Information Systems Review
Vol. 19, No. 2 June 2017 http://dx.doi.org/10.14329/isr.2017.19.2.021

초연결시대의 협력: IT 기업 간 협력 네트워크와 성과에 관한 연구

The Power of Connectivity: Cooperative Network and Firm Performance in the IT Industry

박 지 혜 (Ji Hye Park) 고려대학교 경영학과 박사과정

요 약

모든 것이 이어지는 초연결시대에 기술의 융합으로 새로운 비즈니스가 생겨나고 산업의 경계가 허물어지고 있다. IT 산업의 빠른 변화에 발맞추어 기업은 기존의 사업영역을 재조정하거나 새로운 분야를 선도하는 역할이 더욱 중요해졌다. 또한 글로벌 경쟁이 심화되면서 기업은 경제적 요인을 고려하면서 보다 차별적인 경쟁우위를 확보해야만 하는 상황이다. 따라서 현존하는 자원을 효과적으로 연결하여 최적의 성과를 만들기 위한 방안으로 전방위적 협업을 통한 가치 창출에 주목해야 한다. 이에 본 연구는 특정 IT 영역 내의 기업간 협력 활동에 한정하지 않고 IT 산업 전반에 속한 주요 기업들의 협력 네트워크를 파악해 보았다.

본 연구에서 소셜 네트워크 분석 기법을 활용하여 주요 IT 기업들의 협력 네트워크를 분석하여 성과와의 관계를 살펴본 결과는 다음과 같다. 우선 기업들의 협력 네트워크의 수와 함께 네트워크 상에서 중개자 역할을 표현하는 척도인 매개중심성이 성과에 유의한 영향을 미치는 것으로 나타났다. 이는 네트워크 양적 측면에서 협력의 수뿐만 아니라, 구조적 관점을 고려하며 기업이 네트워크 내에서 어떠한 포지션에 위치해 있는지도 주의를 기울여야 한다는 것이다. 또한 협력 네트워크의 클러스터 분석을 실시해 본 결과, 다양한 IT 영역에서 활동하는 기업들이 밀접하게 연결되어 클러스터를 구성하고 있었다. 이는 주요 기업들이 IT 영역 간 경계를 넘어서 전방위적 협력 관계를 구축하며 경영 활동의 효과를 극대화하고 실제 기업 성과로 연결시키고 있다는 점이다.

마지막으로 본 연구는 4차 산업혁명 시대의 흐름을 반영하여 IT 분야 간 경계를 초월하며 형성되는 협력의 의미를 기존의 네트워크 이론을 통해 재조명해 본다는 의미가 있다. 본 연구 결과는 기업이 새로운 현상을 포착하여 가치를 창출하기 위한 방안으로 다양한 파트너와의 협업 전략을 고려하는데 있어 시사점을 제공할 수 있다. 또한 실제 주요 IT 기업의 협력 관계를 네트워크 분석을 통해 가시화하여 나타냄으로써 IT 비즈니스 관련 연구와 실무진에게 보다 입체적이고 다양한 관점을 제시해 줄 것으로 기대해 본다.

키워드 : IT 산업, 협력 네트워크, IT 비즈니스 네트워크, 전략적 제휴, 매개적 역할, 소셜네트워크 분석

Ⅰ. Introduction

The evolution of technologies has facilitated the establishment of connections among individuals and resulted in the emergence of Internet of Things (IoT), a phenomenon that connects humans to machines. These trends are expected to continue along with the advent of the Fourth Industrial Revolution. One can find the connection among firms by looking at this phenomenon from an organizational perspective. Various technological advancements have also rapidly changed the business activities in the IT industry, and IT firms have gradually realized the importance of developing technologies or creating business models. Accordingly, these firms have begun to seek effective solutions based on their current resources, including capital, technology, and infrastructure. One of these solutions is to establish networks by cooperating with other firms. The implications of B2B collaboration can be broadly discussed from the organizational, strategic, and technical perspectives. This study examines the connection among IT firms from the network perspective. Corporate network studies have analyzed the performance of cooperative relationships (Ahuja, 2000a; Kale *et al*., 2002) and examined the reasons for forming collaborative networks (Ahuja, 2000b; Gulati, 1995). Some studies have characterized the evolution of B2B alliance networks from a dynamic perspective (Doz, 1996; Ring and Van de Ven, 1994), and many others have examined the performance of corporate alliance networks based on their innovative output (e.g., patents) (Ahuja, 2000a; Phelps, 2010; Schilling and Phelps, 2007) and financial measures (e.g., ROA, ROI, and revenue) (Bae and Insead, 2004; Baum *et al*., 2000; Kale *et al*., 2002; Rowley *et al*., 2000). Other studies have examined stock market returns based on alliance announcements (Kale *et al*., 2002; Koh and Venkatraman, 1991).

However, these studies have not examined the performance of alliance networks in the whole IT industry and have mostly focused on a partial IT industrial group that only includes S/W or telecommunication firms. The current business environment of the IT industry must also be considered. The boundaries that separate the firms in the IT industry have begun to collapse along with the development of IoT, and various IT components have been combined to align with the emergence of a new business model. Accordingly, this study does not focus on a specific IT industry but instead examines the collaboration networks of major IT firms across the IT industry. Partial finance measurements, such as ROA and ROE, have also been used in previous studies to evaluate network performance. However, given the increasing interest in IT business cooperation, one must use representative financial measures to evaluate practical network performance.

Therefore, this study examines the performance of an alliance network in the overall IT industry that includes communication, computer, IT distribution, network, S/W, IT services, and telecommunication firms based on composite financial performance ‘rank’ (including sales, sales growth rate, ROE, shareholder interest, and profit) instead of a single finance measurement. This study also identifies the number of alliances with IT firms and the number of alliances within the cooperative network of top IT firms to understand the differences in the characteristics of various cooperation networks. To fulfill these objectives, this study collects and transforms the cooperative activities of key IT firms into a network matrix. This study also analyzes the relationship between corporate financial performance and network measures using the social network analysis approach. The results reveal that the number of

collaborative linkages and the structural positions of firms in IT interfirm networks both have positive effects on firm performance. Specifically, firms must develop a cooperative network with many companies and integrate themselves in the alliance network of major IT firms to achieve an excellent performance. They must also consider an intermediate position in an IT cooperation network that comprises firms from diverse IT fields. In addition, this study analyzes the clusters within an alliance network to compare the characteristics of firms from each cluster. These clusters mostly comprise firms from different IT-related fields that can engage in multilateral cooperation without boundaries.

This study offers contributions that can help new or extant IT firms in developing partnership strategies and assist enterprises in establishing a competitive advantage from a network perspective. The rapid changes in the IT industry have increased the demand for creating new businesses. Accordingly, this research examines the power of the cooperation among various IT industries. The result offers academic implications that can provide extending approach to various IS-related studies from an organizational network viewpoint.

Ⅱ Conceptual Background

2.1 Social Network Theory

Several studies have focused on the “connectivity” from the network and sociological perspectives, with structuralist and connectionist studies adopting the network view (Borgatti and Foster, 2003). Structuralist studies focus on the structure of connections within a network (Burt, 1993; James, 1990), while connectionist studies focus on the various resources (e.g., information and capital) that flow through the link. According to social capital theory, a connected relationship provides several benefits, such as economic or informational gain (James, 1990). Therefore, social capital theory relates to the structural hole (Burt, 1993) and focuses on the structural position of a node in a network. The importance of the mediating role of a node depends on its position in a network. If the mediation link that connects heterogeneous groups disappears, then the connections and associated benefits will be destroyed at the expense of the entire network. Therefore, the mediating role of a node in a network is important, and a node in a high mediation position has more opportunities than the others. The structural hole concept can also be measured based on betweenness centrality, which refers to the ability of nodes to mediate between heterogeneous groups. In this regard, acquaintances from weak-tie relationships can offer more benefits than those from strong-tie relationships (Granovetter, 1973). From these perspectives, this study examines an intercorporate network that is formed by the alliance and cooperative activities of IT firms.

2.2 Alliance Network in Organization

Organization-level network studies can be divided into two categories depending on the purpose of the network variable. First, those studies that investigate the factors of alliance inducement and partner selection consider network as a dependent variable. They find that technical and commercial capital significantly affects the number of technical collaborative linkages in the global chemicals industry (Ahuja, 2000b). Second, other network studies have examined the impacts of network features by using network measurement as an independent variable. Ahuja (2000) finds that the number of direct and indirect ties in a network of firms from the chemical

industry have significant impacts on the innovation outcomes of these firms, including their patents (Ahuja, 2000a). Another study shows that a high degree of clustering has important effects on patent performance (Schilling and Phelps, 2007). This study indicates that dense local clustering enhances the information transmission capacity in the network by fostering communication and cooperation (Schilling and Phelps, 2007). Moreover, a higher number of similar third-party partner companies in a network increases the possibility for an interfirm collaboration (Gulati, 1995; Gulati and Gargiulo, 1999). According to Powell (1996), the number of R&D alliances influences the centrality and growth of a firm (Powell *et al*., 1996). Besides, another study examines the impact of collaboration on the organization performance depending on the IT utilization levels (Lee, 2009). Traditional studies have mainly used innovative outputs (e.g., patents) (Ahuja, 2000a; Phelps, 2010; Sampson, 2007; Schilling and Phelps, 2007), financial measures (e.g., ROA and ROI) (Bae and Insead, 2004; Rowley *et al*., 2000), and market share (Zaheer and Bell, 2005) to assess network performance. The alliance networks of the telecommunication (Bae and Insead, 2004; Sampson, 2007), steel and semiconductor (Rowley *et al*., 2000), automobile (Jiang *et al*., 2010), chemical (Ahuja, 2000b), biotechnology (Baum *et al*., 2000; Walker *et al*., 1997), television production (Soda *et al*., 2004), internet portal (Chae, 2007), and 11 other high-tech manufacturing industries (e.g., aerospace equipment, automotive, and chemicals) (Schilling and Phelps, 2007) have also been analyzed.

However, these studies have not examined the performance of cooperation networks in the overall IT industry. Partial financial output has also been used to assess network performance. Therefore, this study uses comprehensive IT-related firms (e.g., communication, computer, IT distribution, network, S/W, IT services, and telecommunication firms) with a composite financial value (e.g., "rank" data, including sales, sales growth rate, ROE, shareholder interest, and profit) to measure the effect of a cooperative network. This approach considers the situation in which IT firms form a multifaceted alliance within the IT industry in response to the emergence of IoT-related technologies with the Fourth Industrial Revolution. This study also generates highly reliable results by applying more composite financial portfolios than the previous studies. The research model and hypotheses are discussed in the following sections.

Ⅲ. Theory and Hypotheses

3.1 Network Degree and Performance

Several studies have analyzed the relationship between the number of alliance networks and firm performance based on the quantitative aspects of a network. These studies have identified resource and knowledge sharing, complementary skills, and scale economics as the benefits from a cooperation (Ahuja, 2000a; Stuart, 2000). In other words, firms can gain the knowledge and complementary skills of their alliance partners by establishing a cooperation relationship with them (Arora and Gambardella, 1990; Berg *et al*., 1982). Firms may also achieve economies of scale through a collaborative connection. Expanding the size of business can also minimize their initial investment costs and increase their profits. Therefore, those firms with a larger number of cooperative networks can gain a greater amount of knowledge and skills as well as magnify the benefits from economies of scale. In this respect, this study explains the relationship between the number of B2B alliance net-

works and the financial performance of firms as shown in Hypotheses 1 and 2. Hypothesis 1 identifies the alliance cases (degree) formed by the top 94 IT firms and examines the relationship of such alliances with financial performance. Hypothesis 2 identifies the number of cooperative linkages within an alliance network of top 94 IT firms (degree centrality), analyzes the relationship of these linkages (degree centrality) with firm performance. Based on an earlier study on the relationship between the capability of alliance partners and performance, a small start-up firm can demonstrate a better performance by forming alliances with innovative and large-scale partners (Stuart, 2000). From this perspective, this study examines whether a meaningful relationship exists between firm performance and the linkages within a collaborative network of major IT firms. Accordingly, this study calculates degree centrality by creating an alliance network matrix comprising the top 94 IT firms, and then examines the relationship of degree centrality with firm performance as posited in Hypothesis 2. Hypothesis 1 identifies the total number of alliance networks and examines its relationship with the financial performance of firms.

H1: The degree of collaborative activity is positively associated with the financial performance of firms.

H2: The degree centrality within an interfirm collaborative network of major IT firms is positively associated with the financial performance of firms.

3.2 Network Structure and Performance

From the network structure perspective, some studies have examined the relationship of ROA and ROI with the bridging position of a firm in the alliance network for the telecommunications industry (Bae and Insead, 2004) as well as that of ROA with network density for the steel and semiconductor industry (Rowley *et al*., 2000). Another study has examined how the innovativeness and structural hole of Canadian mutual fund firms affect their market share (Zaheer and Bell, 2005). These studies have focused on the concept of structural hole with the bridging position of a firm in a collaborative network (Burt, 1993), thereby emphasizing the importance of the mediating role of a firm in a bridging position. Because, weak-tie relationships can connect heterogeneous groups within a network, losing such relationships can result in the loss of the entire network. Therefore, a mediating firm can have more opportunities than non-mediating ones in the alliance network. Accordingly, hypothesis 3 tests the relationship between firm performance and the betweenness centrality - which refer to how often does the company locate at the shortest path connecting between other firms - in the alliance network of major IT corporations. Previous studies have analyzed the role of structural hole in a single industrial network. However, the IT industry is becoming increasingly borderless and converged. Therefore, the network of a single industry cannot adequately reflect the-current phenomenon and business model in the IT area. To address this limitation, this study draws a network of comprehensive global IT industries (e.g., communication, computer, IT distribution, network, S/W, IT services, and telecommunication) and identifies the relationship of this network with firm performance as shown in Hypothesis 3. Understanding the role of structural hole in the comprehensive IT industry can help us understand the macro aspects of the IT business model and cooperation. Unlike previous studies, this study also uses composite finance output, ‘rank’ data (including sales, sales

growth rate, ROE, shareholder interest, and profit) to assess the tangible performance of the network.

H3: The betweenness centrality in an interfirm collaborative network of major IT firms is positively associated with the financial performance of firms.

Ⅳ. Research Methods

4.1 Research Framework

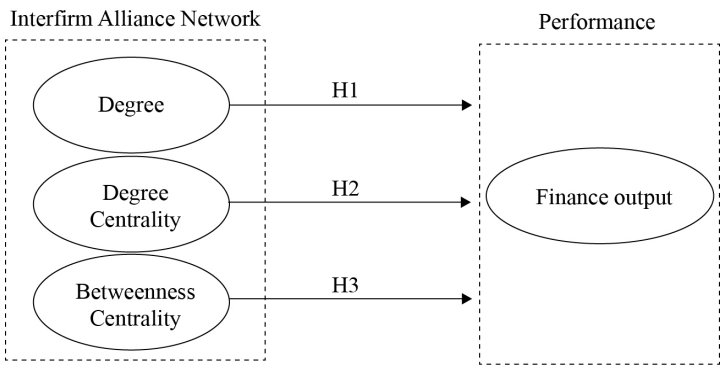
Based on conceptual background described above, the research model is developed as shown in <Figure 1>. Hypothesis 1 identifies the total number of alliances that are formed by the top IT firms (degree) and examines its relationship with firm performance. Hypothesis 2 measures the alliance linkages based on the alliance network of top IT firms (degree centrality). Hypothesis 2 is evaluated using the network matrix that comprises the alliance between top 94 IT firms. Hypothesis 3 also assesses the relationship of betweenness centrality and firm performance based on the alliance network of major 94 IT firms.

4.2 Data Collection

The proposed hypotheses are validated as follows. The alliance cases and performance data of the top 94 IT firms are obtained from the Korea Trade-Investment Promotion Agency (KOTRA). The global IT business partnership status report published by KOTRA includes information on the corporate rankings of these IT firms based on the list of InfoTech Top 100 firms published on Business Week. The number of interfirm alliances is measured by manually reviewing the alliance cases of each firm as published in the report of KOTRA. A network matrix composed of the alliance cases of 94 IT firms is then built, and various network measures, such as degree centrality and betweenness centrality, are calculated using NodeXL based on the social network analysis approach (Hansen *et al*., 2010). The social network analysis approach is further described in the following section.

4.3 Social Network Analysis

This study investigates two types of networks such as a socio-centric and an ego-centric network. Socio-centric network is composed of the total network



〈Figure 1〉 Research Model

such as team, group, and firm. Ego-centric network focuses on the individual connectivity. The primary concept of network measurement relates to the quantity and structure within the whole network set. Centrality is a representative concept that focuses on the structural position of a network (Freeman, 1978). Network measures can be classified into several ways depending on the basic concept of centrality. First, degree centrality calculates the number of links in a network. Second, closeness centrality measures the distance among nodes. Third, betweenness centrality calculates the shortest distance between nodes as a bridge or brokerage score (Freeman, 1977; Newman, 2005). Given its aim to understand the impacts of collaborative network linkages and structural position on firm performance, this study uses degree centrality and betweenness centrality to examine an IT interfirm network.

4.4 Measurement Items

To validate the effects of collaborative linkages and structural position in an alliance network, this study uses the finance output (rank) data from secondary data (the report of KOTRA), including sales, sales growth rate, ROE, shareholder interest, and profit. An interfirm alliance network is measured by degree, degree centrality, and betweenness centrality, where degree refers to the number of collaborative linkages of each IT firm, degree centrality denotes the number of collaborative links within the alliance network of major 94 IT firms, and betweenness centrality measures the sum of the shortest path between heterogeneous firms in the alliance network of IT firms.

Ⅴ. Results

5.1 Descriptive Statistics

This study uses STATA version 13 for the statistical analysis. <Table 1> shows the descriptive statistics of the network variables. Degree denotes the total number of mergers and acquisitions (M&As), direct alliances, and indirect alliances among the 94 major IT firms. Degree centrality denotes the total number of M&As, direct alliances, and indirect alliances within the network matrix of the 94 firms. Betweenness centrality denotes the brokerage score of firms as measured using NodeXL. This study uses the log-transformed value of betweenness centrality.

The total number of collaboration cases conducted by top 94 firms is 589. And, the number of cooperation among them is 126 in the network comprised of top 94 IT firms. Collaboration networks of firms are established 6.3 to 23 times on average, while cooperative cases of firms are formed 1.3 to 11 times within the top 94 firm's alliance network.

〈Table 1〉 Descriptive Statistics

Items	Sum	Mean	Std.Dev	Min	Max
Degree	589.0	6.3	3.9	0	23.0
Degree Centrality	126.0	1.3	2.0	0	11.0
Betweenness Centrality	46.2	0.5	0.8	0	2.6
Obs.	94				

5.2 Empirical Analysis

This study validates all hypotheses by conducting a regression analysis. <Table 2> shows the main estimation results. First, with regard to the number of collaborative linkages, Hypotheses 1 (0.01***) and 2 (0.05**) are significantly supported. All negative coefficient values relate to performance rank value as a finance indicator, thereby suggesting that companies with many alliance linkages are highly ranked in performance. In addition, having a high degree centrality indicates that a firm is actively connected and highly ranked in the network of 94 major IT firms, thereby underscoring the importance for these major IT companies to form cooperative relationships. These companies must also form a cooperative network with various companies according to their business strategy to achieve a positive corporate performance. Overall, an interfirm collaborative tie greatly contributes to ensuring a favorable performance. Second, in terms of structural position, Hypothesis 3 shows that the betweenness centrality of each firm within a network of 94 IT firms is positively associated with financial performance. This hypothesis is significantly supported at the 0.10 level (0.10*). Despite having a weaker explanation level compared with the other hypotheses, Hypothesis 3 identifies the mediating role of firms in the comprehensive network of global IT firms. In other words, the structural position of an IT firm in the alliance network significantly affects its financial performance. Therefore, It is significant that this study examines the performance of firms with intermediate roles in collaborative networks of diverse IT industries, not a single IT field.

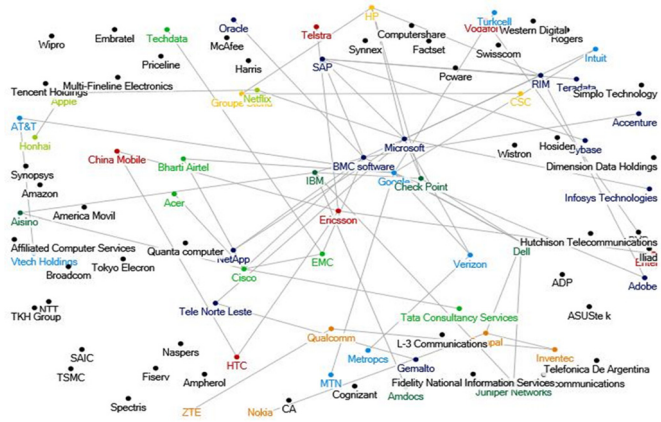
5.3 Network Visualization and Clustering Results

<Figure 2> illustrates the alliance network of 94 major IT enterprises as well as the status of top degree centrality and betweenness centrality firms. The clustering results are presented based on the alliance network set of IT firms. This study applies the Clauset-Newman-Moor algorithm (Clauset *et al.*, 2004) in NodeXL to identify each cluster that comprises highly connected firms. A total of 50 firms are classified into eight clusters using this algorithm as shown in <Figure 3>. The firms from each cluster are marked with different colors. <Figure 4> classifies the firms of each cluster into seven groups by industry, including communication, computer, IT distribution, network, S/W, IT services, and telecommunications. <Figure 5> shows the average financial performance (rank) of companies in each cluster. The software and telecommunication firms are somewhat concentrated in some clusters, while the communication and computer related firms are evenly distributed across each cluster. Most of these clusters comprise a mix of firms from different industries, thereby suggesting the multi-faceted formation of an intercorporate alliance among various IT firms.

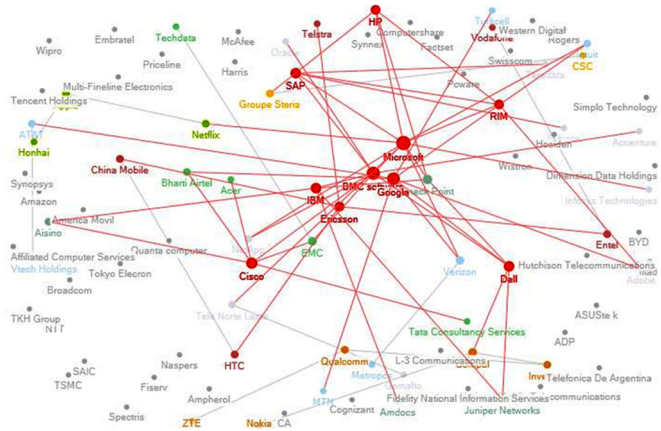
〈Table 2〉 Main Estimation Results

Performance (DV)	Coef.	t	p > |t|	R-squared	Adj R-squared	Root MSE
Degree (H1)	-2.094	-3.04	0.003***	0.0913	0.0814	26.146
Degree Centrality (H2)	-2.779	-2.03	0.045**	0.0428	0.0324	26.834
Betweenness Centrality (H3)	-6.040	-1.78	0.079*	0.0333	0.0228	26.967
Obs.	94					

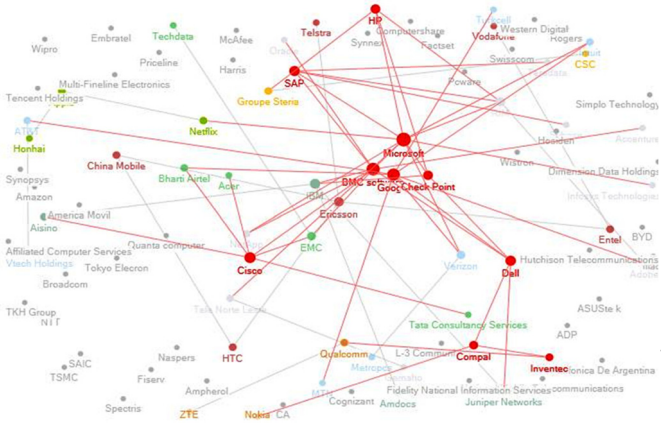
*p < 0.10, **p < 0.05, ***p < 0.01.



Major IT Firms Total Collaborative Network

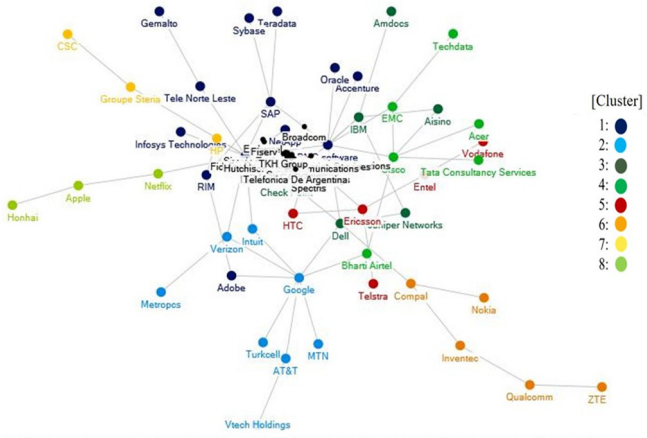


Top 10 High Degree Centrality Firms

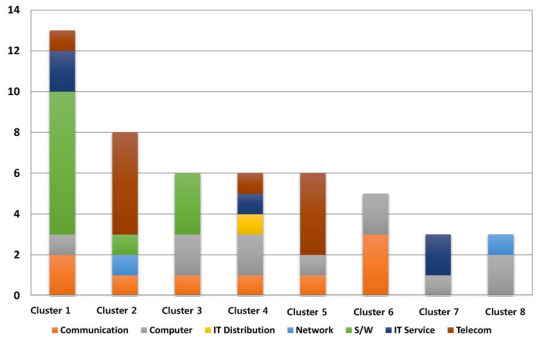


Top 10 High Betweenness Centrality Firms

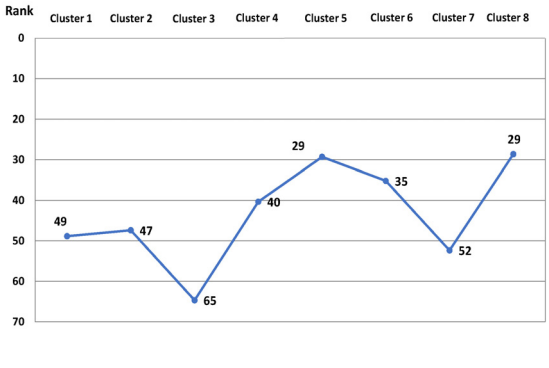
〈Figure 2〉 Alliance Network Visualization



〈Figure 3〉 Clustering Groups



〈Figure 4〉 IT Industry Classification of Firms in the Cluster



〈Figure 5〉 Average Financial Rank of Firms in the Cluster

Ⅵ. Conclusion

This study analyzes the cooperative network of major IT corporations using the social network analysis approach and examines its relationship with financial performance. The collaborative linkages and structural position of IT firms within a network have significant impacts on their financial performance. H1 and H2 highlight the importance for major IT companies to form cooperative relationships, and it is also very important to develop cooperative networks with various companies to guarantee a positive performance. H3 highlights the importance for diverse IT firms to play an intermediate position in a cooperation network among IT industries. Based on these results, we must consider the structural intermediate position and quantitative connection of firms in an alliance network. The clustering analysis results reveal that most clusters in the network of major IT firms comprise a combination of firms from various fields, thereby suggesting that IT firms establish multilateral cooperation without boundaries to maximize their business capabilities. In comparison with previous studies, this study identifies the status of cooper-

ation among companies belonging to various IT fields. These results are significant that the phenomenon regarding the disappearance of boundary in IT industry is viewed from the perspective of cooperative network. The implications and contributions of these findings are outlined as follows.

6.1 Research Implication

This study offers several research implications. First, this study analyzes the cooperative networks of comprehensive IT firms to illustrate the weakening boundary of the IT industry and the strengthening multidimensional cooperation among IT firms as a result of the emergence of IoT. This approach addresses the limitations in previous studies that have analyzed the cooperative networks of firms from a single industry. This study can also guide future studies on cooperation networks that reflect the integrative phenomenon. We can also extend this approach to future IS-related studies that investigate the IT ecosystem and business model from the collaborative network perspective. Unlike previous research, this study also uses composite financial value (rank) to assess the financial performance of firms and to provide a highly reliable understanding of network performance.

Second, this study develops a cooperation network matrix of global major IT companies based on various social network theories. By calculating network measurement and analyzing its relationship with firm performance, this study provides implications for future research to utilize social network analysis methods. This study also develops the cooperative network between IT industries. Therefore, this study encourages a further investigation of the alliance network of diverse IT organizations.

The findings must be interpreted in light of the limitations of this study. For instance, this study extracts data from a secondary source to analyze the alliance network. Therefore, the findings may not rigorously reflect the most recent alliance status and time series data. Future studies must use a highly complementary dataset for their analyses.

6.2 Contribution

The practical contributions of this study are as follows. First, this study provides practitioners with a macroscopic framework to examine the actual cooperation relationship among major IT firms. These findings also contribute to the establishment of a cooperation strategy of IT business based on the network perspective. Second, this study uses composite financial value (rank) to assess the financial performance of firms. This result contributes to the suggestion of more practical output to the stakeholder in the current situation of growing interests in cooperative activities. Third, this study groups IT firms into several clusters. In this way, this research captures the trends in the IT industry based on the intercorporate activities among related firms. Finally, we must further examine new phenomenon by combining the cooperation network viewpoint with other research areas as well as by proposing a more robust approach to identify the influence of a network.

References

[1] Ahuja, G., “Collaboration networks, structural holes, and innovation: A longitudinal study”, *Administrative Science Quarterly*, Vol.45, No.3, 2000a, pp. 425-455.

[2] Ahuja, G., “The duality of collaboration: Inducements and opportunities in the formation of inter-

firm linkages", *Strategic Management Journal*, Vol.21, No.3, 2000b, pp. 317-343.

[3] Arora, A. and A. Gambardella, "Complementarity and external linkages: The strategies of the large firms in biotechnology", *The Journal of Industrial Economics*, Vol.38, No.40, 1990, pp. 361-379.

[4] Bae, J. and M. G. Insead, "Partner substitutability, alliance network structure, and firm profitability in the telecommunications industry", *Academy of Management Journal*, Vol.47, No.6, 2004, pp. 843-859.

[5] Baum, J. A., T. Calabrese, and B. S. Silverman, "Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology", *Strategic Management Journal*, Vol.21, No.3, 2000, pp. 267-294.

[6] Berg, S. V., J. Duncan, and P. Friedman, *Joint Venture Strategies and Corporate Innovation*, Oelgeschlager, Gunn & Hain, Cambridge, Mass, 1982.

[7] Borgatti, S. P. and P. C. Foster, "The network paradigm in organizational research: A review and typology", *Journal of Management*, Vol.29, No.6, 2003, pp. 991-1013.

[8] Burt, R. S., "The social structure of competition", *Explorations in Economic Sociology*, Vol.65, 1993, pp. 103.

[9] Chae, S. W., "The analyses of successful strategy for internet portals: From the analyses of M&A cases", *Information Systems Review*, Vol.9, No.2, 2007, pp. 85-108.

[10] Clauset, A., M. E. Newman, and C. Moore, "Finding community structure in very large networks", *Physical Review E*, Vol.70, No.6, 2004, pp. 066111.

[11] Doz, Y. L., "The evolution of cooperation in strategic alliances: Initial conditions or learning processes?", *Strategic Management Journal*, Vol.17, No.S1, 1996, pp. 55-83.

[12] Freeman, L. C., "A set of measures of centrality based on betweenness", *Sociometry*, Vol.40, No.1, 1977, pp. 35-41.

[13] Freeman, L. C., "Centrality in social networks conceptual clarification", *Social Networks*, Vol.1, No.3, 1978, pp. 215-239.

[14] Granovetter, M. S., "The strength of weak ties", *American Journal of Sociology*, Vol.78, No.6, 1973, pp. 1360-1380.

[15] Gulati, R., "Social structure and alliance formation patterns: A longitudinal analysis", *Administrative Science Quarterly*, Vol.40, No.4, 1995, pp. 619-652.

[16] Gulati, R. and M. Gargiulo, "Where do interorganizational networks come from?", *American Journal of Sociology*, Vol.104, No.5, 1999, pp. 177-231.

[17] Hansen, D., B. Shneiderman, and M. A. Smith, *Analyzing social media networks with NodeXL: Insights from a connected world*, Morgan Kaufmann, Burlington, Massachusetts, US, 2010.

[18] James, C., *Foundations of Social Theory*, Cambridge, MA: Belknap, 1990.

[19] Jiang, R. J., Q. T. Tao, and M. D. Santoro, "Alliance portfolio diversity and firm performance", *Strategic Management Journal*, Vol.31, No.10, 2010, pp. 1136-1144.

[20] Kale, P., J. H. Dyer, and H. Singh, "Alliance capability, stock market response, and long-term alliance success: The role of the alliance function", *Strategic Management Journal*, Vol.23, No.8, 2002, pp. 747-767.

[21] Koh, J. and N. Venkatraman, "Joint venture formations and stock market reactions: An assessment in the information technology sector", *Academy of Management Journal*, Vol.34, No.4, 1991, pp. 869-892.

[22] Lee S. J., "The effect of collaboration and organization's performance depending on the partnership by information technology using level: Key subject is moderating variable of information technology using level", *Information Systems Review*, Vol.11, No.2, 2009, pp. 67-90.

[23] Newman, M. E., "A measure of betweenness centrality based on random walks", *Social Networks*, Vol.27, No.1, 2005, pp. 39-54.

[24] Phelps, C. C., "A longitudinal study of the influence of alliance network structure and composition on firm exploratory innovation", *Academy of Management Journal*, Vol.53, No.4, 2010, pp. 890-913.

[25] Powell, W. W., K. W. Koput, and L. Smith-Doerr, "Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology", *Administrative Science Quarterly*, Vol.41, No.1, 1996, pp. 116-145.

[26] Ring, P. S. and A. H. Van de Ven, "Developmental processes of cooperative interorganizational relationships", *Academy of Management Review*, Vol.19, No.1, 1994, pp. 90-118.

[27] Rowley, T., D. Behrens, and D. Krackhardt, "Redundant governance structures: An analysis of structural and relational embeddedness in the steel and semiconductor industries", *Strategic Management Journal*, Vol.21, No.1, 2000, pp. 369-386.

[28] Sampson, R. C., "R&D alliances and firm performance: The impact of technological diversity and alliance organization on innovation", *Academy of Management Journal*, Vol.50, No.2, 2007, pp. 364-386.

[29] Schilling, M. A. and C. C. Phelps, "Interfirm collaboration networks: The impact of large-scale network structure on firm innovation", *Management Science*, Vol.53, No.7, 2007, pp. 1113-1126.

[30] Soda, G., A. Usai, and A. Zaheer, "Network memory: The influence of past and current networks on performance", *Academy of Management Journal*, Vol.47, No.6, 2004, pp. 893-906.

[31] Stuart, T. E., "Interorganizational alliances and the performance of firms: A study of growth and innovation rates in a high-technology industry", *Strategic Management Journal*, Vol.21, No.8, 2000, pp. 791-811.

[32] Walker, G., B. Kogut, and W. Shan, "Social capital, structural holes and the formation of an industry network", *Organization Science*, Vol.8, No.2, 1997, pp. 109-125.

[33] Zaheer, A. and G. G. Bell, "Benefiting from network position: Firm capabilities, structural holes, and performance", *Strategic Management Journal*, Vol.26, No.9, 2005, pp. 809-825.

Information Systems Review
Volume 19 Number 2
June 2017

The Power of Connectivity: Cooperative Network and Firm Performance in the IT Industry

Ji Hye Park*

Abstract

The advancement of IT and the "Fourth Industrial Revolution" blurred the boundary between industries. The importance of strategic cooperation between enterprises is emphasized. IT companies must consider their existing business areas and create new territories to drive changes in the industry. They must also secure their competitive edge and manage economic costs to enable them to compete with their global counterparts. By utilizing their resources effectively, these firms can create value through inter-firm cooperation. This study analyzes the collaborative network of global IT companies using social network analysis and examines the effect of this network on firm performance. Collaborative linkages and betweenness centrality, which represent the bridging position of a firm in a network, significantly affect firm performance. This result highlights the importance of the structural position of a firm in a cooperative network of IT companies. This study also characterizes clusters in a network of IT companies. Most of these clusters comprise a combination of IT companies in diverse IT industries. These clusters suggest that these companies engage in multilateral cooperation without boundaries to maximize their business capabilities. This study offers practical implications for establishing a cooperative strategy and framework that can capture business trends in the IT industry from a macroscopic view. This study also visualizes collaborative networks in a multifaceted way using social network analysis to provide researchers and business practitioners with an informative viewpoint.

Keywords: ***IT Industry, Cooperative Network, IT Business Network, Strategic Alliance, Intermediation Role, Social Network Analysis***

* Ph.D. Candidate, Korea University Business School, Korea

◐ 저 자 소 개 ◑

Ji Hye Park (parkji@korea.ac.kr)

Ji Hye Park is a Ph.D. candidate in MIS at Business School of Korea University in Seoul, Korea. Her research interests are network analysis, strategic alliance, social media, diffusion, and internet of things. She has published papers in Journal of Information Technology Applications & Management, The Journal of Society for e-Business Studies, and presented papers at the PACIS and KMIS conferences.

논문접수일 : 2017년 03월 13일 **게재확정일 : 2017년 06월 05일**
1차 수정일 : 2017년 05월 25일