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Influence of the Strategic Resources and Community Engineering on R&D Performance

전략적 자원과 공동체공학이 연구성과에 미치는 영향

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목 차

ABSTRACT

Korea is characterized by a high R&D expenditure rate to the GDP. The performance of R&D in Korea, however, hardly seems to be satisfied. The purpose of this study is to investigate the influence of strategic resources and community engineering on R&D performance in bio-tech industry in Korea. The results of the study show strategic resources and community engineering are determinants of technological outcome. The strategic resources have a significant positive effect on economic impact whereas community engineering has no significant effect. In addition, the study results reveal that there is no moderating effect of strategic resources on the relation between community engineering and R&D performance. The major limitations of the study are on the measure of the variables.

Key Words : Strategic resources, Community engineering, R&D performance, Bio-tech industry

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국 문 요 약

우리나라는 GDP 대비 R&D투입율이 세계최고의 수준에 있으나 성과는 이에 비해 저조한 실정이다. 본 연구의 목적은 국내 바이오산업에서 전략적 자원과 공동체 공학(community engineering)이 R&D 성과에 미치는 영향을 분석하는 것이다. 본 연구에서는 성과를 기술적 성과와 경제적 성과로 구분하였으며 조사 분석 결과 전략적 자원과 공동체 공학은 기술적 성과의 결정변수로 나타났으나 경제적 성과에 대해서는 전략적 자원만이 통계적으로 유의미한 영향을 미치는 것으로 나타났다. 또한 전략적 자원이 공동체 공학과 연구 성과 간의 관계에 대한 조절효과를 나타내지 못하는 것으로 나타났다.

핵심어 : 전략적 자원, 공동체 공학, 연구성과, 바이오기술산업

I. Introduction

It is well known that R&D has been assumed a key functional role in many firms. Innovation in the high-tech industries in particular receives wide recognition of its important contribution to the economy (Drucker, 1985; Hayton, 2005). However, innovation can be regarded as an important determinant of competitiveness as well as wealth creation, only if the new products can be brought to market and successfully overcome the inevitable barriers to the market (Kim and Mauborgne, 2000; McDonald, Corkindale and Sharp, 2003). In fact, successful technology commercialization is crucial for the survival of firms.

Korea is characterized by a high R&D expenditure rate to the GDP. New government plans to strengthen the R&D intensity, which signifies that more and more Korean firms and government are well aware of the value of innovation. However, the performance of R&D in Korea hardly seems to be satisfied. In fact, the innovation impact is low in comparison with OECD economies. It is an important issue for Korea to justify the high R&D expenses.

An emerging body of recent literature on the firm's performance suggests that strong strategic resources and open innovations system are determinants of firms performance (Widener and Sally. K, 2005; Crook et al., 2008; Chesbrough, 2003; Chiaroni et al., 2009). In this context, this study aims to investigate in Korea (1) whether there is a significant association between strategic resources and R&D performances and (2) whether there is a significant association between community engineering, which is relatively new aspect of open innovation and R&D performances. In addition, this study aims to investigate (3) whether strategic resources moderate the relationship between community engineering and R&D performances.

This study is conducted in the bio industry on which innovation theories and application of studies are relatively rare. Researchers (Baker, 2003; Baker, 2004; Fuchs and Krauss, 2003) have argued that bio firms are unique for at least three reasons. First, they are strongly science based, more nimble, and less risk averse than pharmaceutical companies, and innovation within these firms are far more radical than in other industries (Gans and Stern, 2004; Powell, Koput and Smith-Doerr, 1996). Second, bio technology companies represent tacit knowledge. The generation and economic exploitation of knowledge thus requires intense science-based interactions (Fuchs and Krauss, 2003). Alliances with other bio tech firms, university research centers are considered as a norm in the industry. Finally, the timeline between establishing the company and return is long. On average, the entire biotech process, from scientific discovery to commercialization can take up to 15 years (MdBio, 2003).

II. Strategic Resources, Community Engineering and Performances

According to Crook et al., (2008), over the last two decades, resource-based theory has emerged as a very popular theoretical perspective for explaining performance (Newbert, 2007; Crook et at., 2008). A series of studies have sought to link strategic resources and performance, and Crook et al. (2008) found out the fact that organization's performance is enhanced to the extent that they posses strategic resource. Their study was based on a meta analysis, and the result was very robust. Such result could be applied to the research firms in the domain of bio technology in Korea. In that case, the so-called RBT(Resource Based Theory), which is still evolving as a theory could be more clearly defined as a key factor of performance.

The strategic resources include innovative resources, reputational resources, unique knowledge, organization resource and social responsibility (Crook et al., 2008). Among them the present article chose the first two facets considering the domain of the study, i.e. R&D performances in the bio tech firms. A research examining the relationship between the innovation resources and reputational resources, and the market and financial performance of organization found support for that relationship.

Ebner et al. (2009) developed an integrated framework called Community Engineering for Innovation, based on a literature review in the field of community building and innovation management. Their study is the first to present an integrated concept for IT -supported idea competitions in virtual communities for leveraging the potential of crowds that is evaluated in a real world setting. In order to understand the relationship between innovation and community, they adopt the stage model of innovation (Ebner et al., 2005). The studies in this field recommend more research attention to understand and to transfer this concept to the innovation communities is started as one of the most promising concept for the future.

In bio tech industry, the way to attract outside collaborations is very important. Since most small bio tech companies do not possess all the necessary competencies, an integrated innovation with alliance with other bio tech firms, university research centers would be a good strategy. We propose a hypothesis on the positive correlation between community engineering and R&D performance as follows,

H1 : Competitively superior strategic resources are positively related to the R&D performance

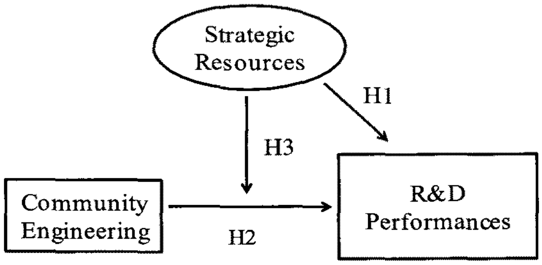
H2 : Community engineering is positively related to the R&D performance.

According to Surowiecki(2005), large group of people are smarter than an elite few, no matter how brilliant, better at solving problems, fostering innovation. Community engineering is currently one of the most discussed key words within the open innovation community (Ebner et al., 2009). The major question for both research and business is how to find and lever the enormous potential of the collective brain to broaden the scope of open R&D.

Despite open innovation has raised huge interest by many scholars and practitioners, further investigation is needed (Chiaroni et al., 2009). In particular, two issues are acknowledge as open challenges (Gassmann, 2006) ; (1) to investigate the relevance of open innovation as a new paradigm beyond high-tech industries and (2) studying how firms can implement open innovation in practice. Whereas the paradigm open innovation is already well-known, a new approach has emerged with the phrase 'Crowd sourcing'. This phenomenon is described as everyday people using their spare cycles to create content, solve problems, even do corporate R&D (Howe, 2006), which implies the integration of customers as one of the biggest resources for external innovations (Grassmann, 2006; Wagner and Prasarnphanich, 2007 ; Ebner, 2009).

In addition, in spite of the lack of prior research, it appears that the influence of community engineering on the R&D performance is moderated by the strategic resources. In other words, the firm which has more strategic resources, reputation or innovation has more chance to strengthen the R&D performance by external collaboration activities. Accordingly we hypothesize as follows:

H3 : Strategic resources moderate the relation between the community engineering and R&D performance.



(Figure 1) Conceptual Model

III. Method

3.1 Sample and Data Collection

To test these hypotheses, a questionnaire-survey approach was adopted for data collection. A sample frame was provided by Korea Health Industry Development Institute. These companies are beneficiaries of government R&D support program in the field of health. Research population was about 1,000 people and a total of 800 enterprises were approached by e-mail. 150 companies replied in the survey, which were executed by e-mail. The survey was conducted from Dec. 4 till 21 2009.

3.2 Measurement

R&D performance, the dependent variable, was based on prior researches. 5 point scale was developed to two types of performance. The first group was on the technological outcome, made up of improvement of technology and product quality, enhancement of retraining of technicians, contribution for the export, employment and import substitution (6 items). The second one was on the economic impact, such as royalty, saving of royalty, export of technology, new employment and sales of the recent 3 years (5 items). Among the independent variables, strategic resources were composed of the reputational resource and innovation resources (Snoj, 2007). The former was made up of two questions of 5 scales; 1) company or brand name and reputation, and 2) credibility with customer through being well established in the market. The latter also consisted of two questions of 5 scales 1) ability to launch successful new product and services, 2) effective new product and service development processes. Community engineering, the other independaent variable, was composed of four questions including cooperation with other research institutes to solve the problems, doing a collaborative research in the process of development, solicitation of help from outside and utilization of virtual community regarding the biology research.

IV. Analysis and Results

4.1 Data Analysis

Hierarchical regression technique was used to analyze data. Two variables, organizational age and institution in charge, were used as control variables. Institution in charge was converted into a dummy variable so that firm/association had a value of one and university/research institute had a value of zero. Hierarchical regressions were conducted through three stages. At stage 1, each of the two dependent variables, technological outcome and economic impact, was regressed on two control variables, organizational age and institution in charge. At stage 2, in addition to the two control variables, two independent variables, strategic resources and community engineering, were entered into the regression equations. At stage 3, an interaction term between strategic resources and community engineering was added the regression equations in order to test the moderating effect of strategic resources. To avoid the multicollinearity problem, all the theoretical variables were standardized so that they had a mean of zero and a standard deviation of one and the interaction term was created using the standardized variables.

Exploratory factor analysis was used to assess the validity of the measures. Separate factor analyses were undertaken for independent and dependent variables. The exploratory factor analyses employed principal axis factoring methods of extraction where Varimax rotations were used to determine the factor structure. As shown in Tables 1, four items from the measure of strategic resources (SR1 to SR4) and three items from the measure of community engineering (CE1 to CE3) factor together respectively with factor loading greater than .40. As Tables 2 and 3 indicate, items of the technological outcome measure and the items of the economic impact measure factor together with factor loadings greater than .40. These results show that the measures used in this study have satisfactory validity.

Descriptive statistics and reliability estimates for the measures used in this study are presented in Table 4. As Table 4 shows, Cronbach's alphas for the measures used in this study are all above .70, which is a satisfactory level of reliability.

〈Table 1〉 Factor Analysis Results for the Measures of Two Independent Variables

Item	Factor 1	Factor 2
SR1	.842	
SR2	.886	
SR3	.805	
SR4	.799	
CE1		.825
CE2		.895
CE3		.772
Eigen value	3.561	1.537
% of Variance	41.178	31.664
Cumulative % of Variance	41.178	72.841

〈Table 2〉 Factor Analysis Results for the Measure of Technological Outcome

Item	Factor 1
TO1	.418
TO2	.605
TO3	.532
TO4	.805
TO5	.769
TO6	.777
Eigen value	2.667
% of Variance	44.451

〈Table 3〉 Factor Analysis Results for the Measure of Economic Impact

Item	Factor 1
EI1	.815
EI2	.916
EI3	.906
EI4	.708
EI5	.899
Eigen value	3.633
% of Variance	72.662

〈Table 4〉 Descriptive Statistics and Reliability of Measures

	# of Items	Range	Mean	SD	Cronbach's α
Strategic Resources	4	1~5	3.52	.96	.87
Community Engineering	3	1~5	3.44	.93	.80
Technological Outcome	6	1~5	3.04	.69	.75
Economic Impact	5	1~5	2.69	1.01	.90

4.2 Results

(1) Correlation Analyses

Zero-order correlations among the variables included in the analysis are presented in Table 4. As shown in Table 4, two independent variables, strategic resources and community engineering are all positively correlated with two dependent variables, technological outcome and economic impact. With regard to the two control variables, organizational age is negatively associated with the two dependent variables, technological outcome and economic impact, whereas institution in charge is positively correlated with them.

〈Table 5〉 Correlations among Variables

	1	2	3	4	5
1. Organizational Age					
2. Institution in Charge[1)]	-.468**				
3. Strategic Resources	-.141	.390**			
4. Community Engineering	-.139	.279**	.380**		
5. Technological Outcome	-.176*	.490**	.443**	.347**	
6. Economic Impact	-.263**	.389**	.363**	.200**	.575**

1) firm/association=1, university/research institute=0

* p 〈.05, ** p 〈.01(two-tailed)

(2) Regression Analyses

Regression analysis results are shown in Table 5. First, consider the results for technological outcome. M1a indicates that institution in charge has a significant positive effect on technological outcome and the variance of technological outcome is explained by 23.0% in terms of adjusted R^2. As M1b shows, two independent variables, strategic resources and community engineering, positively affect technological outcome and additionally explain the variance of technological outcome by 7.6% in terms of adjusted R^2. As M1c demonstrates, an interaction term between strategic resources and community engineering does not have a significant effect on technological outcome, which means that strategic resources does not moderate the effect of community engineering on technological outcome.

Next, consider the results for economic impact. As presented in M2a, institution in charge has a significant positive effect on economic impact and the variance of economic impact is explained by 15.7% in terms of adjusted R^2. M2b shows that the addition of the two independent variables increases the explained variance 4.4% in terms of adjusted $R^2$and that strategic resources has a significant positive effect on economic impact, where as community engineering has no significant effect. As M2c indicates, an interaction term between strategic resources and community engineering does not have a significant effect on economic impact, which means that strategic resources does not moderate the effect of community engineering on economic impact.

〈Table 6〉 Regression Analysis Results

	Dep.= Technological Outcome			Dep.= Economic Impact		
	M1a	M1b	M1c	M2a	M2b	M2c
Organizational Age	.066	.055	.037	-.099	-.113	-.109
Institution in Charge[1]	.516**	.378**	.355**	.352**	.245**	.251**
Strategic Resources		.227**	.275**		.251**	.239**
Community Engineering		.153*	.164*		-.001	-.004
SR*CE			.120			-.029
R^2(Adj.R^2)	.239** (.230)	.321** (.306)	.333** (.315)	.166** (.157)	.219** (.201)	.220** (.197)
ΔR^2(Adj.ΔR^2)	.239** (.230)	.082** (.076)	.012 (.009)	.166** (.157)	.053** (.044)	.001 (-.004)

Note: Figures presented in the above table are standardized regression coefficients.
1) firm/association=1, university/research institute=0
* p 〈.05, ** p 〈.01(two-tailed)

V. Conclusion and Discussion

5.1 Major Research Results and Implications

The major findings of this study are as follows ; First, this study examined the effects of strategic resources and community engineering on R&D performance. The results of the study show that there are positive relationship between strategic resources and community engineering, and technological outcome. In addition, strategic resources have a significant positive effect on economic impact whereas community engineering has no significant effect. Second, the study results reveal that there is no moderating effect of strategic resources on the relation between community engineering and R&D performance.

〈Table 7〉 Major Research Results

	Ind. Var.	Dep. Var.	result
H1	Strategic resources	Tech. outcome Economic impact	O O
H2	Community engineering	Tech. outcome Economic impact	O X
H3	Moderatingn effect of strategic Resource on the relation between the community engineering and performance		X

This study extended the current literature in several ways. First this study confirms that strategic resources are important determinant of R&D performances. Previous studies have linked strategic resources to financial performance and in the overall business context. This study is applied to the biotech firms which are known as the sources of innovation. Strategic resources, especially innovation and reputational resources are becoming increasingly important to firms as drivers of their competitive advantage. Second, the findings show that firms community engineering is a promising approach for R&D activities, in particular in the aspect of technological outcome. As a more precise form of open innovation, community engineering seems to be an effective interaction with other peer in the community, by on-line or off-line, from idea generation to the commercialization. Third, the biotech industry is well known for its operation amid uncertainty and rapid change. It faces an increasing cost of R&D, global competition, and lack of critical mass which interferes with the benefits of the economies of scale(Shaista et al., 2006).

In Korea, in particular, many biotech firms suffer from commercialization lead time and lack of marketing knowledge. An intense interaction and strategic resources could be a good way of effective solution of this problem. The results of the study reveal that strategic resources do not have a significant effect on economic impact. As presented early in this article, the entire biotech process, on average, is very long and economic impact seems to appear very late. It is assumed to be a cause of the lack of significant correlation.

5.2 Limitations

One limitation is that not all strategic resources measures were used in this study. In view of the biotech R&D, this study investigated two types of strategic resources – innovation resources and reputation resources. In this regards, correction should be made in generalizing the results. Second limitation is that the measurement of the community engineering have not yet been established in the previous studies, for which this study could not but adopt several definition of the prior studies. As far as we know, there is no solid definition either. This point adds the necessity of the future study on this topic. Third limitation is that the study primarily used self-administered survey data, which could cause a failure of respondent control.

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서상혁

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