

Determinants and Outcomes of Radical Product Innovations by Korean Firms^{*}

Moon, Byeong-Joon^{**}

〈Abstract〉

This study is concerned with the factors that influence the radicalness of new product development by firms. The innovativeness of firms' new product development differs in their frequency and radicalness. Based on previous research on product innovations, this study provides a hypothetical model that links firms' internal variables and external relations variables to the radicalness of product innovation, which in turn is linked to marketing performance. For an empirical analysis, the data were collected from South Korean firms.

The result of this study provides evidence that the stronger is firms' management attitude toward risk taking, marketing competency, and technical competency, the higher is the possibility of radical product innovation. It also shows that, contrarily to the hypothesis, firms with collective reward system rather than individual reward system are more likely to develop radically new products. This study also shows that the better are firms' R&D collaboration with suppliers and interfaces with customers, the higher is the possibility of radical product innovation.

I . Introduction

Many firms facing severely competitive environments seek competitive advantage through the development of breakthrough products. Lynn et al. (1996) and Song and Parry (1999) noted and emphasized the importance of radical product innovations in current business administration. However, unfortunately, extensive research on product innovation (for example, Crawford 1977; Booz Allen & Hamilton 1982; Kleinschmidt

and Cooper 1991; Montoya-Weiss and Calantone 1994; Ogawa and Piller 2006) estimated that more than 40 percent of new products fail. High failure rates of new product developments imply that while breakthrough products offer more significant opportunities for competitive advantage, they also accompany significant risks.

After Etlie et al. (1984) and Dewar and Dutton (1986) had classified product innovations into radical innovations and incremental innovations, previous research on new product development shows two distinct streams. One stream has examined the

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^{**} School of International Management, KyungHee University

relationship between the degree of innovativeness and new product success (for example, Ettlie and Rubenstein 1987; Kleinschmidt and Cooper 1991; Song and Parry 1999). They primarily investigated whether radical innovations are more likely to succeed than incremental innovations or vice versa. The other stream of product innovation research has focused on innovating firms. That is, they tried to examine the characteristics of the firms that adopt radical product innovations (for example, Abernathy and Clark 1985; Clark and Hujimoto 1990, 1991; Ettlie et al. 1984; Holak and Lehman 1990; Lilien and Yoon 1989; Tushman and Anderson 1986). The impacts of internal variables of firms such as organizational cultures, organizational structures, strategic orientations, competencies and external variables of firms such as competitive environments, technological changes, and relationships with suppliers on product innovation patterns were examined in diverse viewpoints. However, a comprehensive model to understand the factors that influence and promote radical product innovations is sparse. Thus, the objective of this research is to provide a comprehensive model of the determinants of radical product innovations and analyze it empirically.

II. Previous Research on Radical Product Innovation

1. Research on Innovation Type

Utterback (1974) defined an innovation as the first use or application of a technology. Previous research on innovations classified innovations based on their characteristics. For example, Marquis (1969) distinguished between new-to-the firm innovations and new-to-the-economy innovations. Utterback (1974) distinguished product innovations from process innovations. Tushman and Anderson (1986) distinguished competence enhancing innovations from competence destroying innovations. Ettlie (1984) and Dewar and Dutton (1986) distinguished radical innovations from incremental innovations based on the degree of innovativeness. Subramanian and Nilakanta (1996) distinguished continuous innovations from periodic innovations based on the frequency of innovations. All of these distinctions reflect the fact that different kinds of innovations require different capabilities from innovating firms and place different demands on adopting customers (Abernathy and Clark 1985).

The term “product innovation” that denotes narrower concept than “innovation” has been defined in terms of a development

of product that is new to the firm and new to the outside world (Booz-Allen & Hamilton 1982; Kleinschmidt and Cooper 1991; Song and Montoya-Weiss 1998). Song and Parry (1999) pointed out that newness refers to the degree of familiarity with the new product, as well as the related technologies and target markets.

2. Research on Radical Product Innovations

Previous research on the degree of product innovativeness has produced two streams. One stream has examined the relationship between degree of innovativeness and new product success. Another stream of research has focused on the characteristics of radical innovation adopters or determinants of radical product innovations. That is, it focused on what are the factors that influence firms to adopt relatively more radical product innovations. Our research may be categorized as one of the second stream of research.

Booz-Allen & Hamilton (1982) classified new products into six categories: new to the world products, new product lines, additions to existing product lines, revisions to existing products, repositioning, and cost reduction. The company's study reported that the first two categories accounted for 30 percent of new products and 60 percent of

the most successful new products. Ettlie and Rubenstein (1987) found that "as firms grow between 1,200 and 11,000 employees, they are significantly more likely to introduce breakthrough products which, in turn, are more likely to be successful than incremental new products" (p.100). Kleinschmidt and Cooper (1991) used the Booz-Allen & Hamilton categorization to analyze 195 new products and found a U-shaped relationship between degree of innovativeness and new product success. They pointed out that moderately innovative products suffered because they were "not innovative enough to benefit from the impact of product advantage and not close enough to the base business to gain from the effects of synergy and good marketing" (p. 250). Song and Parry (1999) found that product innovativeness weakens the impact of technical synergy on technical proficiency, the impact of technical proficiency on product competitive advantage, and the impact of product competitive advantage on new product success.

Among the innovation characteristics examined by previous research on new product development, innovation radicalness, that is, how much a new product is radically different from existing products is pointed out as an important feature. Because the radicalness of product innovation not only affects innovation cost and risk of innovating firms but also influences

consumers' perception of relative benefit of a new product, in turn, affects new product success (Nord and Tucker 1987).

Hage (1980, pp. 188-199) defined innovation radicalness as "a trait that results in fundamental or significant change in inputs, outputs, or processes." Hage (1980) denoted the cost, radicalness, and distinctiveness as most important characteristics of innovation and pointed out that radical innovation is concomitant with high cost and risk because it embodies new knowledge and separates from previous routine.

Previous research proposed and investigated the factors that influence whether a new product development will be radical or incremental in diverse viewpoints (for example, Ettlie, Bridges, and O'Keefe 1984; Gatignon and Xuereb 1997; Germain 1996). Those proposed influencing factors are organizational culture, strategic orientation, organizational structure, resources and competencies, cross-functional coordination, uncertainty of external environment. In the perspective of organizational culture, Chandy and Tellis (1998) showed that the higher is a firm's willingness to cannibalize existing products, the higher is the possibility of radical product innovation.

In the perspective of strategic orientation and organizational structure, Ettlie et al. (1984) showed that radical process innovations are promoted by aggressive

technology oriented strategy and centralized decision making structure. They also demonstrated that and incremental process innovations are promoted by growth strategy based on market advantage and large scale, complex, decentralized decision making structure. Germain (1996) suggested that decentralized organizations are more likely to adopt incremental logistics innovation and centralized organizations are more likely to adopt radical logistics innovation.

In the perspective of resources and competencies, Ettlie et al. (1984) found that firms that have more engineers are more likely to adopt radical process innovation. Gatignon (1997) suggested that firms with technology orientation and excellent cross functional coordination are more likely to adopt radical product innovation. Song and Parry (1997) demonstrated that high marketing skill and resources, technical skill and resources, and cross-functional integration enhances the positional advantage of product differentiation, and results in higher product performance resultantly.

In the perspective of the impacts of interface with suppliers and customers, R&D collaboration with suppliers on new product development, Sivadas and Dwyer (2000) found that cooperative competency is a key factor affecting new product development success, regardless whether it is an intra firm or inter firm endeavor. Bstieler (2006)

showed that high levels of trust between new product development partners create the conditions for successful outcomes. Sethi (2000) pointed out that customers' involvement in new product development procedure is positively related to new product quality. Day (1994) conceptualized new product development as a "spanning process" that integrates inside-out (e.g., technology development) and outside-in (e.g., effective management of customer and channel relationships) capabilities. Supporting his conception, Bierly and Chakrabarti (1996) and Roth and Jackson (1995) suggested that firms need effective internal and external learning for the generic knowledge management.

III. A Model and Research Hypotheses

In this study, previous research results regarding the factors that influence the characteristics of new product developments are reviewed. Based on this, we provide a hypothetical model to understand the determinants and outcomes of radical product innovation and empirically analyze it using product innovations by Korean firms.

Im, Nakata, Park, and Ha (2003) conducted a study on the determinants of new product development performance. They

surveyed product developers about how strategic, organizational, and process factors influence new product performance. They showed that new product performance is determined by factors such as customer orientation, cross-functional integration, and new product team proficiency; however the effects are not uniform. Song and Parry (1997) also identified strategic, tactical, and environmental factors that influence the success of new products.

Based on previous research on product innovations, we provide a hypothetical model that links firms' internal variables and external relations variables to the radicalness of product innovation, which in turn is linked to marketing performance. These relationships are summarized in Figure 1. As the internal variables that influence the radicalness of product innovation, organizational culture, organizational structure, resources and competencies are identified. As the external relations variables, R&D collaboration with suppliers and interface with customers are identified. As environmental variables, market potential and competitive intensity are identified.

1. Internal Variables that Influence the Radicalness of Product Innovation

As discussed before, in the perspective of

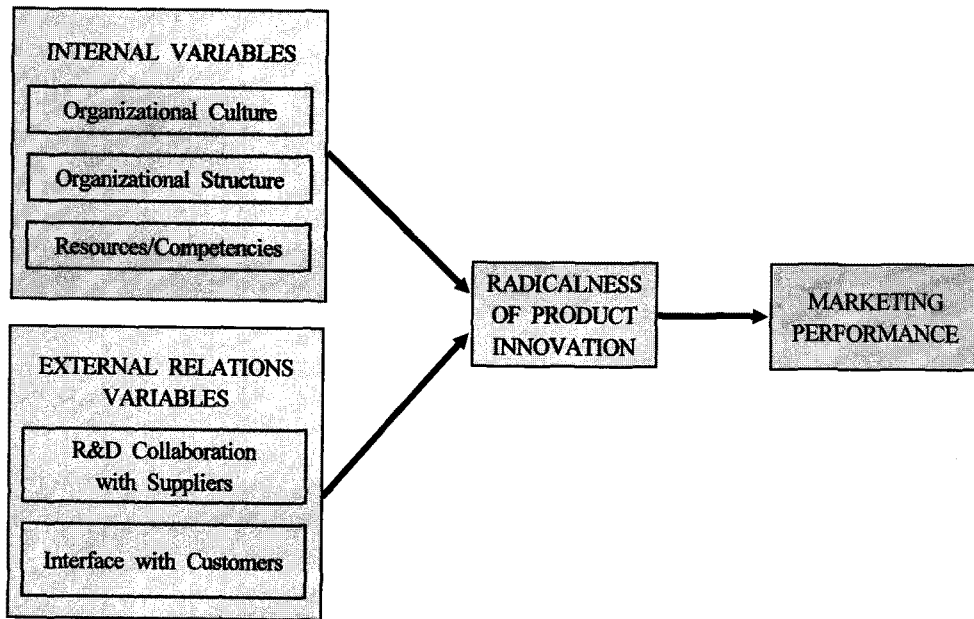


FIGURE 1 A Model to Understand the Determinants and Outcomes of Radical Product Innovations

organizational culture, Chandy and Tellis (1998) showed that the stronger is a firm's willingness to cannibalize former investments, the higher is the possibility of radical product innovation. Chandy and Tellis (1998, p. 475) conceptualized that "willingness to cannibalize" refers to "the extent to which a firm is prepared to reduce the actual or potential value of its own former investments." Deshpande and Webster (1989) also pointed out that organizational culture is an attitudinal trait of the key decision makers of the firm and shared values and beliefs, of the firm. In general, well established incumbents that have competitive advantages don't want changes and are likely reluctant to tackle

breakthrough innovation. Thus, such kind of organizational culture—willingness to cannibalize — is essential for radical innovations. It is, in other words, management attitude toward risk taking. Dewar and Dutton (1986) showed that a managerial attitude toward change is positively related to radical product innovation. Managerial positive attitudes toward change can be construed as a corporate culture that has high commitment to innovation. Based on this reasoning, we provide following hypothesis:

H1: The stronger is management attitude toward risk taking, the higher is the possibility of radical product innovation.

The reward system is another dimension of organizational culture. Jaworski and Kohli (1993) suggested that an organizational culture that pursues an individual reward system is positively related to radical product innovation; In contrast, an organizational culture that pursues a collective reward system is positively related to incremental product innovation. Ettlie et al. (1984) found that the role of product champion is critical for radical product innovation. That is, incremental innovation can be achieved in some degree through collective efforts. In contrast, efforts of creative minorities will be essential for developing a new product that requires radically new technology or attributes. Based on this, we hypothesize as follows:

H2: A firm with individual reward system rather than collective reward system is more likely to develop radically new products.

In the perspective of organizational structure, Damanpour (1991) suggested that the way an organization is organized influences its performance of radical product innovation. Previous research shows conflicting results regarding whether the organizational autonomy is positively related to radical product innovation or incremental product innovation. Olson et al. (1995) showed that high autonomy in the firm is

positively related to radical product innovation. To the contrary, Ettlie et al. (1984) found that radical process innovation is promoted by centralized decision making structure and aggressive technology oriented strategy; Incremental process innovation is promoted by decentralized decision making structure and market oriented growth strategy. Germain (1996) also found that centralized organization is more likely to adopt radical logistics innovation; Decentralized organization is more likely to adopt incremental logistics innovation. Moorman (1995) and Moorman and Miner (1997) showed that smooth information flow is positively related to creativity for new product development. In previous research on the impact of organizational structure on radicalness of product innovation, the frequency of innovation seems to be mixed with radicalness of product innovation and it seems to result in conflicting research result. That is, in developing radically new product, a firm may face unforeseen situation that jumps over existing accumulated knowledge. To overcome this kind of situation, centralized decision making structure may be necessitated. Contrarily, an organizational structure with smooth information flow and high autonomy may fit into continuous and more frequent product innovation. Based on this, we provide following hypothesis:

H3: An organization with centralized decision making structure is more likely to develop radically new products.

In the perspective of resources and competencies, Song and Parry (1997) presented marketing skills and resources, technical skills and resources, and cross functional integration as sources of competitive advantage to succeed in new product development. They found that a project's fit with the firm's existing marketing skills and resources is positively related to proficiency in idea development and screening, business and market opportunity analysis, product test, and product commercialization. Also, a project's fit with the firm's technological skills and resources is positively related to proficiency in the technological development stage of new product development. Furthermore, the level of cross-functional integration is positively related to proficiency in idea development and screening, business and marketing opportunity analysis, technological development, product testing, and product commercialization. Nakata, Im, Park, and Ha (2006) identified new product team proficiency as one of antecedents of new product advantage. Lee and Na (1994) showed that a firm's R&D competency, production competency, and financial competency affect the technological success

of new products and this relationship becomes stronger when the radical ness of the product is high. Based on this, we provide following hypotheses:

H4: The stronger is a firm's marketing competency, the higher is the possibility of radical product innovation.

H5: The stronger is a firm's technological competency, the higher is the possibility of radical product innovation.

2. External Relations Variables that Influence the Radicalness of Product Innovation

Research on the impact of interfaces and collaboration with suppliers and customers on the characteristics of product innovation is scanty. As discussed before, Sivadas and Dwyer (2000) found that cooperative competency is the key factor affecting new product development success, regardless of whether it is an intra-firm or inter firm endeavor. Sethi (2000) also showed that customers' involvement in new product development process is positively related to the quality of the new product. As a research that relates indirectly to this issue, Day (1994) conceptualized product development as a "spanning process" that integrates inside-out and outside in capabilities. Supporting this conception, Bierly and

Chakrabarti (1996) and Roth and Jackson (1995) argued that firms need effective internal and external learning for generic knowledge strategy. Considering that a firm may face unforeseen situation that jumps over existing accumulated knowledge in developing radically new product, and to overcome this kind of situation, interfaces with suppliers and customers, and R&D collaboration with suppliers will be necessitated. Based on this reasoning, we provide following hypotheses:

H6: The better is a firm's R&D collaboration with suppliers, the higher is the possibility of radical product innovation.

H7: The better is a firm's interface with customers, the higher is the possibility of radical product innovation.

IV. METHODOLOGY

Our overall research design, which combines interviews and survey research, follows the procedure for conducting new product development research by Song and Parry (1997). Measurement scales were developed based upon previous study and from group interviews with new product development teams. After completing the

group interviews and consulting with a panel of experts, we prepared a draft questionnaire. The resulting questionnaire was pre-tested twice. The first pretest was conducted by interviewing four Korean graduates from two business schools and four Korean executives. The second pretest was conducted using 50 front line employees of manufacturing firms. Both pretests yielded minor suggestions for improvement, which were incorporated into the final version of the questionnaire.

1. Sample Design and Data Collection

To investigate the factors that influence the radical-ness of product innovation, we collected data from 246 Korean firms. The respondents are executives and managers of marketing, R&D, and planning department. The sampling frame was defined in two steps. First, all Korean companies traded on the Korea Stock Exchange were identified. Second, the identified 702 companies were contacted through a phone call for one page survey. The purpose of this second step was three fold as suggested by Song and Parry (1999): to gain firms' tentative commitment to participate in the study, to identify key contact persons, and to ensure that the final sample consisted of companies that were

actively involved in developing new products. This pre survey identified 574 firms.

For each selected company, we asked the managers or executives of marketing, R&D, or planning departments complete the questionnaire. Each participating firm was asked to consider all new product projects introduced after 2001. To maximize potential variance and avoid perceptual biases, each company was asked to consider all successful projects and failure ones. We concluded the data collection phase with a phone call/e mail to the contact person and a personalized letter thanking for its cooperation. After three follow up letters and two phone calls, we received 246 usable questionnaires. The effective company response rate was 43 percent (246/574).

To confirm whether the 246 sample companies represent the population, we checked the respondents' self selection bias. To do this, we randomly selected 246 firms from non sample companies and analyzed whether there is significant differences in sales, capital, and number of employees between sample group and non sample group. We did not find any significant differences between these two sample groups.

2. Measures

All variables were measured with multiple-item scales. Although some items were developed specifically for this study, other measurement items derived from existing validated scales. In Appendix A, we report the items used to measure each of the constructs and the response format employed in the questionnaire. All items employed a zero-to-ten point scale.

To measure the radical ness of product innovation ($\alpha = .91$), we use three items as shown in Appendix A. These items were adapted from Song and Montoya Weiss (1998) and Song and Parry (1999). These items measure the radicalness of product innovations of a company.

To measure marketing performance, we use three different scales. One three item scale measured profitability ($\alpha = .93$), a second three-item scale measured sales ($\alpha = .92$), and a third three item scale measured market share ($\alpha = .95$). The use of the subjective scale may be criticized for not generating objective measures of new products' marketing success and failure across firms and industries. However, as argued by Song and Parry (1997), this is an artifact of real world differences among firms, industries, and economic situations rather than a criticism of these scales. Moreover, many recent marketing studies also use subjective measures of performance

(Jaworski and Kohli 1993; Olson, Walker, and Ruekert 1995).

Management attitude toward risk ($\alpha = .92$) refers to the attitude of a firm's top managers toward risk taking. All items were adapted from Dewar and Dutton (1986). Reward system: group versus individual ($\alpha = .81$) refers to a firm's system of rewarding the employees for their contribution with the spectrum of individual versus group orientation. These measures were also adapted from the items developed by Kohli (1993). Decision making structure ($\alpha = .83$) refers to the way a firm is organized for its decision making with the spectrum of centralization versus autonomy. These measures were also adapted from the items developed by Ettlie et al. (1984). Marketing competency ($\alpha = .87$) refers to a firm's existing marketing capabilities. This construct was measured with three items that addressed the firm's marketing research, distribution, and advertising/promotion skills and resources. These items were adapted from the items developed by Cooper (1979). Technological competency ($\alpha = .82$) refers to a firm's existing technological capabilities. The three item scale used to measure this construct addresses the firm's R&D, engineering, and design/specifications skills and resources. These items were adapted from the items developed by Cooper (1979). R&D collaboration ($\alpha = .86$) refers to a

firm's alliances and collaborative researches with suppliers and other external parties. These items were adapted from the items developed by Song and Parry (1999). Interface with customers ($\alpha = .91$) refers to the interactions with customers. These items were also adapted from the items developed by Song and Parry (1999).

V. Model Estimation and Results

We evaluate the research hypotheses in two steps. First, we estimate an ordinary least square (OLS) regression model explaining radicalness of product innovation. This model permits us to evaluate H1-H7, which links radicalness of product innovation to determinants. Second, we estimate an OLS regression model assessing marketing performance, which permits us to assess the moderating effects of environmental variables on the relationship between radicalness of product innovation and marketing performance.

We performed several diagnostic tests and examined scatter-plots of the residuals as part of the initial regression analysis to test for appropriateness of the assumptions of normality, linearity, and homoscedasticity. An examination of residual plots suggests that these assumptions were appropriate in

the sample. An application of the Belsley, Kuh, and Welsch (1980) multicollinearity diagnostic test indicates no serious problems.

In Table 1, we report the path coefficients from model estimation via OLS regression. In the sample, radicalness of product innovation was positively and significantly related to management attitude toward risk, marketing competency, technological competency, R&D collaboration, interface with customers. These results support H1, H4, H5, H6, and H7. Therefore, radicalness of product innovation appears to be positively influenced by management attitude toward risk, marketing competency, technological competency, R&D collaboration, and interface with customers.

Overall, when considered apart from the mediating effects of radicalness of product innovations, the internal and external factors show a significant ability to account for marketing performance such as profit ($R^2 = 0.39$, $p < 0.01$), sales ($R^2 = 0.40$, $p < 0.01$), and market share ($R^2 = 0.39$, $p < 0.01$). Equal interest focuses, however, on the manner in which the radicalness of product innovations mediates these effects of internal and external factors on marketing performance. Taken by itself, it strongly predict marketing performance such as profit ($R^2 = 0.36$, $p < 0.01$), sales ($R^2 = 0.39$,

TABLE 1 Path Coefficients from Model Estimation via OLS Regression

Determinants	Radicalness	Profit	Sales	MS	Profit	Sales	MS	Profit	Sales	MS
Management Attitude toward Risk (H1)	.12 ^a	.19 ^a	.21 ^b	.20 ^a				.09	.08	.05
Reward System (H2)	-.33 ^b	-.35 ^b	-.31 ^b	-.29 ^a				-.26 ^a	-.24 ^a	-.21
Decision Making Structure (H3)	.14	.22	.24	.21				.11	.07	.06
Marketing Competency (H4)	.17 ^a	.24 ^b	.22 ^a	.22 ^b				.14	.13	.11a
Technological Competency (H5)	.19 ^a	.26 ^a	.24 ^a	.25 ^a				.16	.15	.13
R&D Collaboration (H6)	.07 ^b	.13 ^a	.15	.11				.04 ^a	.05	.02
Interface with Customers (H7)	.24 ^a	.29 ^a	.27 ^a	.24 ^a				.20	.18 ^a	.17
Radicalness of Product Innovations					.27 ^b	.28 ^b	.26 ^b	.10 ^a	.13 ^a	.09a
Adjusted R-square	.24 ^b	.39 ^b	.40 ^b	.39 ^b	.36 ^b	.39 ^b	.38 ^b	.43 ^b	.46 ^b	.44 ^b

^a $p < .05$

^b $p < .01$

$p < 0.01$), and market share ($R^2 = 0.38$, $p < 0.01$). When the internal and external factors are added to these equations, the effect of radical-ness of product innovations remain significant, though less so, whereas the internal and external factors fail to contribute significantly to marketing performance such as profit ($R^2 = 0.43$ vs. 0.36 , $F = 2.23$, n.s.), sales ($R^2 = 0.46$ vs. 0.39 , $F = 2.04$, n.s.), and market share ($R^2 = 0.44$ vs. 0.38 , $F = 2.16$, n.s.). Though still significant, the effects of reward system, marketing competency, R&D collaboration, and interface with customers have declined greatly. In sum, these results fulfill the conditions for interpreting the radicalness of product innovations as mediating the effects of internal and external factors on marketing performance. This result resonates with the findings by Song and Parry (1997) that link sources of advantages to the positional advantage of product differentiation, which in turn is linked to new product performance.

Not all hypotheses, however, were supported in the sample. In contrary to H2, radicalness of product innovation was negatively and significantly related to individual reward system. That is,

radicalness of product innovation was positively and significantly related to collective reward system. It may mean that a collective reward system is more effective to encourage radical product innovation in a collective oriented culture such as South Korea. This result resonates with the findings by Nakata and Sivakumar (1996) and Nakata, Im, Park, and Ha (2006). They denote that high degrees of collectivism (low degrees of individualism) promote new product development through emphasis on interdependence, cooperation, and unified purpose.

Moreover, the coefficient of decision making was positive but was insignificant. Therefore, radicalness of product innovation appears not to be influenced by the characteristics of decision making structure. Thus, H2 and H3 were not supported in the sample.

VI. Discussion

The results summarized here confirm the usefulness of our conceptual framework in understanding the

relationship between new product's performance, radicalness of product innovation, and determinants of radical product innovation. In particular, the new product development data examined here clearly support the following five conclusions. First, management's positive attitude toward risk taking leads to high possibility of radical product innovation. The importance of management attitude toward risk taking assumes much significance given Dewar and Dutton's (1986) notion on the role of management attitude toward change in radical product innovation.

Second, our findings suggest that, in collective oriented culture such as South Korea, firms' collective reward system may be more effective than individual reward system for their radical product innovation. That is, the result underscores the importance of match between firms' reward system (as a factor of organizational culture) and underlying national culture. Previous research (Jaworski and Kohli 1993) pointed out that the effective reward system is different depending upon the type of product innovation. However, our results support the notion that the impact of

national culture may surpass the impact of type of product innovation. As pointed out by Jaworski and Kohli (1993), an organizational culture that pursues an individual reward system may be positively related to radical product innovation. Nevertheless, if the firm operates mainly in the collective oriented national culture, collective reward system rather than individual reward system may be more effective to encourage radical product innovation.

Third, this study confirmed the importance of marketing competency and technological competency in radical product innovation. This finding resonates to the notion by Song and Parry (1997). These results highlight the importance of firms' marketing skills and resources as well as technological and manufacturing capabilities for their radical product innovation.

Fourth, our findings confirmed the importance of external relations with suppliers and customers in radical product innovation. This result resonates to the findings by Sethi (2000) and Sivadas and Dwyer (2000). Considering that a firm may face unforeseen situation that jumps over existing accumulated knowledge in

developing radically new product, and to overcome this kind of situation, this finding underscores the importance of interfaces with suppliers and customers, and R&D collaboration with suppliers.

1. Managerial Implications

The results presented here have clear implications for the new product development strategy. Firms are advised to assess internal factors and external relations factors to choose the type of product innovation, that is, either radical product innovation or incremental product innovation to enhance their marketing performance. With regard to internal factors, firms are advised to assess organizational culture such as the characteristics of reward system and core competencies to decide on the degree of radicalness of product innovation, that is, whether they should pursue a radical innovation or incremental innovation. With regard to external relations factors, firms are recommended to assess R&D collaboration with suppliers and interface with customers to decide on the degree of radicalness of product innovation.

2. Limitations and Implications for Further Research

The results reported here must be qualified in several ways. First, the retrospective nature of the data collection process raises the possibility that memories are incomplete and may be colored by known success or failure of a new product development project. In the future research, this problem could be addressed by a longitudinal study methodology assessing internal factors, external relations factors, and environmental factors at various points during the new product development stages.

Second, the data collected from only one national culture constitutes another limitation. As discussed before, our findings suggest that, in collective oriented culture such as South Korea, firms' collective reward system may be more effective than individual reward system for their radical product innovation. In the future research, data should be collected from at least two nations which have collective oriented culture, to generalize the impact of national culture.

Third, the use of subjective scale to measure marketing performance constitutes another limitation. Further research may generate objective measures of new products' marketing success and failure across firms and industries.

Fourth direction for further research involves the impact of organizational behavioral factors on radical product innovation and new product success. Akgun, Lynn, and Yilmaz (2006) analyzed the effects of learning process in new product development teams on product success. Schulze and Hoegl (2006) studied the relationship between knowledge creation modes in new product development

and new product success. Further research may address the relationship between team learning process or knowledge creation mode and radical product innovation and marketing performance. In addition, further research may address the interaction effects of product innovation type (radical vs. incremental) and internal factors. For example, when a company performs a radical product innovation, an organization with decentralized decision making structure is likely to be more efficient or vice versa.

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APPENDIX A

Measurement Items and Response Formats

I. To what extent does each statement listed below correctly describe the characteristics of your company? Please indicate your degree of agreement or disagreement by circling a number of zero (0) to ten (10) on the scale to the right of each statement. Here: 0 = strongly disagree (0% agreement), 10 = strongly agree (100% agreement), and numbers between 0 and 10 indicate various degrees of agreement and disagreement.

Management Attitude toward Risk ($\alpha = .92$)

Top managers in my firm favor low-risk projects (R).

Over the past three years, top managers in my firm have shown a strong preference for high-risk projects (with chances of very high return).

Our management formally promotes and encourages high-risk new projects.

Reward System: Group vs. Individual ($\alpha = .81$)

Our company rewards champions rather than teams for successful new products.

In our company, all individuals involved in the development of a successfully commercialized new products are equally rewarded (R).

Product team members are evaluated based on the team performance instead of individual performance (R).

Decision Making Structure ($\alpha = .83$)

In our company, high autonomy is given to diverse functional departments and hierarchy for most decision making (R).

In our company, important decision makings are centralized and usually made by CEO.

The organizational structure of our company requires that we get a consensus on all decisions (R).

Marketing Competency ($\alpha = .87$)

Overall our company has greater marketing research resources than major competitors in the industry.

Overall our company has greater distribution resources than major competitors in the industry.

Overall our company has greater advertising/promotion resources than major competitors in the industry.

Technological Competency ($\alpha = .82$)

Overall our company has greater R&D resources than major competitors in the industry.

Overall our company has greater technological and engineering resources than major competitors in the industry.

Overall our company has greater product design and specifications resources than major competitors in the industry.

R&D Collaboration ($\alpha = .86$)

Our company has a lot of experience in managing R&D collaborations with suppliers.

Our company has developed many collaborative researches activity in the past three years.

Our company has developed a large number of R&D alliances with suppliers.

Interface with Customers ($\alpha = .91$)

Our new product developments encompass inputs from our customers.

Our development process involves getting early customers inputs before investing significant R&D expenditures.

Our new product development process incorporates the voice of customers at all levels.

II. New product performance can be measured in a number of ways. Please indicate, from what you know today, how successful your new product was or has been using the following criteria.

Profitability ($\alpha = .93$)

How successful was your new product from an overall profitability standpoint? (0 = a great financial failure, i.e., far less than our minimum acceptable profitability criteria;

10 = a great financial success, i.e., far exceeded our minimum acceptable profitability criteria).

Relative to competing products, how successful was your new product in terms of profits? (0 = far less than the competing products; 10 = far exceeded the competing products).

Relative to your firm's objectives for your new product, how successful was the product in terms of profits? (0 = far less than the objectives; 10 = far exceeded the objectives).

Sales ($\alpha = .92$)

How successful was your new product from an overall sales standpoint? (0 = far less than our minimum acceptable sales criteria; 10 = far exceeded our minimum acceptable sales criteria).

Relative to competing products, how successful was your new product in terms of sales? (0 = far less than the competing products; 10 = far exceeded the competing products).

Relative to your firm's objectives for your new product, how successful was the product in terms of sales? (0 = far less than the objectives; 10 = far exceeded the objectives).

Market Share ($\alpha = .95$)

How successful was your new product from an overall market share standpoint? (0 = far less than our minimum acceptable market share criteria; 10 = far exceeded our minimum acceptable market share criteria).

Relative to competing products, how successful was your new product in terms of market share? (0 = far less than the competing products; 10 = far exceeded the competing products).

Relative to your firm's objectives for your new product, how successful was the product in terms of market share? (0 = far less than the objectives; 10 = far exceeded the objectives).

III. Product innovativeness can be measured in a number of ways. Please indicate, from what you know today, the degree of innovativeness of new product developments of your company in the last year using the following criteria. Here: 0 = strongly

disagree (0% agreement), 10 = strongly agree (100% agreement), and numbers between 0 and 10 indicate various degrees of agreement and disagreement.

Radicalness of Product Innovation ($\alpha = .91$)

Overall our company develops really new products.

Overall our company's new products are highly innovative.

Overall our company's product innovations are radical rather than incremental.

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〈국문요약〉

한국기업의 급진적 제품혁신의 영향요인과 결과

문 병 준

본 연구에서는 기업의 급진적인 제품혁신에 영향을 주는 요인을 탐구하였다. 기업들의 제품혁신 (혹은 신제품개발)은 급진성과 빈도 측면에서 그 정도를 달리한다. 제품혁신에 관한 기존 연구들을 토대로 하여 본 연구는 기업의 내부요인과 외부요인이 기업의 제품혁신의 급진성에 영향을 미치고, 이는 다시 기업의 마케팅 성과에 영향을 미친다는 인과관계를 나타내는 개념적 모델을 제시하고 이 모델의 검증을 위하여 한국 기업을 대상으로 하여 실증분석을 수행하였다.

연구결과, 기업의 마케팅역량, 기술적 역량, 경영자의 위험수용도가 높을수록 급진적 제품혁신을 수행할 가능성이 높게 나타났다. 한편 가설과는 상반되게 개인적 보상시스템보다는 집단적 보상시스템을 가진 기업일수록 급진적인 제품혁신을 수행할 가능성이 높게 나타났다. 또한 공급자와의 연구개발 제휴를 잘 하거나 고객과의 관계를 긴밀하게 유지하는 기업일수록 급진적인 제품혁신을 수행할 가능성이 높게 나타났다.

주제어: 제품혁신, 신제품개발, 급진적/점진적, 혁신빈도