The Characteristics of Network and Innovation in the IT Venture Company: Examining the Roles of Absorptive Capacity

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Abstract

The purpose of this study is to provide an explanation for the association between the characteristics of a network and the type of innovation by considering the effect of absorptive capacity. To do so, this study examined the moderating effects of absorptive capacity on the characteristics of network-innovation relationship in a technical-driven venture company.

In order to obtain a better understanding about consequences caused by interfirm network, information was obtained from 169 Korean IT venture companies. Results confirmed that the network diversity is positively associated with exploration. Our results also suggested that the network strength is positively associated with exploitation. Finally, we found a positive two-way interaction between absorptive capacity and the network diversity-exploration relationship. Then, we discussed implications and directions for future research.

Keywords : Network Diversity, Network Strength, Exploration, Exploitation, Absorptive Capacity

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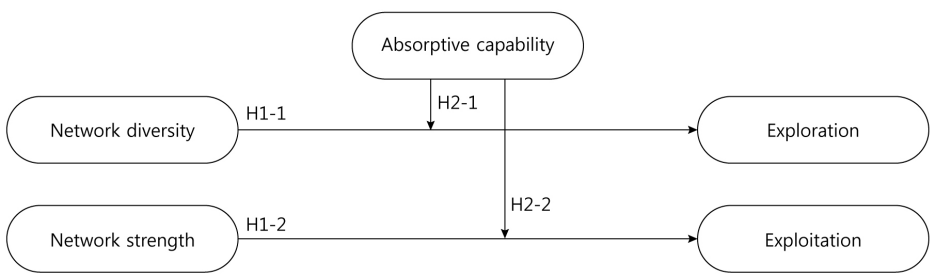
1. Introduction

Start-up ventures have to secure generic competitive advantage by overcoming liability of newness and continuously engaging in innovation in order to ensure their survival and success. These companies, whose resources and capabilities fall short of those of large corporations, are having difficulties in continuously developing and delivering innovative technology due to the rapid technological changes and shortening product life cycles. As a solution to these problems, these firms are making efforts to share and absorb resources and knowledge through continued exchanges and cooperation with outside sources, while actively exploring external sources of knowledge [Baum et al., 2000; Storey, 1994]. Such a process of securing and exploiting resources essential for venture businesses'survival and innovation can be explained by network theory [Lavie and Rosenkopf, 2006]

Thus far, research on network characteristics among corporations has been divided into two distinct areas, structural and relational properties. If venture businesses aim to secure necessary or complementary resources through external networks, it seems safe to say that the strength of ties that they have built up with external sources holds great significance. As frequency increases and relationships become strong, however, relationship routines among corporations will eventually emerge, and that may constrain implementation of innovative ideas through an approach based on a new viewpoint. In other words, though earlier studies have proven that diversified network and intensified relationship have a positive impact on organizational performance, the types of performance may also differ depending on network features. Therefore, such structural and relational characteristics of network can also have a bearing on how companies develop new products and technology.

Although many researchers have emphasized network resource that can be an important factor in a venture company's success because networks are important mechanisms that allow organizations to access new and/or complementary assets and resources in a technical-driven venture company [Kraatz, 1998; Thorelli, 1986], there are few studies about the positive impact of networks with a focus on venture companies. In addition, we also try to find which factor can make stronger the positive relationship between network resource and firms' innovative performance. In sum, this research explores how network resource will affect types of new product or tech-



〈Figure 1〉 Research Model

nology innovation and a process thereof; an organization's absorptive capacity will have an impact on the relationship between network resources and types of innovation. Aside from that, the study also plans to take into account such control variables as firm age during the model verification process.

2. Theoretical Background and Hypotheses Development

Pfeffer and Salancik [1978] asserted that the capacity to acquire and maintain resources is a critical factor in the organizational survival based upon the Resource Dependency Theory. Therefore, many companies try to develop an inter-firm network in order to create sustainable advantage which could be realized through the combination of idiosyncratic, yet complementary resources of each firm [Kogut and Zander, 1992; Grant, and Baden-Fuller, 2004]. Network has a significant effect on the firm's existing knowledge and learning patterns which can lead to certain types of innovation [Hennart et al., 1998; Kim et al., 2006].

Gulati [1999] argued that network resource is strongly connected with diversity and strength of firm's ties. Demirkan et al. [2013] documented that network diversity and network strength were used as network resources in order to investigate the relationship between the characteristics of a network and quality of knowledge. Based upon the previous studies, these two network resources (network strength and network diversity) are used as antecedents of certain types of innovation which are exploration and exploitation

2.1 Network Resource and Innovation

It can be said that companies develop new products through either exploitative innovation strategy, which improves on existing technology and products, or explorative innovation strategy, which focuses on challenging new technology and markets by developing entirely different set of products. For venture businesses, with relatively limited financial and human resources to be put into efforts to make technological innovation happen, to decide whether to focus on one of these two areas or have it both ways and find the right balance between them involves a critical question of resource allocation, which can have a direct bearing on corporate success and growth. Therefore, an innovative strategy that drives development of new products depends on resources these companies have and resources they can get from outside. This research predicts that there will be differences in knowledge and resources offered based on the characteristics of external network a venture business has and that such differences will have influence on types of innovation.

Among network features, network diversity can be defined as a "diversity of network sources a company possesses", and more diversified network provides greater access to diverse resources [Katila and Mang, 1999; Baum et al., 2000]. Organizations with network diversity can access various ideas and information from its partners via networks [Khandwalla, 1973; Miller and Chen, 1994]. Ma et al. [2009] also suggested that network diversity can be a proxy for information and knowledge diversity which can be a basis of exploratory behavior. For this rea-

son, we expected that network diversity inspires organizational experimentation and exploration.

On the other hand, network strength, which means the strength of relationships among participating companies that constitute a network, also indicates how often they buildup relationships with one another and how strong those relationships are. Increased frequency and strengthened relationships can lead to an exchange of resources [Hansen, 1995]. Organizations having strong relationship between partners would be presented with more narrow and in-depth information because of path-dependency. Exploitation, unlike exploration, needs more repetitive learning in order to obtain refined solutions related to organization's existence knowledge and technology [Sharifirad, 2010]. Therefore, this study predicts that there are different types of innovation depending upon which network resource a company has. Based upon our discussions so far, the following two hypotheses have offered.

Hypothesis 1) Network resource (network diversity and strength) have an impact on innovation.

Hypothesis 1-1) Network diversity is positively associated with exploration.

Hypothesis 1-2) Network strength is positively associated with exploitation.

2.2 Absorptive Capacity as a Moderator

According to the organizational learning perspectives, the organizational performance of network resources (network strength and network diversity) depends on the firm's skills, resources and capacity which have an influence on the degree of network resource leverage [Collinson and Wilson, 2006].

Meanwhile, of all capabilities a company possesses, absorptive capacity has a positive influence on innovative activities and performance. Absorptive capacity is an ability to digest the existing knowledge as well as an ability to create new knowledge [Nieto and Quevebo, 2005; Rothaermel and Alexandre, 2009]. Therefore, it can be said that such capacity a company has is an important factor in absorbing new knowledge and ensuring the smooth integration of the new knowledge with the existing one in the process of developing new products based on the knowledge transferred via external network.

Previous research studies demonstrated that absorptive capacity has been widely considered as a critical factor assisting firms to innovate and learn [Barkema and Vermeulen, 1998; Simonin, 1999; Lewin et al., 2011] also argued that absorptive capacity may be attributed to moderating or mediating a range of phenomena relating to firm-level innovation, adaptation, and performance.

In consideration of the roles of absorptive capacity, this study assumes that absorptive capacity can leverage firm resources and knowledge and also that this leveraging effect may influence the relationship between network resources and innovation. Based upon these research findings, it is anticipated that absorptive capacity will be an important factor in enhancing the effect of network resources on innovation, specifically in situations where technology development is the most important factor

in firms' survival as is often the case with IT venture companies.

Hypothesis 2) A company's absorptive capacity will further strengthen the relationship between network characteristics and innovation.

Hypothesis 2-1) A company's absorptive capacity will further strengthen the relationship between network diversity and exploration.

Hypothesis 2-2) A company's absorptive capacity will further strengthen the relationship between network strength and exploitation.

3. Method

3.1 Data Collection and Sampling

To test this study's hypotheses, we identified a random sample of 550 IT Venture companies from a Venture firm list in South Korea. Survey subjects were selected using the following procedure. First, we sent emails for the survey participation requests to executive directors of all 550 sample firms. Participants were assured that the survey would be performed under strict confidentiality, and we offered them a summary of survey. Second, among 550 firms, 188 executive directors are willing to participate in the survey. We confirmed their intent to participate and explained the objectives and necessary of this research via personal contact. Through this process, a total of 169 Venture firms were selected.

Firm age groups were reported to include firms between 1~10 years (48.1%), followed by firms classified as being 11~20 years (35.2%), and 21~30 years old (11.1%). The average lifetime tenure period of CEO was 101 months (8 years and 4 months), the tenure period varied substantially, ranging from one to 20 years. The average number of employees of firms was 14 about 56% of all respondent firms have less than 10 employees.

3.2 Measures

The survey instrument for this study consisted of 5 sections (1) network diversity (2) network strength (3) exploration (4) exploitation (5) absorptive capacity (6) demographic characteristics of CEO and general information of firms

Network Diversity: Network diversity was measured using the generator technique [Baum et al., 2000] that inquired into the firm's R&D alliance network as follows: how many organizations hasyour firm maintained inter-organizational network in terms of technology and R&D? Among the organizations, how many are (1) governmental organizations, (2) various business organizations (e.g. firm level suppliers, customers and other collaborations), (3)universities (4) research institutes (5) organizations from abroad, and (5) other organizations? To calculate network diversity, we used Blau [1977]'s heterogeneous index:

Network diversity = 1−Σj(pj)2 ; 1-j-5;

"Where j is the number of partner type and pj is the proportion of all the firm's collaborators that are from partner type j" [Ma et al., 2009, p. 1091].

Network strength: Network strength was measured by using seven items, 7-point Likert type scale, based upon published findings [Reagans and McEvily, 2003]. Network strength was measured using 7 items representing trust in partner's ability and capacity and willingness to sharing ideas and information with partners.

Innovation (exploration, exploitation): Innovation is measured by an eight-item scale adopted from prior research [Benner and Tushman, 2003; He and Wong, 2004; Jansen et al., 2006; Lubatkin et al., 2006]. The 8 innovation items represented 4 exploration items (e.g. new technology, market development) and 4 exploitation items (e.g. improvement existing product or process), 7-point Likert type scale that the researchers used to question the CEO.

Absorptive capacity: This study also measured absorptive capacity, based on the results of Jansen, Van Den Bosch, and Volberda [2005]'s study. Absorptive capacity was measured with a 9-item, 7-point Likert type scale that the researchers used to question the CEO. An example of the item states, "We constantly consider how to better exploit knowledge."

4. Results

4.1 Validity and Reliability of Measurements

Prior to hypotheses validation, the reliability and validity of measurement tools were tested <Table 1>. First, among the network strength items that might lower the internal consistency, two items were eliminated. Finally, internal con-

〈Table 1〉 Validity and Reliability of Measurements

Items	Factors				Cronbach's alpha
	1	2	3	4	
Exploration 1	**.847**	.012	.170	.129	.850
Exploration 2	**.808**	.105	.085	.109	
Exploration 3	**.712**	-.002	.309	-.001	
Exploration 4	**.716**	.064	.366	.005	
Exploitation 1	-.140	**.715**	.131	.169	.850
Exploitation 2	-.056	**.896**	.117	.067	
Exploitation 3	.169	**.853**	.101	-.020	
Exploitation 4	.200	**.795**	.042	.030	
N/W Strength 3	.182	.137	**.693**	.041	.865
N/W Strength 4	.187	.025	**.790**	.035	
N/W Strength 5	.119	.100	**.776**	.141	
N/W Strength 6	.391	.085	**.684**	.238	
N/W Strength 7	.143	.119	**.729**	.320	
Absorptive Capacity 1	.104	.107	.076	**.724**	.904
Absorptive Capacity 2	.056	.110	.293	**.647**	
Absorptive Capacity 3	.154	.086	.250	**.614**	
Absorptive Capacity 4	.051	.095	.121	**.765**	
Absorptive Capacity 5	.123	.058	.141	**.599**	
Absorptive Capacity 6	.097	-.081	.161	**.647**	
Absorptive Capacity 7	.095	.100	-.070	**.700**	
Absorptive Capacity 8	-.045	.091	.071	**.561**	
Absorptive Capacity 9	.163	-.110	.239	**.558**	

Factor Extraction: Principal Component Analysis.
Rotation: Varimax with Kaiser Normalization.
Factors were converged after 7 rotations.

sistency of each construct estimated with coefficients of Cronbach's alpha was ranged from 0.850 and 0.904 which surpassed the criteria for reliability acceptability [Nunnally, 1978]. Second, to evaluate the construct validity, we ran an exploratory factor analysis (EFA) using the principal component analysis with Verimax rotation for the items used. <Table 1> summarizes the results of the EFA, and demonstrates that all the factor loadings are greater than 0.5, supporting the convergent validity of the measurement [Hair et al., 1998]. This factor analysis also demonstrates discriminant validity because the factor loadings are greater than the cross-loading values [Chin, 1998].

<Table 2> contains the descriptive statistics and the correlation matrix for all the variables included in this study. The means, standard deviations, and correlations for all variables are displayed in <Table 2>.

4.2 Hypotheses Testing

In Hypothesis 1-1, we argued that the exploration innovation would increase as the level of network diversity increases. In Hypothesis 1-2, we expected that the exploitation innovation would increase as the level of network strength increases. To test these hypotheses, we analyzed the regression equations with the independent variables (network diversity and network strength), a control variable (firm age), and dependent variable (exploration innovation).

The results are presented in <Table 3>. As predicted, Model 1 showed that the network diversity has a positive effect association with exploration innovation ($\beta = .258$, $p < .001$). Additionally, Model 2 indicates that the network strength is positive and significant effect on exploitation innovation [$\beta = .340$, $p < .001$). Therefore, Hypothesis 1-1 and Hypothesis 1-2 are supported.

〈Table 2〉 Descriptive Statistics and Correlation of Variables

Variables	Mean	Std.	1	2	3	4
1. N/W Diversity	.05	.219				
2. N/W Strength	4.87	1.01	.168*			
3. Absorptive Capacity	.068	.87	.094	.377**		
4. Exploration	5.16	1.09	.284**	.425**	.251**	
5. Exploitation	4.64	1.22	.043	.322**	.209**	.136

*p < .05, **p < .01.

〈Table 3〉 Results for Hypothesis 1

Dependent variables	Exploration	Exploitation
Independent variables	Model 1	Model 2
Network Diversity	.258(3.345)***	
Network Strength		.340(4.560)***
Firm age	.083(1.065)	.082(1.100)
R^2	.080	.121
Adjusted R^2	.068	.110
F value	6.850***	10.897***

Standardized regression coefficients are reported (t values are in parentheses).
* p < .10, *p < .05, **p < .01, ***p < .001.

In Hypothesis 2, we argued that the moderating effect of the network characteristics (network diversity and network strength)-innovation relationship (exploration and exploitation) would strengthen with increases in absorptive capacity. To test this hypothesis, first we sequentially added to the regression equations the independent variables, a moderation variable, and the interaction terms between the independent and a moderation variable. The results are presented in <Table 4>. Model 1 provides the results including the main effects of network diversity and a control variable on exploration. Model 2 adds the main effect of absorptive capacity as a moderator. As predicted, absorptive capacity has a positive main-effect association with exploration (β = .222, $p < .01$). Specifically, Model 3 shows that the interaction term between network diversity and absorptive capacity (β = .176, $p < .01$) is positive and significant. Therefore, Hypothesis 2-1 is supported.

The results of Hypothesis 2-2 are presented in <Table 5>. Model 1 shows that network strength positively affects exploitation. Model 2 shows the results with the main effect of absorptive capacity as a moderator on exploitation (β = .105, $p > .1$). Finally, Model 3 shows the full model with all the two-way interaction terms entered. Our results suggest that the interaction of network strength and absorptive capacity is not significant (β = .132, $p > .1$). Therefore, Hypothesis 2-2 is not supported.

〈Table 4〉 Results for Hypothesis 2-1

	Dependent variable: Exploration		
Independent variables	Model 1	Model 2	Model 3
Network Diversity (A)	.284(3.817)***	.239(3.165)**	.264(3.512)***
Absorptive capacity (B)		.222(2.969)**	.217(2.938)**
(A)×(B)			.176(2.374)**
Firm age	.083(1.065)	.084(1.111)	.080(1.073)
R^2	.080	.129	.159
Adjusted R^2	.068	.112	.138
$\triangle R^2$	.080***	.049**	.030**
F value	6.850***	7.731***	7.379***

Standardized regression coefficients are reported (t values are in parentheses).
† p < .10, *p < .05, **p < .01, ***p < .001.

〈Table 5〉 Results for Hypothesis 2-2

	Dependent variable: Exploitation		
Independent variables	Model 1	Model 2	Model 3
Network Strength (A)	.322(4.378)***	.301(3.575)***	.277(3.418)***
Absorptive capacity (B)		.105(1.317)	.060(0.719)
(A)×(B)			.132(1.646)
Firm age	.082(1.100)	.081(1.083)	.082(1.103)
R^2	.121	.131	.147
Adjusted R^2	.110	.114	.125
$\triangle R^2$	.121	.010	.016
F value	10.897***	7.877***	6.697***

Standardized regression coefficients are reported (t values are in parentheses).
† p < .10, *p < .05, **p < .01, ***p < .001.

5. Discussion and Conclusions

The purpose of this paper was to explore the association between network characteristics (network diversity and network strength) and relationship (exploration and exploitation) by examining the role of absorptive capacity. We argued that the different network resources (network diversity and strength) have different impacts on innovation and the effect of network resources on innovation is not identical in all situations but instead is strengthened by the level of absorptive capacity. Herein we discuss the implications of our results.

Our results indicate that the association between network characteristics (network diversity and network strength) and innovation (exploration and exploitation) can be positive and significant. In specific, results confirmed that the network diversity is positively associated with exploration. Our results also suggested that the network strength is positively associated with exploitation.

With regard to the perspectives of organizational learning, we argued that absorptive capacity moderates the relationship between network resources and innovation such that the positive relationship becomes stronger as absorptive capacity increases. This argument was based on our theory that the positive aspects of network diversity in relation to exploration become stronger with increases in absorptive capacity, and also the positive aspects of network strength remain unchanged even if absorptive capacity increases. Our results provide partial support for such theorizing. We found that absorptive capacity acts as a moderator for the network diversity-exploration relationship. In contrast, we found that absorptive capacity does not moderate the network strength-exploitation relationship.

Absorptive capacity is an important factor in absorbing new knowledge and ensuring the smooth integration of the new knowledge with the existing one in the process of developing new products based on the knowledge transferred via external network [Nieto and Quevebo, 2005; Rothaermel and Alexandre, 2009]. However, the relationship between network strength and exploitation just focuses on organizations' existing knowledge and gradual innovation using the knowledge. Therefore, it can be interpreted that absorptive capacity does not moderate the network strength-exploitation relationship. Furthermore, Zahra and George [2002] noted that absorptive capacity consists of four dimensions that represent the acquisition, assimilation, transformation, and exploitation capacities that allow firms to process external knowledge. Further research is needed to divide absorptive capacity into four dimensions and to validate the moderating role of absorptive capacity between the network diversity-exploration relationship.

The results of the present study suggest some important implications for scholars and business practitioners alike. Our study provides a framework for explaining the network characteristics and innovation relationship. We also provide evidence to support our framework in which the absorptive capacity moderates the network diversity-exploration relationship in IT venture company.

The practical implications of our research are that firms need to consider the characteristics of external network when deciding on the types of innovation. For example, a firm needs to build a network with more diversity to achieve greater explorative innovation. Additionally, a firm needs to increase network strength to achieve greater exploitative innovation. Furthermore, the firm needs to enhance its absorptive capacity to strengthen the relationship between network diversity and exploration innovation.

Although care was taken to achieve rigor, this study has several limitations, which open up opportunities for future research. First, the sample of this study consists of Korean firms only. One important reason for using only Korean firms as samples was attributed to data availability. Measuring the characteristics of network requires the collection of detailed information on venture companies. Therefore, our findings cannot be generalized to venture companies in other countries because of such limitations. Future research should be directed at testing our hypotheses in countries outside Korea. A second limitation of our study concerns the measurement of absorptive capacity. We measured absorptive capacity as a variable with 9 items, while Zahra and George [2002] noted that absorptive capacity consists of four aspects including the acquisition, assimilation, transformation, and exploitation capacities. Future research should be directed at incorporating additional aspects of absorptive capacity. Third, this study used cross-sectional data in testing for the study framework. Although the results are in line with our theoretical expectation, a future study with longitudinal data may validate the results of our study.

This study aims to contribute to the literature by examining the important roles of absorptive capacity in determining the characteristics of network-the type of innovation relationship. We hope that our findings open up productive new paths for future research on the characteristics of network and organizational innovation.

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