structural properties of keyword networks for APJIS and MIS Quarterly during the year 2005~2009.²⁾ The underlying algorithms in QAP include two steps as follows: (1) It computes a Pearson's correlation coefficient between corresponding cells of the two matrices; (2) It randomly permutes rows and columns of one matrix and recalculates the correlation. The second step is run hundreds of times to compute the proportion of times until a random correlation is larger than or equal to the observed correlation calculated in step 1. A low proportion (*i.e.*, $p < 0.05$ or $p < 0.01$) indicates a strong and stat-

istically significant relationship between the matrices that is unlikely to have occurred by chance [Borgatti *et al.*, 2002].

The QAP correlation between two keyword networks in 5 years was .16 ($p < .05$). The relationship was statistically significant, and APJIS and MIS Quarterly were structurally equivalent. However, the degree of association between two journals was rather weak or modest at best.

We checked the yearly patterns between APJIS and MIS Quarterly. The results of QAP correlations among 5 yearly-based networks for APJIS and MIS Quarterly revealed the following trends. <Table 1> shows the results of the correlations of each year's keyword network for APJIS with regard to each year's keyword network for MIS Quarterly. Because of sparsity of co-occurring keywords, the strengths of correlation were relatively weak but there were some significant relationships between the yearly-based APJIS and MIS Quarterly keyword networks. It is difficult to say there was synchronization between two journals because the annual similarity was found only in two years: 2007 and 2009. Except for APJIS in 2008, APJIS in 2005, 2006, and 2007 showed similarity with MIS Quarterly in following years, showing a sign of preceding trend. At the same time, however, the preceding trend is also found between MIS Quarterly and APJIS (e.g., MIS Quarterly 2006~APJIS 2007, 2008, 2009; MIS Quarterly 2007, 2008~APJIS 2009). Thus, the results were so mixed that we hardly can argue whether one journal had preceding keywords and whether there was a time lag pattern in the research topics.

2) UCINET v. 6.90 [Borgatti *et al.*, 2005) was used to analyze the structural properties of the keyword network constructed from the raw data. UCINET is a network analysis statistical package that provides various network-related measures from centrality indicators to QAP in a convenient way.

connected to other central keywords, has its own centrality boosted, and, in turn, boosts the centrality of other keywords to which it is connected. The centralization for APJIS keyword

network in terms of eigenvector centrality was 69.71% while that for MIS Quarterly was 45.10%.

<Table 2> and <Table 3> show the top 30 keywords from 2005 to 2009 in terms of four

<Table 2> The Top 30 Keywords in Degree and Betweenness Centrality from 2005 to 2009 in APJIS and MIS Quarterly

Degree Centrality		Betweenness Centrality	
APJIS	MIS Quarterly	APJIS	MIS Quarterly
e-commerce(61)	outsourcing(49)	technology adoption(1462.05)	Outsourcing(751.25)
technology adoption(60)	technology adoption(46)	e-commerce(780.74)	KM(562.44)
trust(45)	organizational characteristic(41)	IT innovation(451.02)	decision making(550.50)
enterprise system(21)	research method(38)	trust(450.99)	enterprise system(514.44)
KM(21)	quantitative method(38)	e-learning(311.84)	technology adoption(476.03)
e-learning(20)	trust(35)	enterprise system(295.43)	Organizational characteristics(438.227)
IT innovation(18)	decision making(35)	KM(277.57)	Quantitative method(329.46)
purchasing(17)	e-commerce(35)	user(247.37)	IS(327.047)
user(17)	IS use(33)	virtual team(218.15)	IS development(296.91)
satisfaction(17)	enterprise system(33)	quantitative method(201.227)	research method(293.67)
collaboration(16)	KM(33)	satisfaction(194.85)	trust(293.32)
web(15)	IS(27)	privacy(163.75)	HCI(284.88)
social influence(14)	IS development(26)	context-awareness(156.19)	information theory(273.27)
recommendation system(14)	culture(26)	business process(144.59)	culture(245.30)
self-efficacy(13)	IT innovation(23)	IS(144.40)	user(238.87)
information theory(13)	information theory(23)	data quality(141.73)	e-commerce(232.09)
IS(12)	design research(23)	SEM(140.87)	IT innovation(214.70)
risk management(12)	IT value(20)	business intelligence(116.87)	IS use(214.45)
mobile service(12)	empirical research(20)	web(108.76)	SEM(204.06)
usefulness(12)	SEM(18)	SME(108.03)	design research(193.98)
product management(11)	e-learning(17)	integration(107.41)	empirical research(168.32)
business intelligence(10)	virtual team(17)	outsourcing(106.12)	privacy(154.40)
personalization(10)	HCI(17)	semantic(99.73)	Implementation(153.83)
ease of use(9)	SW development(17)	research method(96)	task characteristics(146.82)
communication(9)	task characteristic(17)	qualitative research(96)	virtual team(135.90)
knowledge(9)	Web(16)	purchasing(93.99)	community(121.30)
search(9)	multilevel approach(16)	longitudinal study(84.38)	sense making(120.00)
SME(9)	community(16)	information theory(68.47)	IT value(113.78)
relationship(8)	process management(16)	community(66.92)	IT governance(111.65)
community(8)	media richness(15)	collaboration(63.99)	strategic information system(102.74)

<Table 3> The Top 30 Keywords in Closeness and Eigenvector Centrality from 2005 to 2009 in APJIS and MIS Quarterly

APJIS	Closeness Centrality MIS QUARTERLY	APJIS	Eigenvector Centrality MIS QUARTERLY
technology adoption(2.82)	outsourcing(8.52)	e-commerce(0.49)	technology adoption(0.35)
e-commerce(2.81)	decision making(8.48)	trust(0.45)	research method(0.30)
trust(2.80)	KM(8.48)	technology adoption(0.39)	quantitative method(0.29)
enterprise system(2.79)	organizational characteristics(8.48)	purchasing(0.17)	IS use(0.28)
user(2.79)	trust(8.48)	risk management(0.15)	Outsourcing(0.24)
IT innovation(2.79)	enterprise system(8.46)	satisfaction(0.15)	trust(0.23)
satisfaction(2.79)	research method(8.46)	self-efficacy(0.15)	organizational characteristic(0.23)
e-learning(2.79)	quantitative method(8.45)	user(0.14)	e-commerce(0.20)
IS(2.79)	technology adoption(8.45)	enterprise system(0.14)	culture(0.17)
web(2.79)	culture(8.45)	collaboration(0.13)	decision making(0.14)
self-efficacy(2.78)	IT innovation(8.41)	product management(0.13)	IT innovation(0.14)
SME(2.78)	information theory(8.40)	recommendation system(0.13)	IS(0.13)
community(2.78)	IS(8.40)	usefulness(0.12)	KM(0.13)
information theory(2.78)	design research(8.40)	e-learning(0.12)	design research(0.13)
usefulness(2.78)	empirical research(8.40)	KM(0.12)	empirical research(0.13)
system use(2.78)	e-commerce(8.40)	mobile service(0.12)	enterprise system(0.13)
social influence(2.78)	IS development(8.37)	ease of use(0.11)	IT value(0.12)
purchasing(2.78)	SEM(8.37)	customer(0.11)	SEM(0.11)
personalization(2.78)	IS use(8.40)	web(0.10)	IS development(0.11)
product management(2.78)	IT value(8.33)	IT innovation(0.10)	SW development(0.10)
customer(2.78)	media richness(8.31)	pricing(0.09)	Usefulness(0.10)
IS use(2.78)	community(8.31)	social influence(0.09)	information theory(0.10)
recommendation system(2.78)	SW development(8.30)	IS(0.09)	e-learning(0.09)
mobile service(2.78)	DSS(8.29)	outsourcing(0.08)	web(0.09)
SEM(2.78)	e-learning(8.29)	loyalty(0.08)	relationship(0.08)
business intelligence(2.78)	multilevel approach(8.28)	information theory(0.08)	HCI(0.08)
collaboration(2.78)	IT governance(8.28)	SEM(0.08)	multilevel approach(0.08)
ease of use(2.78)	IT function(8.28)	system use(0.08)	ease of use(0.08)
search(2.78)	task characteristics(8.27)	personalization(0.08)	Community(0.08)
KM(2.78)	web(8.26)	community(0.07)	media richness(0.08)

centrality measures in two journals. Generally speaking, e-commerce and technology adoption were the most frequently used central key-

words across four centrality measures in APJIS. In MIS Quarterly, outsourcing, technology adoption, research method, decision making, and KM

were the most frequently used central keywords. When each centrality was examined, e-commerce, technology adoption, trust, enterprise system and KM showed the highest degree centrality in APJIS. In MIS Quarterly, outsourcing, technology adoption, organizational characteristics, research method and quantitative method were of the highest. In the case of betweenness centrality, technology adoption, e-commerce, IT innovation, trust and e-learning showed the highest in APJIS while outsourcing, KM, decision making, enterprise system and technology adoption were of the highest in MIS Quarterly.

Concerning closeness centrality, technology adoption, e-commerce, trust, enterprise system, and user were of the highest in APJIS. On the other hand, outsourcing, decision making, KM, and organizational characteristic showed the highest closeness centrality in MIS Quarterly. In terms of eigenvector centrality, e-commerce, trust, technology adoption, and purchasing were of the highest in APJIS. In MIS Quarterly, technology adoption, research method, quantitative method, and IS use indicated the highest centrality scores.

There were some keywords which showed noticeable differences in centrality scores. Among them, e-commerce, trust, purchasing, self-efficacy, and user were higher in APJIS and research method, quantitative method, IS use, outsourcing, culture were higher in MIS Quarterly. To check whether the positional strength of each keyword has similarity between journals, correlation analysis was conducted. The correlations of centrality scores between two keyword networks were .419 ($p < .01$) in degree, .445 ($p < .01$) in betweenness, and .416 (p

$< .01$) in eigenvector centrality.⁴⁾ It implies that APJIS and MIS Quarterly have a rather strong association in the hierarchy of keywords prominence.

4.3 Clustering of Keywords: Comparison of Research Themes in APJIS and MIS Quarterly

The third research question asks what research themes each journal had and how similar the patterns of groupings were. Then, hierarchical clustering was used to identify subgroups within two (132×132) keyword networks. The detailed procedure of hierarchical clustering operates as follows: from a 132×132 matrix, the pair of nodes with the greatest similarity (i.e., highest frequency of relation) is combined to form a cluster C_1 . A new similarity matrix, S , is generated with the pair of combined nodes treated as a single node. S is an (131×131) matrix. The process is repeated with a third node added to C_1 or a new pair of nodes combined to form C_2 . This process continued until all n nodes are included to form C_m clusters [Johnson, 1967].

The hierarchical clustering for the APJIS keyword network revealed that there were eight major topical areas from 2005 to 2009. <Table 4> shows that those eight topical areas and related keywords. Also, it represents the brief description of what each topical area has dealt with. <Figure 4> is the graphical representa-

4) The correlations of centrality scores between two keyword networks in terms of closeness centrality were not computed because the numbers of nodes which have meaningful scores in APJIS were not equivalent to those in MIS Quarterly.

<Table 4> Results of Hierarchical Clustering for 2005~2009 APJIS Keyword Network

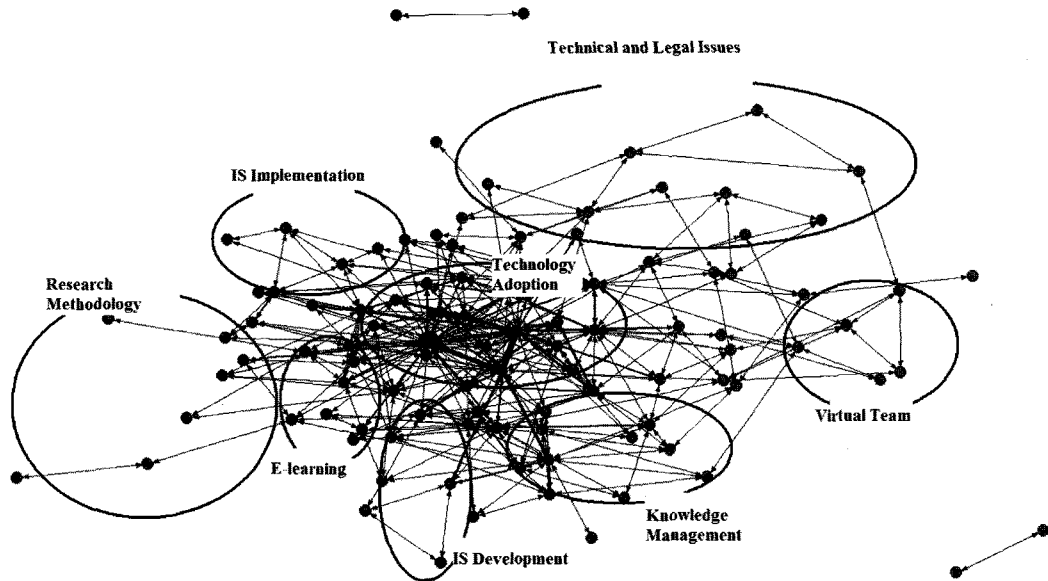
	Clustered keywords	Brief description
1. E-Learning	E-learning, Absorptive Capacity, Project Management, Cognitive, Communication, Information Sharing, Complementarity, SME, Faithfulness, Management Support	Examined E-learning and information sharing and their effects on project management
2. Knowledge Management	Knowledge Management, Knowledge, Resource-Based View, Community, Corporate Performance, Needs, Online Community, Competitive Advantage	Examined knowledge management and its effect on performance in the context of organizational works and online community
3. IS Development	IS Development, Healthcare IS, Outsourcing, Business Intelligence, Collaboration, Recommendation System, Product Management, Purchasing	Examined IS development and outsourcing, especially in the context of healthcare
4. Technology Adoption	Technology Adoption, Ease of Use, Usefulness, E-commerce, Trust, Satisfaction, Risk-Management, Self-Efficacy, Pricing, IS Use, Personalization, Social Influence, Enterprise System, IT Innovation, User, Semantics, Loyalty, Relationship, Service Quality, Facilitating Conditions, Mobile Service, Visibility	Examined technology (including new technology-based services such as mobile service) adoption in e-commerce by considering several characteristics of the technology such as ease of use and usefulness
5. IS Implementation	Implementation, Organizational Theory, Information Theory, Web, SW Development, SW Quality,	Examined IS implementation (including SW implementation) and its quality
6. Research Methodology	Research Method, Casual Model, SEM, IS, IS Success, Meta-Analysis, Qualitative Method, Empirical Research, Organizational Characteristics, Quantitative Method, System Use, ELM, IT Function, Longitudinal Study, IT Personnel	Focused on the research methodology and its applications in the context of IS based on theoretical foundations such as organizational theory and information theory
7. Technical and Legal Issues	Agent, Context-Awareness, Privacy, DSS, ECT, Time, Business Process, Data Quality, Decision Making, Task Characteristics, Integration, IT Infrastructure, Market, Technical Characteristics	Examined the technical issues of Decision Support Systems (DSS) and its applications
8. Virtual Team	Virtual Team, CMC, Media Richness, Process Management	Examined the role and effect virtual team on the performance improvement, especially using computer-mediated communication technology.

tion of the relative positions of eight clustered topological areas in APJIS keyword network.

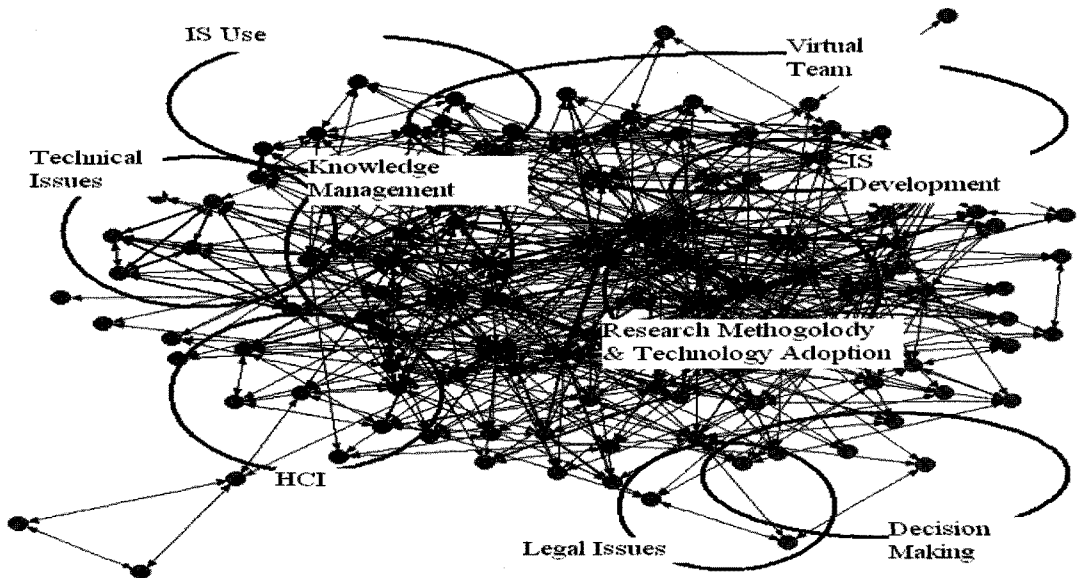
On the other hand, the hierarchical clustering for the MIS Quarterly keyword network re-

<Table 5> Results of Hierarchical Clustering for 2005~2009 MIS Quarterly Keyword Network

Theme	Clustered keywords	Brief description
1. IS Development (Outsourcing)	Outsourcing, Absorptive Capacity, Culture, User, Transaction Cost Economics, Agency Theory, Uncertainty, Incomplete Contact Approach	Examined IS outsourcing based on several perspectives such as transaction cost economics and absorptive capacity
2. Knowledge Management	Knowledge Management, Business Intelligence, Usefulness, Economic Model, IT Innovation, Enterprise System	Examined knowledge management, IT innovation, and electronic commerce, especially based on the application of economic model
3. Virtual Team	Virtual Team, Organizational Characteristics, Visibility, E-learning, SEM, Auction, Community, Knowledge, Pricing, Purchasing, Relevance, Boundary, Collaboration, Intention, Power, CMC, Communication, Open Source Software, Time, E-Commerce, SW Quality, Transitive Memory	Examined virtual team and electronic commerce including the relevant issues such as auction, online community, open source software, and pricing
4. Research Methodology +Technology Adoption	Research Method, Causal Model, Data Quality, Empirical Research, Qualitative Research, Qualitative Method, Quantitative Method, Technology Adoption, Process, Management, Social Influence, IS Use, Technical Characteristics, Implementation, IT Value, Recommendation System, Business Process, Web, Design Research, Integration, IT Function, IS,	Focused on research methodology and its application including design research
5. HCI	HCI, Agent, Facilitating Conditions, Procurement, Cognitive, Customer, Task Characteristics, Competitive Advantage, Perceived Behavioral Control, DSS, Trust, Market, Product Management, Online Community	Examined Human-Computer Interaction (HCI) issues in diverse context such as online community, product management, and the use of decision support systems (DSS)
6. IS Use	IS Success, Intrinsic Motivation, Longitudinal Study, Meta-Analysis, Investment, IS Development, Resource-Based View, SME, IT Governance, Turnover, IT Personnel, System Use, Multilevel Approach, SW Development, Semitics	Examined IS success including system use and their determinants
7. Decision Making	Decision Making, Distance, Management Support, Evaluation, Morality, ELM, Organizational Theory, Service Quality, Search, Ease of Use, Network Analysis, Self-Efficacy	Examined decision making and decision support
8. Legal Issues	Privacy, Developing Countries, Faithfulness, Healthcare IS, Information Theory, IT Infrastructure, Needs, Relationship, Personalization, Security	Examined privacy and security issues in the use of IS including healthcare IS
9. Technical Issues	Context-Awareness, ECT, Query, Risk Management, Composition, Conceptual Modeling, Complementarity, Coordination, Differentiation, Multi-business Firms,	Examined technical issues such as query and conceptual modeling



<Figure 4> The Graphical Representation of Clustered Group in APJIS Keyword Network



<Figure 5> The Graphical Representation of Clustered Group in MIS Quarterly Keyword Network

vealed that there were nine topical areas from 2005 to 2009. <Table 5> shows those nine topical areas and related keywords with the brief description of each topical area. <Figure 5> is

the graphical representation of the relative positions of nine clustered topical areas in MIS Quarterly keyword network.

In clustering, both similarities and differences

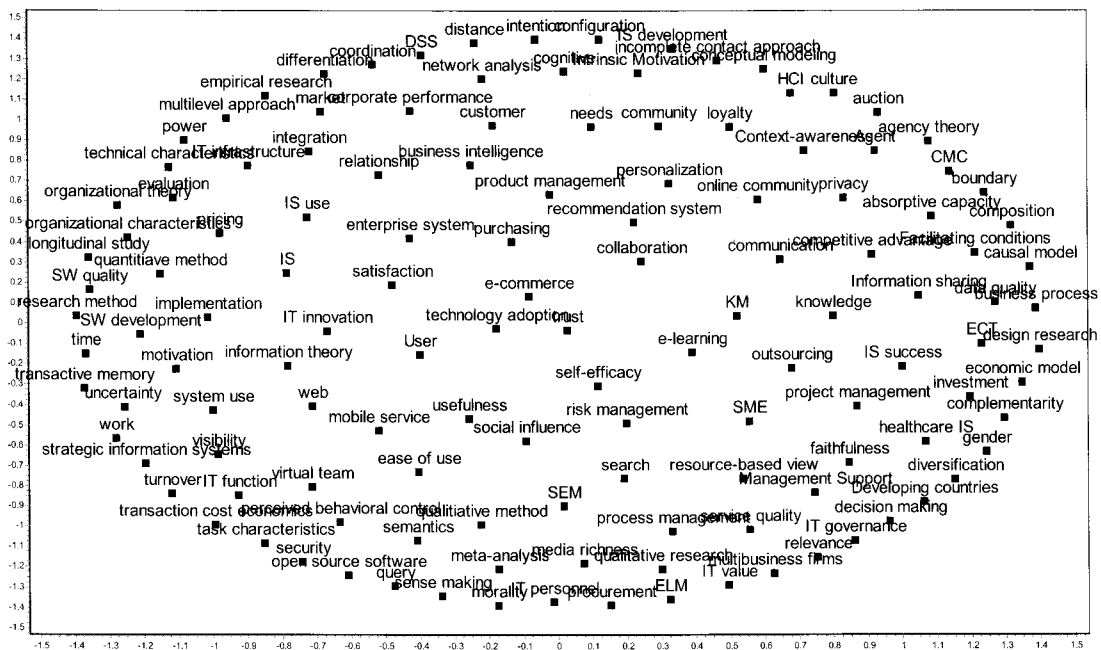
were found between APJIS and MIS Quarterly keyword networks. There were overlapped emerging topical areas including knowledge management, virtual team, and technology adoptions. However, differences also existed in the areas of E-learning and HCI. It is also noteworthy that research methodology clustered into the same group with technology adoption in the case of MIS Quarterly while they were in the separate groups in APJIS.

4.4 Mapping of Thematic Grouping of Keywords

To illustrate a thematic grouping of keywords by co-occurrence, we conducted multidimensional scaling (MDS) which displays the centrality of each keyword and distances between keywords in two-dimensional spaces.

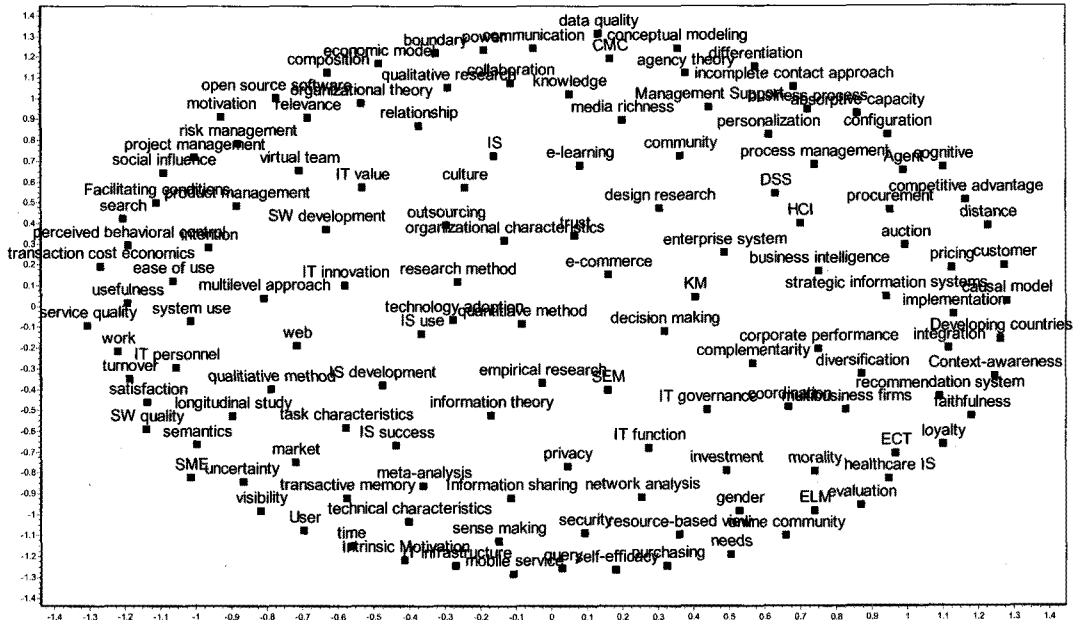
The output of MDS is a set of estimated distances among pairs of nodes, which can be expressed as coordinates in two or higher dimensional space [Wasserman and Faust, 1994]. MDS seeks to represent proximities or similarity of relations among keywords in the two-dimensional map so that keywords that are more proximate to each other in the input data are closer in the map, and ones that are less proximate to each other are farther apart. In other words, the keyword closest to the origin of the coordinate system can be understood as what researchers have used most often as an important concept for their research.

<Figure 6> shows that the following keywords are closer to the origin of MDS coordinate in the APJIS keyword network compared to the others: trust (0.02), technology adoption (0.19), e-commerce (0.19), self-efficacy (0.30),



<Figure 6> Multidimensional Scaling of APJIS Keyword Network, 2005~2009

Semantic Network Analysis on the MIS Research Keywords



<Figure 7> Multidimensional Scaling of MIS Quarterly Keyword Network, 2005~2009

<Table 6> Results of Distances from the Origin in MDS During 2005~2009 (Top 30 Keywords from the Shortest to the longest)

APJIS	MIS Quarterly	APJIS	MIS Quarterly
trust(0.02)	quantitative method(0.13)	product management(0.67)	IT innovation(0.61)
technology adoption(0.19)	e-commerce(0.21)	IT innovation(0.68)	complementarity(0.61)
e-commerce(0.19)	technology adoption(0.30)	outsourcing(0.69)	IS development(0.62)
self-efficacy(0.30)	research method(0.30)	SME(0.71)	culture(0.63)
e-learning(0.40)	decision making(0.32)	mobile service(0.72)	IT governance(0.65)
collaboration(0.41)	trust(0.35)	communication(0.72)	E-learning(0.69)
user(0.43)	organizational characteristics(0.35)	search(0.75)	IT function(0.72)
purchasing(0.46)	empirical research(0.37)	personalization(0.79)	SW development(0.75)
risk management(0.49)	KM(0.39)	knowledge(0.79)	IS(0.75)
usefulness(0.51)	IS use(0.40)	information theory(0.81)	web(0.76)
KM(0.52)	SEM(0.42)	web(0.81)	business intelligence(0.76)
satisfaction(0.54)	outsourcing(0.50)	ease of use(0.81)	corporate performance(0.76)
social influence(0.55)	enterprise system(0.54)	IS(0.84)	privacy(0.76)
recommendation(0.57)	design research(0.55)	business intelligence(0.85)	HCI(0.79)
enterprise system(0.63)	information theory(0.55)	online community(0.86)	IT value(0.80)

e-learning (0.40), collaboration (0.41), and user (0.43) (see <Table 6> for the distances of other keywords). On the other hand, <Figure 7> presents the results of MDS for the MIS Quarterly keyword network during the period from 2005 to 2009. As in the case of APJIS keyword network, the keywords closer to the origin of the coordinate compared to the others are noteworthy. The results shows that these keywords are quantitative method (0.13), e-commerce (0.30), research method (0.30), decision making (0.32), trust (0.35), and organizational characteristics (0.35) (see <Table 6> for the distances of other keywords).

In MDS, some similarities and differences were found between APJIS and MIS Quarterly keyword network. Those keywords related to technology adoption cluster such as technology adoption (0.19 in APJIS and 0.30 in MIS Quarterly) have the shortest distances from the origin in both keyword networks. Those keywords relevant to knowledge management cluster such as KM (0.52 in APJIS and 0.39 in MIS Quarterly) have also a tendency to have shorter distances than others. However, keywords that belong to research methodology such as quantitative method (0.13), research method (0.30), and empirical research (0.37) have relatively shorter distances than others in MIS Quarterly compared to APJIS .

V. Conclusion

5.1 Discussion of Research Results

This study examined the intellectual development of the MIS field from 2005 to 2009 in South Korea and at a global level using a key-

word co-occurrence network analysis. We also statistically tested, using QAP, to what extent the structural properties of intellectual development in the MIS field in South Korea are similar to those at an international level over the entire time span. The results of QAP showed that the structural properties in the Korean MIS field were correlated with those at an international level. In addition, the results of the correlations and statistically significant levels between each year's keyword networks for APJIS and MIS Quarterly based on QAP provides some mixed findings. There were significant relationships between the yearly-based APJIS and MIS Quarterly keyword network, but with 1 or 2 year time lags in general terms. These imply that the Korean researchers have a tendency to follow and, at the same time, precede the global research trend.

A lack of diversity of MIS field in S. Korea also warrants discussions. The results of density and centralization show that APJIS keyword network has much higher focus on limited numbers of important keywords such as e-commerce, trust, technology adoptions than MIS Quarterly. As pointed out by Kim *et al.* (2005), this may imply a rather narrow scope of Korean MIS research compared to that at an international level.

In addition, this study examined which topical areas are more active than the others. The common trends found based on the results of centrality analysis. The e-commerce, trust, and technology adoption were the most widely employed keywords in both journals. It can be interpreted that those keywords are common grounds of MIS research community and, regardless of geographic scope, researchers have

paid attention to electronic commerce topics in the context of the advancement of Internet technology and the increase of e-commerce transactions. They have examined online trust with the greatest interest as a key facilitator of electronic commerce.

Specifically, we questioned what topical areas had emerged since 2005 comparing and contrasting the Korean and international research trends. The results of hierarchical clustering revealed that there were eight major topical areas emerged in South Korea while nine at a global level. The emerged topical areas in South Korea include: 1) E-learning; 2) Knowledge management and its effect on performance; 3) IS development and outsourcing, especially in the context of healthcare; 4) Technology adoption in e-commerce and relevant facilitating factors; 5) IS implementation (including SW implementation) and its quality; 6) Research methodology; 7) Technical and legal issues of Decision Support Systems; and 8) Virtual team and its effect on the performance. On the other hand, the following topical areas were widely discussed at an international level: 1) IS outsourcing; 2) Knowledge management and IT innovation based on the application of economic model; 3) Virtual team and electronic commerce, and their relevant issues; 4) Research methodology and its application; 5) Human-Computer Interaction (HCI) in diverse context; 6) IS success and its determinants; 7) Decision making and decision support; 8) Privacy and security issues in the use of IS; and 9) Technical issues. Generally speaking, there were many overlapped topical areas between Korean trend and international one but with some differences in the areas of E-

learning and HCI.

We found that there were some other differences in active topical areas between Korean and international journals. The results of MDS and centrality indicate that e-learning, purchasing, and recommendation systems were important keywords in South Korea. On the other hand, outsourcing, research method, quantitative method, design research, information theory and empirical research were widely used keywords at an international level.

It implies that the Korean scholarship focused more on practically oriented topics such as e-learning while researchers at an international level rather on academic issues ranging from diversity and identity of MIS field to application of multiple research methods in developing theory. These results of the greatest differences in centrality scores support this argument. It was identified that the centrality scores in those keywords that connote practical aspects of MIS including purchasing, mobile service, and satisfactions were much higher in APJIS than in MIS Quarterly. It is also noteworthy that researchers at an international level deal with outsourcing issues more often than Korean scholarships do. This may be related to the growing interest in the West, especially in the U.S, in outsourcing parts of their functions in developing countries such as India, which makes cultural differences in the context of globalization an important issue. The Korean researchers paid less attention to that issue.

5.2 Implications and Limitations

One of the intentions of his study was to provide some insights into and guidelines for

a future research by examining the current status of intellectual development in the MIS field. The results and conclusions suggest following implications. First, the results in this study are expected to help all the scholars who have been involved in both APJIS and MIS Quarterly define their identity, roles, and status. In addition, the results can increase understandings of where Korean scholars stand compared to global ones.

Second, the current study suggests that scholars in South Korea need to diversify their topical areas. It was found out that Korean scholars have discussed a limited scope of topics such as e-commerce and technology adoption much more than others from 2005 to 2009. In this regard, the scope of topical areas needs to be expanded.

Lastly, it is required that scholars pay more

attention to theory development, applications of a variety of research method. As shown in the results of the current study, Korean scholarships are heavily centralized in practical areas. The developments of theoretical framework, which can contribute to the legitimacy of the MIS field as a reference discipline have been rather neglected. More considerations on this are required.

There are some limitations to this study. We selected two flagship journals and compared the pattern between the local/regional research trend and the international one. We recommend that future research extend the range of journals in the MIS field to include more journals in the data to strengthen the validity. A longitudinal study is also needed to trace the involvement in the knowledge formation and disciplinary identity in MIS.

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<Appendix A> The 132 Keywords Used in the Current Study

Number	Keyword	Number	Keyword
1	absorptive capacity	67	loyalty
2	agency theory	68	Management Support
3	Agent	69	market
4	auction	70	media richness
5	boundary	71	meta-analysis
6	business intelligence	72	mobile service
7	business process	73	morality
8	causal model	74	motivation
9	CMC	75	multibusiness firms
10	cognitive	76	multilevel approach
11	collaboration	77	needs
12	communication	78	network analysis
13	community	79	online community
14	competitive advantage	80	open source software
15	complementarity	81	organizational characteristics
16	composition	82	organizational theory
17	conceptual modeling	83	outsourcing
18	configuration	84	perceived behavioral control
19	Context-awareness	85	personalization
20	coordination	86	power
21	corporate performance	87	pricing
22	culture	88	privacy
23	customer	89	process management
24	data quality	90	procurement
25	decision making	91	product management
26	design research	92	project management
27	Developing countries	93	purchasing
28	differentiation	94	qualitative research
29	distance	95	qualitative method
30	diversification	96	quantitative method
31	DSS	97	query
32	ease of use	98	recommendation system
33	e-commerce	99	relationship
34	economic model	100	relevance
35	ECT	101	research method
36	e-learning	102	resource-based view
37	ELM	103	risk management
38	empirical research	104	satisfaction
39	enterprise system	105	self-efficacy
40	evaluation	106	search
41	Facilitating conditions	107	security
42	faithfulness	108	SEM
43	gender	109	semantics
44	HCI	110	sense making
45	healthcare IS	111	service quality
46	implementation	112	SME
47	incomplete contact approach	113	social influence
48	Information sharing	114	strategic information systems
49	information theory	115	SW development
50	integration	116	SW quality
51	intention	117	system use
52	Intrinsic Motivation	118	task characteristics
53	investment	119	technical characteristics
54	IS	120	technology adoption
55	IS development	121	time
56	IS success	122	transaction cost economics
57	IS use	123	transitive memory
58	IT function	124	trust
59	IT governance	125	turnover
60	IT infrastructure	126	uncertainty
61	IT innovation	127	usefulness
62	IT personnel	128	User
63	IT value	129	virtual team
64	KM	130	visibility
65	knowledge	131	web
66	longitudinal study	132	work

◆ About the Authors ◆



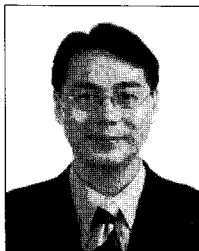
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