Promoting Uncertain Exploration: A Case Study

ABSTRACT

This study empirically explored what promotes exploration, through a case analysis of a Korean SME (small and medium sized enterprise), based on the research framework which focuses on the identification and the selection of exploratory NPD (new product development) alternatives, and the accumulation of novel capabilities in new technology domains. The learning process of the exploratory NPD project described is as follows. The identification barrier of exploratory NPD project is relatively low. Constructive crisis is germane to selecting exploratory NPD alternatives and to enduring the long payback period. New separated R&D unit is likely to implement the exploratory NPD project. The length of the gestation period of the exploratory NPD project is related with the level of the conflict between old members and new members. This study identified several antecedents of the exploratory NPD project. Prior success promotes the identification process of the exploratory NPD projects. Constructive crisis is related with CEO’s personal characteristics such as future oriented and proactive personality. The proactive involvement and persuasion of CEO are germane to reducing the conflict between old and new members and to the success of the exploratory NPD project. Based on the results, this study discusses several implications and future research directions.

Keywords: SMEs, Exploration, Exploitation, Success Trap, Core Rigidity

1. Introduction

Recently many researchers have shown considerable interests in how and why firms build up new kinds of technological capabilities in regimes of rapid and unpredictable change (Eisenhardt and Martin, 2000; Teece et al., 1997). Due to discontinuous technical changes in the environment, prior technological capabilities of incumbent firms may become meaningless or unnecessary, and they may lose their competitive advantages (Utterback, 1994; Tushman and Anderson, 1986). Therefore, the firms must endeavor to build up novel technological capabilities in new technology domains that will be newly demanded in future environment. However, they have difficulties to learn novel capabilities or uncertainties to achieve the commercial successes based on the novel capabilities (Leonard-Barton, 1992; Henderson and Clark, 1990).

Many small and medium-sized enterprises (hereinafter, SMEs) in Korea have experienced similar problems.
Korean SMEs have had to seek new business opportunities, especially through technological learning (Kim and Lee, 2002; Kim, 1997a) because they have lost cost competitiveness in many of their products due to the emergence of Chinese firms. The first option is to seek new opportunities that utilize and expand their existing technologies such as the development of new but technically familiar products and/or the transfer of production facilities to cost-competitive countries such as China and South-East Asian countries. It is relatively easy to implement. However, it is limited to get back or safeguard competitive advantages of the SMEs in the long-term. The second option is to seek new opportunities that build up new kinds of technological capabilities. It is difficult to implement because it requires a departure from the focal firm’s current repository of technological knowledge. On the other hand, it is likely to create or sustain competitive advantages of the SMEs in the long-term because of synergy between new and old technologies (He and Wong, 2004).

To deal with this kind of dilemma, March (1991) presents the concepts of *exploitation* and *exploration*, and conjectures that they are two learning patterns where there exists a trade-off between the short-term certainty of the return at the project level and the long-term potential of the return at the firm level. They clearly express the dilemma between long-term and short-term oriented decisions that exists in strategic management.

A few studies empirically demonstrate how to promote the exploration necessary for the long-term adjustment of the firm (McGrath, 2001; Sorensen and Stuart, 2000; Benner and Tushman, 2002; Gibson and Birkinshaw, 2004; Jansen et al., 2005). These deal with various kinds of antecedents of the exploration such as goal and managerial autonomy, age of firm, process management, organizational context, and environmental and organizational antecedents. However, they don’t have a coherent framework of the antecedents and hardly describe the learning process of the exploration. O’Reilly and Tushman (2004) exceptionally show how the exploration of the ambidextrous organization works based on the case descriptions.

This study endeavors to describe the learning process of the exploration specifically and to identify the antecedents that promote the exploration on the basis of a systematic framework. Especially, this study deals with the issues from the perspective of overcoming the difficulties of the exploration such as success trap and core rigidity (Levinthal and March, 1993; Leonard-Barton, 1992). They mention the difficulties of the identification and selection of exploratory alternatives, and the difficulties to build up novel capabilities in new technology domains (Kim and Ha, 2004). This study also focuses on the new product development (hereinafter NPD) setting, since product development provides a powerful window through which to study the challenge of creating new knowledge and capturing it in the firm’s capabilities (Iansiti and Clark, 1994; Helfat and Raubitschek, 2000; Danneels, 2002). The following research questions are derived.

1. How does firm identify and select exploratory NPD alternatives?
2. How does firm promote the accumulation of novel knowledge in exploratory NPD projects?

This study approaches to describe the learning process of the exploratory NPD project and to identify the antecedents of the exploratory NPD project through an exploratory case analysis of a Korean SME, since researches on this topic are still at its initial stage (Benner and Tushman, 2002; McGrath, 2001; Jansen
et al., 2005), and Korean SME can provide a good empirical setting for the topic. In addition, it is easy to analyze the technological learning of a SME since its products and markets and its capabilities are relatively simple.

In addressing the aforementioned, Section 2 reviews the concepts of exploitation and exploration, the three difficulties of exploration, and the remedies to promote exploration. Section 3 addresses the procedure and methodology of this case study. Section 4 presents the brief history of a case firm ‘company A’ and the analysis results about it and its NPD projects. Section 5 summarizes the findings from the results and discusses the implications and directions for future research.

II. Literature

2.1 Trade off between Exploitation and Exploration

Technological learning pattern of the NPD project can be classified into exploitation, which is the refinement or extension of existing technologies that a firm currently possesses, and exploration, which is the experimentation with novel technologies that a firm does not possess currently (March, 1991; Danneels, 2002; Jovanovic and Rob, 1990). March (1991) conjectures that “compared to returns from exploitation, returns from exploration are systematically less certain, more remote in time, and organizationally more distant from the locus of action and adaption.”

The results of exploitation are easy to predict, and little time is consumed because exploitation makes use of currently held technologies. In terms of the distribution of the return at the NPD project level, the average is a small positive number, and the variance is tiny. An indirect impact of exploitation on the return at the firm level is very small or almost negligible.

On the other hand, the results of exploration are difficult to predict, and much time is consumed because exploration experiments with novel technologies. In terms of the distribution of the return at the NPD project level, the variance is large, and the average can differ considerably in accordance with the potential of the novel technology. Moreover, an indirect impact of exploration on the return at the firm level may be more important than its direct impact at the NPD project level.

To summarise, in terms of its impact on firm performance, exploitation and exploration are two technological learning patterns where there exists a trade-off between the short-term certainty of project success or performance improvement at the NPD project level and the long-term potential to enhance firm performance dramatically at the firm level (Kim and Ha, 2004).

2.2 How to Promote Exploration?

The uncertainty or difficulty of exploration can be explained by the concepts of success trap (Levinthal and March, 1993) and core rigidities (Leonard-Barton, 1992). The former focuses on the difficulties of the identification and selection of exploratory NPD alternatives, and the latter focuses on the difficulties to build up novel capabilities in new technology domains (Kim and Ha, 2004). <Table 1> summarizes these logics prior researches have suggested. First, firms may not be able to recognize or identify exploratory NPD alternatives that are based on novel capabilities because existing core capabilities serve as the window by which firms enact the environment in their search process (Cohen and Levinthal, 1990; Henderson and Clark, 1990; Levinthal and March, 1993). This can be explained with a mental model, which is defined as
“the concepts and relationships individuals, groups or firms use to understand various situations or environments” (Barr et al., 1992). The firm tends to enact reality with the mental model extracted from the past experience because a firm is limited in its information processing capacity (Simon, 1955; Barr, 1998).

Therefore, the firm may neglect or wrongly interpret external information unfamiliar to existing core capabilities and fail to identify exploratory NPD alternatives (Barr, 1998; Cohen and Levinthal, 1990; Ahuja and Lampert, 2001). For instance, the incumbent bag makers are more likely to identify new business alternatives involving bags for notebooks and mobile phones rather than ones involving the information technology (hereafter, IT) itself during the IT boom.

Second, even when firms identify exploratory NPD alternatives, they are unlikely to select them because of high short-term uncertainty (Levinthal and March, 1993; March, 1991; Christensen, 1997; Ahuja and Lampert, 2001). Moreover, managers prefer exploitative NPD alternatives to exploratory NPD alternatives especially when their turnover rate is rapid, when their aspiration level is low, or when network externality exists (Levinthal and March, 1993; March, 1991; Lee et al., 2003).

Third, even when firms select exploratory NPD alternatives, their existing core capabilities such as knowledge base, value, technical and management system may prevent them from building up novel capabilities (Leonard-Barton, 1992; Cohen and Levinthal, 1990; Henderson and Clark, 1990). According to Leonard-Barton (1992), managers may neglect their role in temporary units, which are charged to build up novel capabilities, because their priority is given to permanent organization units with the associated career paths. Various technical systems outdated or tailored to existing core capabilities may be inappropriate for building up novel capabilities. Because managers of non-dominant disciplines charged with unaligned projects (i.e. exploratory projects) have a lower competence level and status than those of dominant disciplines of the firm, the former may not work well to succeed the exploratory NPD projects.

Further, several researchers have proposed the following remedies for the difficulties of exploration (Kim and Ha, 2004). First, to identify exploratory NPD alternatives, firms need to adopt new perspective from the outside through unusual experiences (Barr, 1998; Kuwada, 1998). Specific measures include the slow socialization of new entrant members, the moderate turnover rate of members, more open organizational environments, cross-functional teams, and the development of heuristics and insights to define exploratory NPD alternatives (March, 1991; Henderson and Clark, 1990; Ahuja and Lampert, 2001).

Second, to select exploratory NPD alternatives, managers must be prepared to accept the uncertainty (Levinthal and March, 1993; Christensen, 1997). Specific measures include the upward adjustment of aspiration level, the high compensation for the success, and the high leniency for the stretched failure (Levinthal and March, 1993; March, 1991; Winter, 2000; Gersick, 1991; Daft and Weick, 1984). Managers have incentives to select uncertain NPD alternatives when their goals are much higher than the current performance level of the firm. Kim (1998; 1997b) calls this a constructive crisis, and argues that it had motivated Hyundai Motor and Samsung Electronics to accumulate technological capabilities and to catch up their global competitors in the automobile and semiconductor industries respectively. Constructive crisis can be defined as a performance gap that manager intentionally create when its current performance is good (Kim, 1998).
<table>
<thead>
<tr>
<th>Author</th>
<th>Identification barrier</th>
<th>Selection barrier</th>
<th>Capability accumulation barrier</th>
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</thead>
<tbody>
<tr>
<td>Cohen and Levinthal (1990)</td>
<td>Expectation formation: permitting the firm to predict more accurately the nature and commercial potential of technological advances</td>
<td>Returns from exploration are systematically less certain, more remote in time, and organizationally more distant from the locus of action and adoption.</td>
<td>Cumulativeness: By having already developed some absorptive capacity in a particular area, a firm may more readily accumulate what additional knowledge it needs in the subsequent periods.</td>
</tr>
<tr>
<td>March (1991)</td>
<td></td>
<td></td>
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<tr>
<td>Levinthal and March (1993)</td>
<td>Organizations use two major mechanisms to facilitate learning from experience. By simplifying experience and specializing adaptive responses, learning improves organizational performance, on average. The same mechanisms of learning also lead to limits to those improvements: (1) the tendency to ignore the long run. (2) the tendency to ignore the large picture. (3) the tendency to overlook failures. Particularly with rapid rates of turnover of decision makers, the uncertain and distant returns associated with exploration are likely to have a high discount rate associated with them.</td>
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Easily outdated technical system
No associated career path
Lower status for non-dominant disciplines: Pygmalion effect |
| Henderson and Clark (1990) | Information that might warn the organization that a particular innovation is architectural may be screened out by the information filters and communication channels that embody old architectural knowledge | The organization may be tempted to modify the channels, filters, and strategies that already exist rather than to incur the significant fixed costs and considerable organizational friction required to build new sets from scratch. | It is handicapped in its attempts to do this, both by the difficulty all organizations experience in switching from one mode of learning to another and by the fact that it must build new architectural knowledge in a context in which some of its old architectural knowledge may be relevant. |
| Christensen (1997) | | If a company stretches or forces a disruptive technology to unfill the needs of current, mainstream customers, it is almost sure to fail. | |
Third, to promote the capability accumulation of exploratory NPD projects, firms need to realign its human resources, and technical and managerial systems, and to prevent existing core capabilities from acting as core rigidities (Leonard-Barton, 1992; Henderson and Clark, 1990). Human resource realignment includes firing people who inhibit the exploratory NPD projects, and hiring renowned people in new knowledge domains. System realignment includes designing the associated career path or compensation scheme for exploratory NPD projects, and setting up separated subunits to secure task autonomy and to protect the team from the previous dominant disciplines (McGrath, 2001; Henderson and Clark, 1990).

A few studies empirically demonstrate how to promote the exploration necessary for the long-term adaptation of the firm (McGrath, 2001; Sorensen and Stuart, 2000; Benner and Tushman, 2002; Gibson and Birkinshaw, 2004; Jansen et al., 2005). These deal with various kinds of antecedents of the exploration such as goal and managerial autonomy, age of firm, process management, organizational context, and environmental and organizational antecedents. However, they don’t have a coherent framework of the antecedents and hardly describe the learning process of the exploration. O’Reilly and Tushman (2004) exceptionally show how the exploration of the ambidextrous organization works based on the case descriptions.

This study attempts to describe the learning process of the exploratory NPD project specifically and to derive the antecedents that remove the difficulties of the exploratory NPD project and promote the exploratory NPD project on the basis of a systematic framework. This study endeavors to describe whether the three difficulties of the exploratory NPD project actually exist, to describe how the learning process of the exploratory NPD project works, and to identify the antecedents of the exploratory NPD project.

2.3 Research Framework

Based on the literature, the research framework is presented in [Figure 1] This framework encompasses the learning process of the exploratory NPD project. Firm can promote exploratory NPD projects by adopting new perspective from the outside, by inducing
managers to accept an uncertainty, and by realigning the firm (Kuwada, 1998; Levinthal and March, 1993; Leonard-Baron, 1992). This study investigates the process of alternative identification of the firm since prior studies emphasize the role of external agencies to identify exploratory NPD alternatives (March, 1991; Kuwada, 1998; Kim and Ha, 2004). This study also investigates the selection process of the NPD alternatives since stakeholders are likely to oppose the selection of the exploratory NPD alternatives if and when they are uncertain (March, 1991; Henderson and Clark, 1990; Kim and Ha, 2004). Furthermore, this study investigates the implementation process of the exploratory NPD projects in order to analyze capability accumulation process (Henderson and Clark, 1990; Kim and Ha, 2004).

This framework also encompasses the antecedents that remove the difficulties and promote exploratory NPD projects. This study focuses on the factors related with the past history of the firm and the characteristics of its CEO (Kim and Ha, 2004; Sorenson and Stuart, 2000; Leonard-Baron, 1992).

III. Methods

This study approaches the issue through an exploratory case analysis of a Korean SME since researches on this topic are still at its initial stage (Benner and Tushman, 2002; McGrath, 2001; Jansen et al., 2005). Case study method is useful to derive new relationships or patterns, since it allows the researcher to use open interviewing techniques and to lead informants to express their own ideas freely independent of the researcher’s preconceived expectations (Adams et al., 1998). Korean SME can provide a good empirical setting for the topic. It must endeavor to build up novel technological capabilities in new technology domains that will be newly demanded in future environment. Especially, this study analyzed an SME that had transformed into a technology-intensive firm, since I conjecture that it is more likely to learn novel capabilities in new technology domains than the firm with the marginal technical change is. Moreover, it is easy to analyze the technical changes of an SME since its products and markets, and capabilities are relatively simple.

I selected a firm that satisfied the following criteria: the firm, founded without distinctive technological capabilities, had won technology-related awards. I investigated the firm by searching a variety of information sources. These sources included the homepage of the firm itself, credit information providers, Financial Supervisory Service (FSS), Korea Industrial Property Rights Information Service (KIPRIS), and industry associations. I completed the brief history and interview questions for the firm, and selected key people as informants.

I interviewed managers and industry experts. All four interviewees held positions equal to or higher than the department head. The brief history and interview questions of the firm were handed to the interviewees for their preview. The interviews lasted for 1-2 hours per informant. They also provided objective data on its intellectual property rights, external linkages, and financial statements additionally. In order to validate the data, I compared managers’ statements with the objective data collected whether they had discrepancies (Yin, 1989). I then developed the manuscript on the history of a case SME and its NPD activities. The interviewees reviewed the manuscript and corrected the contents of the manuscript.

Recent studies choose product changes or NPD projects as their units of analysis to analyze the knowledge learning of the firm, because of a duality between
firm’s knowledge learning and product innovations (Hargadon and Fanelli, 2002; Danneels, 2002; Helfat and Raubitschek, 2000; Iansiti and Clark, 1994). This duality means that the firm undertakes product innovations on the basis of their existing knowledge and, in turn, learns new knowledge from the experience of product innovations. Product change can be defined as a change of product generation that consists of various product models with similar technological and market characteristics (Helfat and Raubitschek, 2000).

Exploratory NPD project is operationalized as the NPD project which involves novel technologies of new technology domain in which a firm has not done any technological activities until the time (March, 1991; Danneels, 2002). This means that the exploratory NPD project is new to the firm, rather than new to the industry. The exploratory NPD project also may encompass old technologies which the firm already has. The main operationalization issue is to classify the technology domains. In classifying the relevant technology domains and evaluating the learning patterns of NPD projects, this study relied on the subjective judgment of the experts involved (Tushman and Anderson, 1986; Anderson and Tushman, 1990; Leonard-Barton, 1992). Experts’ judgment cannot be seen as inferior, since it bases on the expertise of the relevant industry and firms, and the objective classification of technology domain such as international patent classification (IPC) code often may not reflect the reality of the field.

IV. Analysis and Findings

4.1 Brief History of Company A

Company A is a large telecommunication parts and equipments maker and its main products are antennas, RF (radio frequency) parts, and equipments for mobile communication systems. <Table 2> shows the change of financial performances of company A from 1991 to 2005. The firm only has valid financial data from 1991, in which it became a juridical person. It is divided into two companies, an antenna company and an equipment company in 2006. Its sales volume is 153.9 billion Korean won and IBIT (income before income tax) is 9.5 billion Korean won in 2005. Company A is also a technology-intensive firm even though it was founded as a trading firm. The number of total employees is 594 and the employees of R&D unit occupy 154 persons (25.9%) in 2005. The number of granted patents is 86 in 2005.

<Table 2> summarizes the brief historical events of company A. Company A was founded as a trading company in 1980 by President Koo. He majored in electronic engineering at the university, but gave up

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</thead>
<tbody>
<tr>
<td><strong>Total Assets</strong></td>
<td>3.9</td>
<td>5.3</td>
<td>6.7</td>
<td>9.9</td>
<td>14.8</td>
<td>24.9</td>
<td>50.1</td>
<td>76.0</td>
</tr>
<tr>
<td>Sales</td>
<td>3.9</td>
<td>5.4</td>
<td>6.0</td>
<td>11.4</td>
<td>16.1</td>
<td>20.1</td>
<td>79.6</td>
<td>39.3</td>
</tr>
<tr>
<td>IBIT</td>
<td>0.1</td>
<td>0.2</td>
<td>3.4</td>
<td>9.6</td>
<td>1.1</td>
<td>0.7</td>
<td>9.8</td>
<td>4.4</td>
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</thead>
<tbody>
<tr>
<td><strong>Total Assets</strong></td>
<td>121.3</td>
<td>124.2</td>
<td>122.9</td>
<td>131.6</td>
<td>131.7</td>
<td>126.4</td>
<td>140.8</td>
<td>155.7</td>
</tr>
<tr>
<td>Sales</td>
<td>89.6</td>
<td>101.5</td>
<td>80.5</td>
<td>115.4</td>
<td>148.9</td>
<td>166.4</td>
<td>153.9</td>
<td>163.8</td>
</tr>
<tr>
<td>IBIT</td>
<td>23.5</td>
<td>11.7</td>
<td>1.9</td>
<td>0.2</td>
<td>4.0</td>
<td>9.1</td>
<td>9.5</td>
<td>12.1</td>
</tr>
</tbody>
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Note: IBIT (income before income tax).
### Table 3: Brief Historical Events of Company A

<table>
<thead>
<tr>
<th>Year</th>
<th>Historical Event of Company A</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>Foundation as a trading company</td>
<td>Hoisters, Antenna for car audio system and color TV</td>
</tr>
<tr>
<td>1983</td>
<td>Import substitution of antenna for car audio system</td>
<td>Commercial failure</td>
</tr>
<tr>
<td>1984</td>
<td>Import of antenna for car phone</td>
<td>From Japan</td>
</tr>
<tr>
<td>1985</td>
<td>Import substitution of antenna for car phone</td>
<td>Commercial success Suppling relationships with the major electronics companies such as Samsung</td>
</tr>
<tr>
<td>1987</td>
<td>Development of antenna for codeless phone</td>
<td>Building up the partnership with ETRI, government backed research institute</td>
</tr>
<tr>
<td>Late 1980s</td>
<td></td>
<td>Challenge of Chinese entrants</td>
</tr>
<tr>
<td>1990</td>
<td>Installation of R&amp;D unit Exploration</td>
<td>Three platform technologies: Antenna, RF parts, RF equipment</td>
</tr>
<tr>
<td>1992</td>
<td>Development of combiners for paging system</td>
<td>First commercial success from three platform technologies</td>
</tr>
<tr>
<td>1996</td>
<td>Jangyounsil Award</td>
<td>Honorable national R&amp;D award Advanced model of combiners for paging system</td>
</tr>
<tr>
<td>1997</td>
<td>Development of combiners for CDMA mobile communication system</td>
<td>Partnership with ETRI</td>
</tr>
<tr>
<td>2001</td>
<td>Development of TMA (tower mounted amplifier)</td>
<td>Partnership with Ericsson (new kind of customer)</td>
</tr>
</tbody>
</table>

His hope to become an engineer and started his career in a joint trading firm because of bad economic conditions influenced by second oil shock. He had dealt with many cases of equipment imports and sometimes had done his own import works on the side during five years. Based on these experiences and the earned money, he founded his own trading company A. Company A had imported hoisters (similar to crane), and antennas for car audio system and color TV.

Antenna for car audio system was developed by President Koo for import substitution in 1983. At the first time, he simply thought that "if I made my own product, I could make much money." He had got his friend's supports on this development project. Even though he developed his own product, he failed commercially. Japanese competitors had an automatic manufacturing system, and they could supply high-quality and low-price products. Manufacturing capability was germane to competing with Japanese competitors for this product market. He gave up this product because he didn't have enough capital resources to build up an automatic manufacturing system.

He had imported antennas for car phone from Japan since 1984, the beginning year of mobile phone service in Korea. His company became a major supplier seizing almost seventy percent of the market. He had investigated the technology and market trends of mobile phone services through the literature review and the participation of international seminars. He decided to develop antennas for car phone to substitute the products imported from Japan. He and two of his men, who belonged to the production department in the firm, had tried to develop the product through reverse engineering and trial-and-error methods because they didn't have much technological knowledge and external technological aids. Company A introduced the
<table>
<thead>
<tr>
<th>Technology</th>
<th>Product Category</th>
<th>For</th>
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<tbody>
<tr>
<td>Antennas</td>
<td>For consumer products</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For base station systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aerospace</td>
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<tr>
<td></td>
<td>Marine</td>
<td></td>
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<tr>
<td></td>
<td>Special purpose</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Booster (Cellular)</td>
<td></td>
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<tr>
<td>Components and Site</td>
<td>Transmitter combiners</td>
<td>1983</td>
</tr>
<tr>
<td>Management Solutions</td>
<td>RF and IF components</td>
<td>1984</td>
</tr>
<tr>
<td></td>
<td>Installation and maintenance</td>
<td>1987</td>
</tr>
<tr>
<td></td>
<td>System optimization</td>
<td></td>
</tr>
<tr>
<td>Amplifiers and</td>
<td>LNAS/LNBs for V SAT</td>
<td></td>
</tr>
<tr>
<td>Repeating Systems</td>
<td>RF Amplifiers</td>
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<tr>
<td></td>
<td>Paging repeaters</td>
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<tr>
<td></td>
<td>Cellular repeaters</td>
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<tr>
<td></td>
<td>Comprehensive repeating systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Car Boosters (Cellular)</td>
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<td></td>
<td>Hands free kit</td>
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</table>

(Figure 2) Technology and Product Change of Company A
developed product to the market in 1985 and its price was just half of the imported product. He could have supplying relationships with the major electronics companies in Korea such as Samsung Electronics, Hyundai Electronics, and LG Electronics. He also had developed Antenna for codeless phone in 1987.

Based on these successes, since 1987 his company could keep in touch with ETRI (the electronics and telecommunication research institute), a government-backed research institute. ETRI designated his company as a promising SME with excellent technologies. Company A had supplied its products such as antennas and filters to ETRI, and became a partner for government-sponsored projects of ETRI such as CDMA (code division multiple access) mobile communication project.

At the end of 1980s, company A met the challenge of Chinese firms and needed strategic reorientation. Many Chinese firms had started to manufacture antennas. They supplied the cost-competitive products to the Korean market, and company A had to reduce the price of product and the profit level of the firm. President Koo decided to develop more value-added products because he preferred competing with advanced firms to competing with Chinese firms although the former was more difficult than the latter. He had a vague idea to develop RF parts and equipments even though he didn’t choose the specific items, based on the understandings concern the technological and market trends of telecommunication industry acquired by doing the antenna business.

These RF parts and equipments technologies are quite different from antenna technology. For instance, most competitors haven’t handled antennas, and RF parts and/or equipments together at that time and now. Company A is also divided into two companies, an antenna company and an equipment company in 2006.

He installed a mobile telecommunication R&D unit at his firm in 1990. He said that he could have got together the engineers of other antenna and equipment firms or institutes since the success records (i.e. prior product development performance) of company A fascinated them, and he gave good wage and fringe benefits to them. He had tried to build up platform technologies of mobile telecommunication during two years through the benchmarking of advanced firms, the participation of international exhibitions, seminars, and conferences, and internal R&D activities.

As the period of the gestation increased to the two years, the dissatisfaction and opposition of old members occurred. They couldn’t understand that their compensation level was relatively lower than new members’ level although new members didn’t contribute to the financial performance at all. Moreover, new members had visited other countries frequently to attend international seminars and conferences. They had got huge financial supports to learn new knowledge and experiment new technologies. However, there were no visible research and development outputs new members had made. Old members also didn’t understand the commercial potential of new technologies such as RF parts and equipments. These decreased the organizational commitment of old members and increased the conflict between old and new members.

The proactive involvement and persuasion of President Koo was important to put down the problem. He explained the commercial limitation of the old technology, the commercial potential of new technologies, and the importance of these technologies to the future of company A. He also persuaded that new members had tried to build up new technological platforms, and they would make new products to earn big money sooner or later. He raised old members’ compensation level to soothe them. He explained the
situation of the firm to new members and requested them to commit to R&D activities more intensively.

Eventually, company A had set up three platform technologies such as antenna, components and site management solutions (i.e. RF parts), and amplifiers and repeating systems (i.e. equipments) through various NPD projects. [Figure 2] shows the change of the technologies and products of company A.

After three years of efforts and trial-and-errors, R&D unit had made visible development outputs. The first item of commercial success was combiners for paging system in 1992. Company A became a supplying partner of SK Telecom, first paging service provider in Korea. Company A also got Jangyongsil Award, the honorable national research and development award, for the advanced model of this combiner for paging system in 1996.

The second item of commercial success was combiners for CDMA mobile communication system in 1997. President Koo had visited the Korean CDMA project team in USA frequently since he had a good relationship with ETRI from 1992. Company A could participate in the Korean CDMA project team as an equipment maker easily since ETRI had coordinated the activities of the Korean CDMA project team.

The third item of commercial success was TMA (tower mounted amplifier) with Ericsson in 2001. Company A had tried to diversify its customer base from Korean telecommunication service providers or telecommunication system integrators (SI) to global companies such as Ericsson. Company A had developed TMA without big difficulties based on the accumulated technological capabilities.

4.2 Case Analysis

Company A arrived on a strategic crossroad at the end of 1980s. Chinese firms’ challenge gave company A two options: (1) to exploit the old antenna technology and use various measures in order to reduce the production cost such as the development of cost-reduced antenna models, and the transfer of the production facilities to cost-competitive countries such as China and South-East Asian countries, (2) to explore the new technology and realize new commercial possibilities. Company A chose the second option and expanded its platform technologies to RF parts and equipments technologies around early 1990s. It has got economic returns from RF parts and equipments for paging system, CDMA mobile communication system, and TMA.

President Koo had indentified the exploration option (i.e. expanding to three platform technologies) through usual searching activities concern the telecommunication industry, rather than usual experiences (Barr, 1998; Knuwada, 1998), even though it was a vague idea. He made the idea to develop RF parts and equipments even though he didn’t choose the specific items, based on the understandings concern the technological and market trends of telecommunication industry acquired by doing the antenna business. Especially, he gathered the information and knowledge from ETRI and the major electronics firms in Korea such as Samsung Electronics, Hyundai Electronics, and LG Electronics. He also could understand the worldwide technological and market trends of the telecommunication industry through the oversea experiences such as attending international seminars, conferences and exhibitions.

Prior success of the antenna business had promoted to change this vague idea to specific NPD alternatives. First, prior success had fascinated more high-calibered personnel outside the firm than old members, since it had made the reputation of company A as an in-
innovative company and could have accumulated financial resources to give good wage and fringe benefits to them. These new members had built up three platform technologies and concretized specific NPD alternatives through the benchmarking of advanced firms, the participation of international exhibitions, seminars, and conferences, and internal R&D activities.

Second, prior success also gave an opportunity to keep in touch with ETRI and the major electronics firms. For instance, company A could identify the NPD alternative of the CDMA project based on this relationship, since ETRI was a coordinator of CDMA mobile communication project, a government-sponsored project. External agencies are likely to give opportunities to identify new exploratory NPD alternatives to the firm with success records.

Similar to the argument of prior research (Kim, 1998), the concept of constructive crisis was germane to understanding the selection of the exploratory NPD alternatives. President Koo intentionally chose the exploration option when the financial performance of his firm is good or not bad immediately after the big success of the antenna business. This is constructive crisis, which means a performance gap that managers intentionally create when its current performance is good (Kim, 1998). Many firms had postponed their decisions to invest in new possibilities until desperate situations had occurred, which is called as destructive crisis. Moreover, company A could have endured three years payback period without any economic return from the exploratory NPD projects since it had invested resources to the exploratory NPD projects before its financial performance turned absolutely poor and slack resources exhausted.

The constructive crisis was related with President Koo’s personal characteristics such as future-oriented and proactive personality. He thought that competing with advanced firms would be better than competing with new Chinese entrants without any hesitation although the former was more difficult than the latter, and he didn’t have any specific alternatives. In addition, he had relentlessly tried new possibilities whether the prior trial was commercial success or not. Even though he experienced a big commercial failure of antenna for car audio system, he developed new antenna for car phone without much delay of time. He also pursued new possibilities with the large electronics companies and ETRI immediately after a big commercial success of antenna for car phone. He also has invested various businesses in other kinds of industries until now.

 Basically, new separated R&D unit had implemented exploratory NPD projects without any interaction with old members similar to the arguments of prior researches (Henderson and Clark, 1990; Kim and Ha, 2004; O’Reilly and Tushman, 2004). Although new members had visited other countries frequently to attend international seminars and conferences, and had got huge financial supports to learn new knowledge and experiment new technologies, old members hadn’t recognized the work of new members specifically until the long time of trial-and-errors had passed. The R&D unit is a totally separated intrapreneur unit.

As the period of the gestation increased to the two years, the dissatisfaction and opposition of old members occurred. Old members of the firm opposed President Koo’s policy to give new members good compensation and financial supports to build up new technologies continuously, since new members hadn’t made any visible development outputs during two years. He had persuaded them that new technologies would be germane to the future of company A and the new members would develop new technologies for the firm. He also raised the compensation level of old
members to soothe old members their dissatisfaction. In addition, he explained this situation of the firm to new members, and requested the new members to commit to R&D activities more intensively. These efforts softened the conflicts between old and new members and induced new members to work hard.

This first three years of R&D unit was a gestation period to set up three platform technologies such as antenna, components and site management solutions (i.e. RF parts), and amplifiers and repeating systems (i.e. equipments) through various NPD projects. Even though it didn’t show visible outputs they made technological foundations to be able to develop various commercially successful products since then.

New CEO of company A said that it still had three platform technologies and had accumulated in-depth knowledge in these technological domains until that time. Its products were developed from these technological foundations entirely. Some products were commercially failed. Three big commercial successes were combiners for paging system in 1992, combiners for CDMA mobile communication system in 1997, and TMA in 2001. Jangyounsil-Award on the advanced model of the combiner for paging system was a symbol of technological achievement of company A in 1996.

V. Summary and Discussion

<Table 4> summarizes the findings of this study. The characteristics of learning process of the exploratory NPD project are as follows. The identification barrier of the exploratory NPD project is relatively low. Managers can identify, at least, the vague exploratory NPD alternatives by usual searching activities. Constructive crisis is germane to selecting exploratory NPD alternatives and to enduring the long period without any economic return from exploratory NPD projects. Constructive crisis empirically means a continuous capability accumulation effort without any interruption or complacency in this case. New separated R&D unit is likely to implement the exploratory NPD project. The length of the gestation period of the exploratory NPD project is related with the level of the conflict between old members and new members.

Overall, company A shows a proactive virtuous circle of capability accumulation efforts and the essential role of CEO in the selection and the realignment process of the exploratory NPD project. Success breeds success. Prior success of the antenna business provided the seed of the RF parts and equipments businesses. The proactive and future-oriented CEO can choose exploration options when his or her firm does well. CEO needs to involve proactively and persuade the stakeholders in the realignment process of the exploratory NPD project.

Although this study explored the learning process and antecedents of the exploratory NPD project through an exploratory case analysis, the results of this study provided the following implications. First, this study developed a research framework, which integrated the learning process and antecedents of the exploration presented by prior studies (Levinthal and March, 1993; Cohen and Levinthal, 1990; Leonard-Barton, 1992; Henderson and Clark, 1990). Existing core capabilities may inhibit the identification and the selection of exploratory NPD alternatives, and the accumulation of novel capabilities in new technology domains. Moreover, while prior studies investigated firms in developed countries, this study empirically examined a Korean SME. Regardless of the capability level of the firm, the existing core capabilities may inhibit the firm’s adjustment to environmental conditions through the exploration.

Second, this study derived the antecedents that pro-
(Table 4) Summary of Findings

<table>
<thead>
<tr>
<th>Learning Process of Exploration</th>
<th>Antecedents</th>
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<tr>
<td>The identification barrier of exploration is relatively low. Managers can identify, at least, the vague exploratory NPD alternatives by usual searching activities.</td>
<td>Prior success promotes the identification process: (1) Prior success fascinates high-calibrated personnel with the ideas of exploratory NPD alternatives. (2) External agencies give the firm with success records the opportunities to identify exploratory NPD alternatives.</td>
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<tr>
<td>Constructive crisis is germane to selecting exploratory NPD alternatives and to enduring the long payback period without any economic return from exploratory NPD projects.</td>
<td>CEO’s personal characteristics such as future oriented and proactive personality are related with the constructive crisis.</td>
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<tr>
<td>New separated R&amp;D unit is likely to implement the exploratory NPD project. The length of the gestation period of the exploratory NPD project is related with the level of the conflict between old members and new members.</td>
<td>The proactive involvement and persuasion of CEO are germane to reducing the conflict between old and new members and to the success of the exploratory NPD project.</td>
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...moted the exploratory NPD project on the basis of a systematic framework. Several prior studies empirically presented the fact that it was difficult to implement exploratory NPD projects and some factors that facilitated or inhibited exploratory learning (Leonard-Barton, 1992; Henderson and Clark, 1990; Christensen, 1997; McGrath, 2001; Sorensen and Stuart, 2000; Benner and Tushman, 2002).

The limitations of this study and future research directions are as follows. First, this study is limited in its generalizations as a case study. It is therefore necessary to conduct a survey research that can strictly test the relationships derived here. In conducting a survey research, it is also necessary to define the technological learning pattern of a project not as exploitation and exploration dichotomously, but as the degree of exploration because most projects are between the extreme exploitation and extreme exploration (Benner and Tushman, 2002).

Second, this study is limited in being retrospective. Because it retrospectively analyzed the history of a Korean SME, the possibility that the results were affected by omission or distortion of information cannot be ruled out. For instance, it is impossible to compare the difference between alternatives that managers identified but did not select and those that they selected because this study only analyzed NPD alternatives that had already been selected by managers.

References


Organization Science 9(6), 644-669.


저자 소개

하성욱 (Seongwook Ha)
한국과학기술원(KAIST) 경영과학과를 졸업하고, 한국과학기술원(KAIST)에서 경영공학 전공으로 석사 및 박사를 취득하였다.
현재 경성대학교 상경대학 경영학부 전임강사로 재직 중이다. 주요 관심분야로는 기술의 탐험과 활용, 기술혁신, 조직관리, 중소기업 및 밸류기업, 전략군 등이다.