A Bibliometric Study of International and Domestic Academic Research on Intellectual property

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Abstract Background/Objectives: ***This paper analyzes various intellectual property (IP) publications and predicts their research trends by constructing social networks from the representative international bibliographic databases.***

Methods/Statistical analysis: ***The research trends are then determined by using various social network analysis methods to analyze the relations between the research keywords. Specifically, this paper uses the socio-centric approach, which deals with the whole network, to analyze the overall research trends indicated by the research keywords, and the ego-centric approach to analyze emerging research trends in research keywords in order to identify the latest trend.***

Findings: ***The overall research trends in the International IP-Research Data analyzed that researchers are most active in researching EU Law, copyright infringement, and trademarks. The Korean Domestic IP-Research Data confirmed that infringement and protection of copyrights are the most common research topics in which researchers in Korea are actively involved. The Japanese Domestic IP-Research Data analyzed indicated that researchers in Japan are most active in researching intellectual property rights and laws. We conducted a linear regression analysis using LINEST function on the WDC Percentage to statistically analyze the annual research trends. The 10 research keywords with the highest positive LINEST values were then selected as the major emerging research keywords in the International, Korean domestic, and Japanese domestic IP-Research Data. Additionally, we then constructed an ego-centric network to analyze the 10 major emerging research keywords, and then we utilized the community method to group the emerging keywords in the established ego-centric network by their high relations.***

Improvements/Applications: ***The results presented in this paper can be used to establish policies on IP, suggest directions for academic research, explore promising research topics, and promote joint research.***

Keywords: ***Intellectual property, Academic research trends, Bibliometric study, Social network analysis, bibliographic database***

I. INTRODUCTION

In the current rapidly changing global business environment, in which technologies are becoming increasingly more complex, effective intellectual property (IP) strategies are gaining recognition as the most critical element for technology-oriented companies. For companies to come up with effective and competitive IP strategies, comprehensive analysis of their intellectual properties and associated trends is essential.

Many existing studies on IP, however, are focused on patents in specific industries such as the biotech industry and technologies such as smart technology. Recent studies view IP only in terms of areas such as patents, brands, copyrights, trade secrets, and know-how. Intellectual property is defined as intellectual matters usable in creating wealth, such as knowledge, information, intellectual property, and experience[1]. Also, it is defined as the sum of the intangible assets of a company, which functions as the most important source in securing its competitive edge[2], and further argued that it is implicit knowledge and know-how related to technology and organizational management[3]. Most of the existing studies that attempt to predict research trends rely on simple statistical analyses, with very few comprehensive studies actually attempting to analyze various IP publications. However, it is important to analyze various IP publications because they help to predict research trends in a more comprehensive manner.

This paper first presents extensive social networks built from articles on various IP research areas listed in web-based bibliographic databases from 2007 to 2011. The words contained in the bibliographic information of the articles chosen from the above databases are standardized as "research keywords" by using them to construct a thesaurus. Then, various social network analysis methods are used to analyze the relations between research keywords. The socio-centric approach, which deals with the whole network, is used to analyze the overall research trends of research keywords in the IP-related research area. This is coupled with the ego-centric approach to investigate their in-depth emerging research trends in order to identify the latest trend. Further, the analysis results from Korean and Japanese domestic databases are presented and compared with the results from international databases and demonstrate the importance of the approach.

The remainder of this paper is organized as follows. Section 2.1 gives an overview of bibliometric analysis and social network approaches. Section 2.2 describes the experimental procedures used for data construction, data filtering, and data

Revised Manuscript Received on May 22, 2019.
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analysis. Section 3 presents the results of analyses conducted and discusses the meaning of the results obtained. Section 4 summarizes our findings, looks at their implications as well as the limitations of the study, and outlines future research directions.

II. MATERIALS AND METHODS

2.1. Background

2.1.1. Bibliometric analysis

The bibliometric method, which is used extensively to measure scientific progress in various research areas in science and engineering, is a general research method for systemic analysis[4]. Since the concept of evaluative bibliometric was proposed, many researchers have used publication outputs, subject categories, and citations in books and papers published by governments, research institutions, and journals to evaluate research trends in related fields[5,6,7,8].

Traditional bibliometric methods such as co-citation analysis are based on analysis of the author and journal citations contained in research papers. While this type of analysis leads to interesting results, it does not provide practical research topics for researchers. On the other hand, co-word analysis, which counts and analyzes the co-occurrences of keywords in the papers on a given subject, has the potential to overcome the limitations of co-citation analysis[9].

Researchers have recently started extracting words from bibliographic information: e.g., article title, abstract[10], "author keywords" given by authors, and "keywords plus" suggested by journals[11,12]. These words are used in their analyses of research trends. Article title and "author keywords", in particular, represent the key research topics of related literature[13] and are thus useful tools for analyzing emerging research topics. In order to survey general academic research trends on IP, this paper identifies research keywords extracted mainly from "author keywords" along with the words contained in article title, abstract, table of contents, and the "keywords plus" attribute of each article.

It is well known that future research trends can be predicted through bibliometric research of literature[14]. This paper identifies significant research trends in various IP research areas by focusing on "author keywords" in particular because they are considered significant by the relevant authors.

2.1.2. Social network approaches

A social network represents the social structure of people, organizations, or countries (referred to as "nodes" or "actors") that interact with each other. Given a social network, these relations can be analyzed for any structural patterns that might be present among the nodes. Thus, an analyst of social networks looks beyond the attributes of individuals to also examine how nodes are positioned within a network and how relations are structured into overall network patterns. The aim of social network analysis (SNA) is to detect and interpret the patterns of social ties among nodes using statistics and visualization[15,16,17,18], and the methods of SNA are useful in assessing R&D trends[19,20]. In general, these social networks are expressed by dots (actors or nodes) and lines (links or arcs). In addition, a social network can be classified by two approaches: the socio-centric approach and the ego-centric approach, illustrated in Figure 1[21].

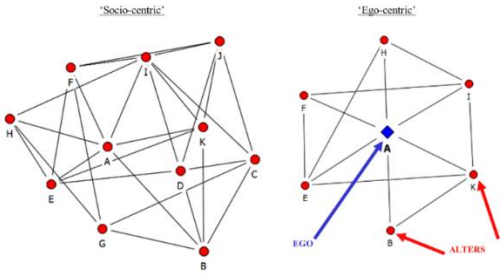

Figure 1. Socio-approach and ego-centric approach

The socio-centric approach examines the relations among nodes that are regarded for analytical purposes as bounded social collectives[22], and places its analytical focus on the whole network[21]. While such an approach can be used to treat incomplete data, it has limitations in terms of the size of the network that can be analyzed. Specifically, if the size of the analyzed network is huge (for example, the number of nodes is greater than 1,000), this method is constrained by limitations imposed by the software and processing capacity of the computer used[23]. The ego-centric approach is used to compensate for the limitations of the socio-centric approach. In this approach, the network selects important ego-nodes and recognizes nodes connected with those nodes. This approach focuses on loosely bound individuals, and is especially useful when the number of nodes is large[24]. This paper uses the socio-centric approach, which deals with the whole network, to analyze the overall research trends of research keywords, and the ego-centric approach to analyze emerging research trends in research keywords in order to highlight the latest trends.

2.2. Experimental Procedures

In order to generate a comprehensive list of IP areas related to academic research, this paper adopts the procedure shown in Figure 2, which comprises three stages: data construction, data filtering, and data analysis.

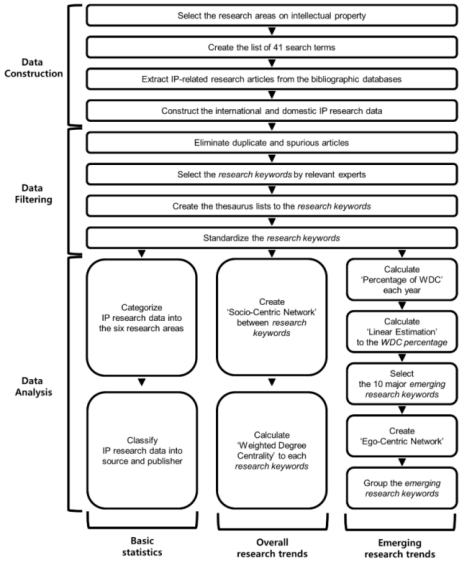

Figure 2. Research procedure adopted to generate a comprehensive list of IP areas

2.2.1. Data construction

The target of the data collection is academic articles in IP-related publications such as journals, papers, news, and reports, listed in web-based bibliographic databases. First, the list of search terms used to search the research articles was generated to extract IP-related articles from various web-based bibliographic search databases. The SCOPUS database, one of the most representative databases for gathering bibliographic information, was searched with the search terms "intellectual property" and "intellectual asset". Then, 114 candidate search terms was chosen from the titles of the extracted articles. Considering the relative frequencies, 13 search terms (including single words and multi-word phrases) in six research categories were finally selected after review by relevant experts including IP experts, and their Korean and Japanese equivalents search terms. The search terms are summarized in Table 1.

Table 1. Search terms for searching the research articles

Category	Search terms
Intellectual Property	Intellectual Property
	Industrial Property
Patents & Utility Models	Patent
	Utility Models
Trademark	Trademark
	Trade Dress
Design	Design Right
	Design Protection
Copyright	Copyright
New Intellectual Property	Geographical Indication
	Publicity Right
	Genetic Resource
	Traditional Knowledge
	Trade Secret

Using the above search terms, IP-related research articles were searched in the specific search fields ("author keywords", title, and abstract) from representative web-based bibliographic databases, in this case, SCOPUS. In particular, some bibliographic databases to provide IP-related specialized articles such as news, research reports, and law & precedent cases were included to reflect the recent research trends in IP, as well as academic databases. The search results obtained are summarized in Table 2.

Table 2. Result of data construction

Search condition			Result of data collection	
Web-based bibliographic databases		**Types of article**	**No. of sources**	**No. of articles**
International Database	SCOPUS	Journal	9,722	55,840
	Westlaw	Journal	760	10,402
	Business Source Complete	Journal	1,456	15,714
	LexisNexis	US Law Reviews	859	20,564
Korean Domestic Database	The National Assembly Digital Library of Korea	Journal	838	4,708
	Research Information Sharing Service	Journal	1,498	7,521
	Policy Research Information Service & Management	Research Reports	43	5,246
	Korea Copyright Commission	Research Reports	38	217
	Korean Intellectual Property Office	Research Reports	30	179
Japanese Domestic Database	Citation Information by National Institute of Informatics	Journal /Research Reports	1,938	16,409

The search results for the bibliographic databases include bibliographic information such as article title, author name, "source title", publication year, abstract, table of contents, "author keywords", and "keywords plus". This is the basic information needed to construct various social networks to analyze varied research trends.

2.2.2. Data filtering

Data filtering was performed to eliminate redundant search results, select proper research keywords, and standardize them. Duplicates can occur since the articles are searched from separate databases. If two or more articles have the same article title, author name, "source title", and publication year, they were considered duplicates (hence, the bibliographic information was collected only once).

Next, the research keywords to be used to investigate the significant research trends in various IP research areas were selected. The experts extracted the candidate research keywords related to IP predominantly from the "author keywords" along with the words contained in article title, abstract, table of contents, and "keywords plus" of each article. Further, when "author keywords" was not provided, such as occurs in news, reports, and reviews, the experts derived the candidate research keywords by reviewing the body of the article.

It was also necessary to standardize the candidate research keywords. In many cases, a specific word or expression used by an author may not be shared by other authors, which can cause insufficiency of continuity and widespread imbalance in the analysis of research topics[25]. To solve this problem and obtain more meaningful results, the candidate research keywords were standardized by using them to construct a thesaurus.

In general, a thesaurus is a collection of controlled terms in a given field that clearly indicates synonymous and hierarchical relations. It can be used to increase efficiency in document searches within systems of information, storage, and search, and to give coherence in document indices[26]. However, there are several technical difficulties that have to be overcome in order to transform a large volume of keywords into a useful thesaurus[27]. Further, questions of credibility related with the methods used to build an automatic thesaurus or ontology exist if specialists are excluded from the process[28]. Consequently, we constructed the thesaurus with the standardized research keywords using a glossary of IP technical terms, and enlisted the aid of the experts to check the thesaurus' list three times to obtain more meaningful results. The number of research articles and research keywords selected in the three filtering steps are shown in Table 3.

Table 3. Results of data filtering

Intellectual Property(IP) research data	No. of filtered articles	No. of research keywords		
		1st filtering	2ndfilterin g	Final selection
International IP-Research Data	19,108	22,110	18,720	18,292
Korean Domestic IP-Research Data	4,220			
Japanese Domestic IP-Research Data	8,132			

2.2.3. Data analysis

Data analysis was performed to analyze the basic statistics of the research data, overall research trends, and emerging research trends in various IP research areas. First, the collected and filtered research articles were categorized into six research areas selected after review by the relevant experts, including IP experts, and classified into key sources and publishers. Next, the socio-centric network, which deals with the whole network, was used to analyze the overall research trends of research keywords at the macro level in the various IP-related research areas.

In general, the research keywords are represented as nodes, and a relation between two research keywords is represented as a link between the corresponding two nodes. Figure 3 shows how a network is generated from five research keywords (A–E) and four articles (AR1, AR2, AR3, and AR4): AR1 = (A, B, C, D) means that article AR1 contains the research keywords (A, B, C, and D). The link between nodes A and B (i.e., research keywords A and B) indicates that they are included in the same article (i.e., AR1). The number on a link, called the "Weight", indicates the number of co-occurrences of the two research keywords. For example, A and B are included together only once, but B and C occur together twice (in AR1 and AR2). The number of links is termed the "Degree", and duplicate relations between nodes are ignored. The sum of the "Weight" on the link is called the "Weighted Degree", and duplicate relations between nodes are considered. The co-occurrence matrix in Figure 3 shows the actual data structure of the network of the research keywords used to analyze the overall research trends.

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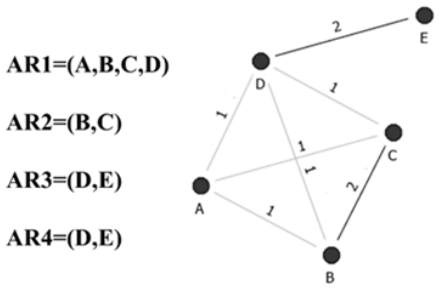

	A	B	C	D	E	Sum
A		1	1	1	0	3
B	1		2	1	0	4
C	1	2		1	0	4
D	1	1	1		2	5
E	0	0	0	2		2
Sum	3	4	4	5	2	18

Figure 3. Example network and co-occurrence matrix

For socio-centric networks, the degree centrality approach is frequently used to measure important nodes among the numerous nodes[22]. A node with a higher degree centrality has a relatively higher probability of information flow in a (socio-centric) network[16]. A node with a higher degree centrality can also be viewed as having the power to affect a greater number of other nodes; therefore, it can communicate more quickly with neighboring nodes[29,30]. This paper uses the Weighted Degree Centrality (WDC) to measure important nodes (i.e., research keywords). WDC is the relative proportion of weighted degree that a node takes up among all nodes. It is defined as follows:

$$WeightedDegreeCentrality(WDC) = \frac{\sum \text{weighted degree of each "research keywords" node}}{No.ofallnode - 1}$$

This paper also analyzes the emerging research trends in various IP research areas in order to identify the latest trend, which is difficult to analyze in the overall network. Since the number of nodes may change from year to year, to measure the importance of a node (i.e., research keyword) in terms of the number of nodes in a network, the WDC percentage is used in ego-centric network analysis. It is defined as follows:

$$WeightedDegreeCentrality(WDC)Percentage = \frac{WDCofeach\ "researchkeyword"\ node}{\sum WDCofeach\ "researchkeyword"\ node}$$

A linear regression analysis using the Microsoft Excel worksheet function Linear Estimation (LINEST) was performed on the WDC percentage to analyze the annual research trends statistically. A positive LINEST value for the research keywords means that its WDC percentage is increasing from year to year. It would therefore be regarded as an emerging research keyword. The ten research keywords with the highest positive LINEST values were then selected as major emerging research keywords. Then, by building the ego-centric network linked directly with each of the 10 major emerging research keywords, we investigated the micro-level research trends in research keywords.

Additionally, in the established ego-centric network, the typical node size of networks can be counted in millions or billions, and new methods are needed to retrieve comprehensive information from such a complex structure. We utilized the community method, a cohesion analysis approach, to facilitate understanding of the complex structure of the node in connection networks. The community method decomposes the networks into sub-units or communities according to highly interconnected nodes[31]. The quality of the partitions resulting from this method is often measured by the so-called modularity of the partition. We used the popular CNM algorithm[32], which is the fastest approximation algorithm for optimizing modularity in large networks.

III. RESULTS AND DISCUSSION

3.1. Basic statistics

We classified the collected IP-related research articles into six research categories (“Intellectual Property”, “Patents & Utility Models”, “Trademark”, “Design”, “Copyright”, and “New Intellectual Property”) selected from review by relevant experts, including IP specialists.

The data in Table 4 shows the changes that occurred in the six research categories over the years. In the Korean Domestic IP-Research Data, research in the “Intellectual Property” category continuously declined while “Design” increased somewhat in recent years. In the Japanese Domestic IP-Research Data, research in the “Patents & Utility Models” category increased while that in the “Intellectual Property” category declined. In the International IP-Research Data, there was little change in all categories except for the “New Intellectual Property” category.

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Table 4. Proportional difference in the six research categories over the years

Research data	Category	WDC Ratio					LINEST
		2007	2008	2009	2010	2011	
International IP-Research Data	Intellectual Property	16.09%	17.70%	17.76%	18.29%	16.84%	+ 0.21%
	Patents & Utility Models	28.23%	30.02%	28.00%	29.95%	30.53%	+ 0.45%
	Trademark	6.28%	7.66%	9.71%	8.23%	7.78%	+ 0.36%
	Design	0.93%	2.90%	2.38%	2.48%	2.80%	+ 0.33%
	Copyright	19.86%	18.85%	17.02%	16.17%	17.78%	- 0.68%
	New Intellectual Property	28.61%	22.87%	25.12%	24.88%	24.27%	- 0.67%
Korean Domestic IP-Research Data	Intellectual Property	17.28%	15.57%	14.26%	13.33%	13.67%	- 0.95%
	Patents & Utility Models	25.27%	26.10%	28.72%	24.37%	27.02%	+ 0.18%
	Trademark	7.99%	5.48%	7.23%	6.95%	7.91%	+ 0.13%
	Design	2.38%	1.86%	3.62%	3.08%	5.11%	+ 0.67%
	Copyright	34.13%	36.18%	35.53%	37.13%	34.10%	+ 0.09%
	New Intellectual Property	12.96%	14.80%	10.64%	15.15%	12.19%	- 0.12%
Japanese Domestic IP-Research Data	Intellectual Property	27.71%	27.14%	23.68%	21.01%	24.98%	- 1.16%
	Patents & Utility Models	30.23%	31.05%	31.33%	31.94%	32.68%	+ 0.58%
	Trademark	4.79%	6.36%	6.22%	7.62%	5.51%	+ 0.27%
	Design	4.18%	2.93%	3.11%	2.78%	2.52%	- 0.35%
	Copyright	19.65%	20.54%	22.33%	23.59%	22.40%	+ 0.86%
	New Intellectual Property	13.45%	11.98%	13.33%	13.06%	11.91%	- 0.20%

Table 5 shows the top 10 sources and publishers of articles in each database in which IP-related research was published for a total of 447 journals. The articles published in the top 20 journals of each database comprised approximately 30% of the total number of journal articles used in our study. Our list further indicates the results of a broad characterization of IP-related research to cover a wide range of subjects, as represented by the journal selection.

Table 5. Top 10 sources and publishers

Research data	Source title	Publisher	Record Count	Ratio of total
International IP-Research Data	Chartered Institute of Patent Agents Journal	Sweet and Maxwell	779	6.7%
	Managing Intellectual Property	Euromoney Publications	424	3.6%
	European Intellectual Property Review	Sweet and Maxwell	417	3.6%
	World Intellectual Property Report	WIPO	356	3.1%
	Journal of Intellectual Property Law And Practice	Oxford University Press	302	2.6%
	International Review of Intellectual Property and Competition Law	Max Planck Institute for Intellectual Property and Competition Law	292	2.5%
	Berkeley Technology Law Journal	University of California School of Law	228	2.0%
	Intellectual Property and Technology Law Journal	Aspen Publishers	189	1.6%
	Computer and Telecommunications Law Review	Sweet and Maxwell	179	1.5%
	World Communications Regulation Report	BNA International Inc.	132	1.1%
Korean Domestic IP-Research Data	Intellectual Property Right	Korea Intellectual Property Right Legislation Institute	224	5.9%
	Industrial Property Right	Korea Industrial Property Law Association	189	5.0%
	Invention & Patent	Korea Invention Promotion Association	180	4.7%
	Intellectual Property 21	Korean Intellectual Property Office	138	3.6%
	Copyright Culture	Korea Copyright Commission	121	3.1%
	Law & technology	Seoul National University	105	2.8%
	Creation & Rights	Sechang Publish Co.	82	2.2%

	Copyright	Korea Copyright Commission	75	2.0%
	The Journal of Intellectual Property	Korea Institute of Intellectual Property	70	1.8%
	Lawyers Association Journal	Lawyers Association	42	1.1%
Japanese Domestic IP-Research Data	Intellectual Property Prism	Research Institute of Economy, Trade and Industry	712	9.5%
	Patent	Japan Patent Attorneys Association	435	5.8%
	Intellectual Property Management	Japan Intellectual Property Association	411	5.5%
	The Invention	Japan Institute of Invention and Innovation	338	5.0%
	International Association for the Protection of Intellectual Property of Japan	A.I.P.P.I Japan	283	3.8%
	Customs Intellectual Property Information Center Journal	Customs Intellectual Property Information Center	222	3.0%
	Chizaiken Forum	Institute of Intellectual Property	160	2.1%
	Law & Technology	Civil Law Study Association	153	2.0%
	Copyright	Copyright Research and Information Center	128	1.7%
	Design Protect	Japan Design Protect Association	128	1.7%

3.2. Overall research trends in IP research areas

Table 6 shows the results for the top 20 WDC values for the IP-research data on research keywords from each database. The overall research trends in the International IP-Research Data analyzed that researchers are most active in researching EU Law, copyright infringement, and trademarks. The Korean Domestic IP-Research Data confirmed that infringement and protection of copyrights are the most common research topics in which researchers in Korea are actively involved. The Japanese Domestic IP-Research Data analyzed indicated that researchers in Japan are most active in researching intellectual property rights and laws.

Table 6. Top 20 WDC values for the IP-research data on research keywords from 2007 to 2011

Rank	International IP-Research Data	WDC values	Korean Domestic IP-Research Data	WDC values	Japanese Domestic IP-Research Data	WDC values
1	European Union Law	0.427	Copyright Law	0.155	Intellectual Property Act	0.182
2	Copyright Infringement	0.343	Copyright Infringement	0.114	Patent Rights	0.130
3	Infringement	0.272	Fair Use	0.089	Copyright Law	0.102
4	Patent Law	0.248	Copyright Protection	0.073	Patent Law	0.091
5	Trademark	0.235	Korea-US FTA	0.070	Intellectual Property Strategy	0.087
6	Information Technology	0.184	Technological Protection Measures	0.069	Invention	0.074
7	R&D	0.184	TRIPs	0.064	Patent Application	0.068
8	Drug	0.182	Patent Infringement	0.059	R&D	0.062
9	Trademark Infringement	0.181	Online Service Provider	0.057	Patent Information	0.049
10	Europe	0.174	Publicity Rights	0.054	Unfair Competition Prevention Law	0.046
11	Software	0.174	U.S.A	0.052	U.S.A	0.044
12	License	0.166	Trade Secrets	0.051	Copyright Protection	0.043
13	Biotechnology	0.156	Licenses	0.047	Genetic Resource	0.042
14	Innovation	0.155	Inventive Steps	0.045	Patent Infringement	0.042
15	Knowledge	0.153	Literary Works	0.044	Trademark Act	0.042
16	Patent Infringement	0.151	Japan	0.044	License	0.040
17	Internet	0.136	Trademark Act	0.037	Trademark	0.039
18	Registration	0.134	Patent Dispute	0.036	Regional Brand	0.039
19	Joint Trademark	0.134	Intellectual Property Protection	0.035	Intellectual Property Protection	0.038

20	China	0.131	Patent Troll	0.034	Patent Strategy	0.038

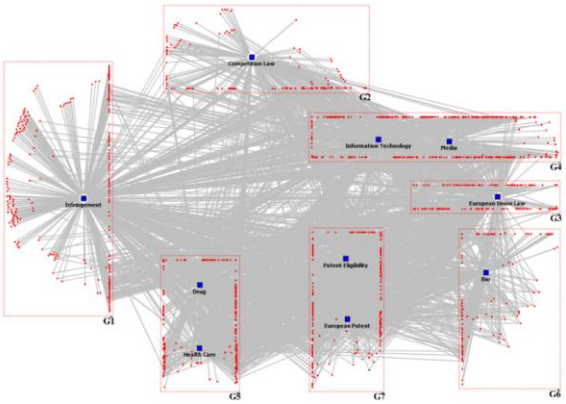
3.3. Emerging research trends in IP research areas

We conducted a linear regression analysis using LINEST function on the WDC Percentage to statistically analyze the annual research trends. The 10 research keywords with the highest positive LINEST values were then selected as the major emerging research keywords in the International, Korean domestic, and Japanese domestic IP-Research Data. The data shown in Table 7 illustrate the changes in these ten emerging research keywords over the years.

Table 7. Major emerging research keywords (2007–2011)

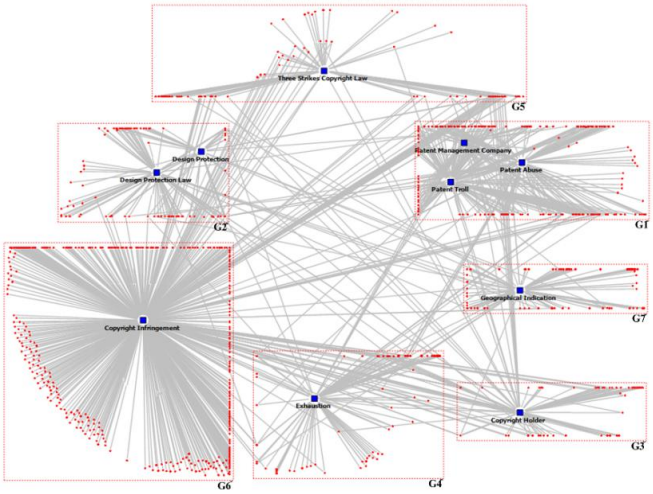
Research Data	Research keywords	WDC Ratio					LINEST
		2007	**2008**	**2009**	**2010**	**2011**	
International IP-Research Data	European Union Law	0.00%	1.36%	1.70%	1.74%	2.00%	+ 0.436
	Infringement	0.06%	0.80%	1.30%	1.45%	1.43%	+ 0.339
	Information Technology	0.53%	0.24%	0.62%	1.07%	1.06%	+ 0.188
	Patent Eligibility	0.00%	0.32%	0.61%	0.53%	0.64%	+ 0.149
	Drug	0.31%	0.54%	0.78%	1.01%	0.81%	+ 0.148
	Health Care	0.11%	0.05%	0.12%	0.63%	0.55%	+ 0.147
	European Patent	0.00%	0.41%	0.58%	0.59%	0.59%	+ 0.135
	Competition Law	0.00%	0.09%	0.19%	0.49%	0.44%	+ 0.128
	Bio	0.04%	0.13%	0.25%	0.26%	0.50%	+ 0.104
	Media	0.00%	0.01%	0.14%	0.25%	0.36%	+ 0.096
Korean Domestic IP-Research Data	Copyright Infringement	0.62%	0.99%	0.67%	1.13%	1.14%	+ 0.120
	Patent Troll	0.09%	0.25%	0.19%	0.39%	0.52%	+ 0.100
	Copyright Holder	0.10%	0.13%	0.15%	0.15%	0.42%	+ 0.066
	Design Protection Law	0.12%	0.14%	0.23%	0.09%	0.44%	+ 0.061
	Patent Abuse	0.06%	0.09%	0.20%	0.24%	0.28%	+ 0.059
	Design Protection	0.05%	0.00%	0.18%	0.05%	0.32%	+ 0.059
	Geographical Indication	0.14%	0.18%	0.15%	0.29%	0.36%	+ 0.056
	Exhaustion	0.12%	0.04%	0.20%	0.04%	0.39%	+ 0.054
	Three Strikes Copyright Law	0.00%	0.00%	0.09%	0.34%	0.07%	+ 0.048
	Patent Management Company	0.02%	0.08%	0.11%	0.06%	0.26%	+ 0.045
Japanese Domestic IP-Research Data	Copyright Law	0.68%	1.23%	1.27%	1.88%	1.68%	+ 0.264
	Patent Information	0.19%	0.45%	0.38%	1.27%	0.92%	+ 0.227
	R&D	0.56%	0.85%	1.08%	1.35%	1.20%	+ 0.176
	Patent Protection	0.09%	0.23%	0.11%	0.39%	0.77%	+ 0.150
	Drug Patent	0.13%	0.10%	0.04%	0.37%	0.65%	+ 0.130
	Convention on Biological Diversity	0.07%	0.00%	0.11%	0.43%	0.49%	+ 0.126
	Software	0.44%	0.17%	0.45%	0.33%	0.93%	+ 0.114
	Genetic Resource	0.39%	0.36%	0.38%	0.74%	0.77%	+ 0.113
	Fair Use	0.05%	0.07%	0.11%	0.57%	0.35%	+ 0.112
	BM Patent	0.04%	0.24%	0.11%	0.12%	0.62%	+ 0.103

Additionally, we then constructed an ego-centric network to analyze the 10 major emerging research keywords, and then we utilized the community method to group the emerging keywords in the established ego-centric network by their high relations. Figure 4 and Figure 5 and Figure 6 shows the grouped ego-centric networks from each set of IP-Research Data, and indicate the five research keywords closely associated with each group.



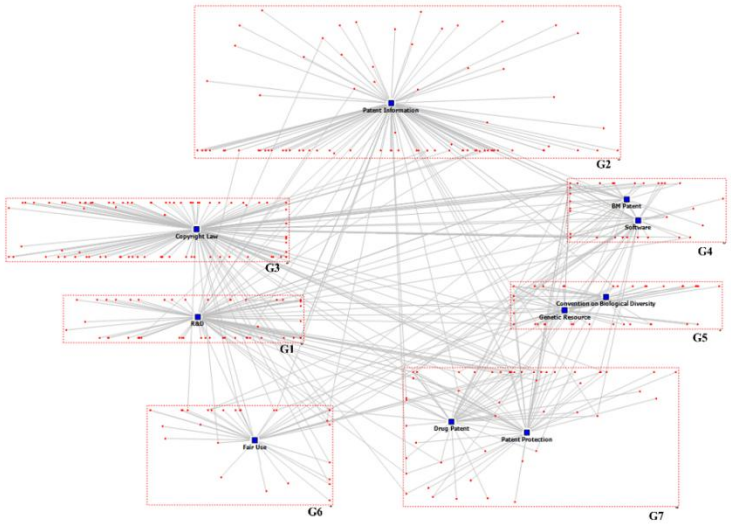
Group	Emerging keywords	WDC	Related Top 5 Research keywords
G1	• Infringement	655.17 (16.6%)	• Trademark Infringement • Joint Trademark • Export • Online Auction Sites • Forum Shopping
G2	• Competition Law	290.83 (7.4%)	• Copyright • Unfair Competition • Misuse • Monopoly • International Law
G3	• European Union Law	620.83 (15.7%)	• 3-D Trademark • Unfair Advantage • Shape • Apparatus Trademark • Cancellation
G4	• Information Technology • Media	485.5 (12.3%)	• Entertainment • Music • Music Product • Website • DMCA
G5	• Drug • Health Care	611.2 (15.4%)	• India • Generic Medicines • Novelty • Spc • Pharmaceutical Industry
G6	• Bio	273 (6.9%)	• DNA • Agriculture • Inventive Step • Plant • Free Trade
G7	• European Patent • Patent Eligibility	1,020.17 (25.8%)	• Intellectual Property • Patent • Software • U.S.A • Validity

Figure 4. Grouped ego-centric network for the International IP-Research Data



Group	Emerging keywords	WDC	Related Top 5 Research keywords
G1	• Patent Troll • Patent Abuse • Patent Management Company	9.67 (6%)	• Abuse of Right • License • Patent Infringement • Patent Litigation • BM Patent
G2	• Design Protection • Design Protection Law	13 (9%)	• Copyright Law • Design Company • Industrial Design • Design Application • Non-Substantial Examination System
G3	• Copyright Holder	20.8 (14%)	• Publication Right Holder • Publication Right • Coexistence • Berne Convention • Literary Works
G4	• Exhaustion	19.17 (13%)	• The First Sale Doctrine • Parallel Import • Patent Exhaustion • TRIPs • Principle of Patent Independence
G5	• Three Strikes out Law	29 (19%)	• Copyright Protection • Copyright Law Reform • Online Service Provider • Anti-Counterfeiting Trade Agreement • Illegal Works
G6	• Copyright Infringement	49.67 (33%)	• Plagiarism • Internet • P2P • UCC • Substantial Similarity
G7	• Geographical Indication	9.33 (6%)	• Collective Mark • Korea-EU FTA • Origin Labeling • Local Specialities • Agricultural Products

Figure 5. Grouped ego-centric network for the Korean Domestic IP-Research Data



Group	Emerging keywords	WDC	Related Top 5 Research keywords
G1	• R&D	27.33 (16.2%)	• Optical Technology • Chinese Business • Technology Transfer • Risk Management • Intellectual Property Management
G2	• Patent Information	16.67 (9.9%)	• Patent Retrieval • Innovation • Patent Office • Patent Database • Patent Digital Library
G3	• Copyright Law	33.33 (19.7%)	• Literary Works • Freedom of Expression • Google Maps • e-Learning • Digitalization
G4	• Software • BM Patent	43.17 (25.5%)	• Invention • Copyright • Precedent for European Patent • Intellectual Property Act • Indirect Infringement
G5	• Genetic Resource • Convention on Biological Diversity	16.33 (9.7%)	• Benefit Sharing • Forestry Area • Traditional Knowledge • Intellectual Property • Bioindustry
G6	• Fair Use	9.83 (5.8%)	• Fair Use in Japanese • Design Rights • Copyright System • Transmission • Watermark
G7	• Drug Patent • Patent Protection	22.33 (13.2%)	• Patent Rights • Biotechnology • Patent Strategy • Compulsory License • Requirement for Patent

Figure 6. Grouped ego-centric network for the Japanese Domestic IP-Research Data

The results of analysis of the relations between research groups in each IP-research data are summarized as follows [Figure 4, Figure 5, Figure 6].

☐ International IP-Research Data: Research on Group 7 (European Patent/Patent Eligibility) was the most active, and was especially analyzed actively with Group 5 (Drug/Health Care) and Group 1 (Infringement) in analysis of the relations between research groups. Research relations between Group 3 (European Union Law) and Group 1 (Infringement) were also high.

☐ Korean Domestic IP-Research Data: Research on Group 6 (Copyright Infringement) was the most active, and was especially analyzed actively with Group 5 (Three Strikes out Law) and Group 3 (Copyright Holder) in analysis of the relations between research groups. Research relations between Group 4 (Exhaustion) and Group 7 (Geographical Indication) were also high.

☐ Japanese Domestic IP-Research Data: Research on Group 4 (Software/BM Patent) was the most active, and was especially analyzed actively with Group 3 (Copyright Law) and Group 1 (R&D) in analysis of the relations between research groups. Research relations between Group 1 (R&D) and Group 2 (Patent Information) were also high.

IV. CONCLUSION

In this paper, we explored the research trends in IP by using the social network analysis technique. We utilized 31,460 pieces of bibliographic information on IP-related research data published in international, Korean domestic, and Japanese domestic web-based bibliographic databases from 2007 to 2011. Bibliographic databases that provided IP-related specialized articles such as news, research reports, and law & precedent cases, in particular, were included to reflect the recent research trends in IP, as well as academic databases. The overall research trends in IP were then analyzed using the socio-centric approach for the relations between research keywords. Further, by building an ego-centric network linked directly with the seven groups comprising the set of emerging research keywords, we investigated the emerging trends in intellectual properties related to the seven research groups in depth.

Because this research was conducted on the basis of "search terms", it is possible that bibliographic information not related to those keywords have been omitted. In the process of building the thesaurus of related research topics, the researchers' perspective could not be fully excluded. This may serve to bias the results from the actual general research trends in IP. To eliminate such a possibility, standardization of the thesaurus was performed in order to achieve maximum reliability.

ACKNOWLEDGMENT

This work (Grants No.10031496) was supported by Business for University Entrepreneurship Center, funded Ministry of SMEs and Startups in 2015.

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