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경영학석사학위논문

**Effects of Marketing-Manufacturing  
Integration on Product Innovativeness and  
Competitive Advantage under Uncertainty**

마케팅-생산관리의 협력이 신제품 혁신성과 경쟁우위에  
미치는 영향과 불확실성의 조절효과

2014년 2월

서울대학교 대학원

경영학과 생산관리전공

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# Effects of Marketing-Manufacturing Integration on Product Innovativeness and Competitive Advantage under Uncertainty

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이 논문을 경영학석사 학위논문으로 제출함

2014년 2월

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## **Abstract**

Today, in cross-functional integration in new product development (NPD), marketing-manufacturing integration (MMI) is considered necessary for success. Adopting Swink and Song's (2007) framework, this paper examines the influence of MMI in new product development on product innovativeness and competitive advantage. The proposed model was examined empirically on the basis of survey data collected from 138 NPD projects in Korean firms. Path analysis showed a negative relationship between MMI in the technical development stage and product innovativeness.

Also, as MMI has been treated as a subsidiary factor that affects NPD, there needs to be a greater focus on MMI itself before applying it to NPD. Therefore, we added uncertainty as a moderating variable and evaluated the effectiveness of demand and supply uncertainty on the relationships between given variables in the model. Demand and supply uncertainty moderated the relationship between product innovativeness and competitive advantage.

***Keywords: Marketing-Manufacturing Integration; New Product Development; Uncertainty: Moderating Effects***

**Student Number: 2012-20504**

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# **1. Introduction**

New product development (NPD) is an innovation process defined as "the technical, industrial and commercial steps that lead to the marketing of new manufactured products" (Central Advisory Council on Science and Technology, 1968). It is also considered a critical way to maintain corporate competitive advantage (White, 1976) and thus improve viability (Hayhurst, 1968). Therefore, NPD is a flexible means of taking advantage of a company's strong points and changes to provide a competitive advantage. Also, it is a significant device in the profit-making process system (Goulding, 1983). Zirger and Maidique (1990) suggested an NPD model that identified the following as exerting influence on product outcomes: the quality of the organization's research and development (R&D), the technical performance of the product, the product's value to the customer, and the synergy of the new product with the firm's existing competencies. A cross-national comparative study of NPD processes was also conducted based on Japanese and U.S. new product data. The results showed a robust correlation between new product success and sources of advantage, quality of implementation, and positional advantages (Song & Parry, 1997). Because product development is essential for successful firm performance, critical factors that improve NPD have captured the interest of researchers. First,

increasing attention has been paid to NPD speed because NPD speed is a crucial factor in time-sensitive business innovation. Chen, Damanpour, and Reilly (2010) conducted a meta-analysis to generalize the relationships between NPD speed and prior research divided into four categories: strategy, project, process, and team.

Marketing-manufacturing integration (MMI) has also been linked to improved NPD. Rigorous studies have been conducted on the advantages and disadvantages of MMI in new product development. Marketing and manufacturing are considered to have the most conflicting perspectives on NPD (Kahn & Mentzer, 1994). Therefore, it is essential that the perspectives and goals of both marketing and manufacturing are reflected in the overall NPD process because integration of this sort can lead to improved product competitiveness.

However, MMI has been treated as a subsidiary factor that affects NPD. Therefore, greater focus on MMI itself before it is applied to NPD is necessary. Supply and demand uncertainty will be considered within MMI because demand uncertainty is crucial in marketing and both of these uncertainties are critical element in manufacturing (Fisher, 1997; Lee, 2002). Uncertainties that occur in a



turbulent environment are not useful (Duncan, 1972); thus, they must be studied in relation to a specific component. In this paper, we will examine whether uncertainties moderate the level of marketing-manufacturing integration and, hence, the relationship between MMI and new product performance.

## **2. Literature Review**

### **2.1 MMI and NPD**

Previous research has noted the impact of cross-functional integration on NPD. Patterns of cooperation among marketing, operations, and R&D in the early and final stages of NPD have been examined to determine whether simply increasing the level of functional integration contributes to a firm's new product performance (Olson et al., 2001). Effects of manufacturing practices and strategy integration have also been investigated, revealing that manufacturing and strategy integration plays a central role in new product flexibility capability (Swink, Narashimhan, & Kim, 2005). The studies then became more specific to MMI in that the nature of the marketing and manufacturing interface in NPD was determined (Calantone et al., 2002). Exploratory empirical investigation proposed a path model to assess the impact of the marketing and manufacturing interface on overall business performance and marketing-manufacturing morale. Both profit performance and marketing-manufacturing morale are enhanced when marketing and manufacturing work together harmoniously to achieve goals (Hausman, Montgonery, & Roth, 2002). Troy et al. (2009) investigated the relationship between cross-functional integration and new product success and

found that although cross-functional integration has a direct impact on new product success, its integration with other variables may be of greater importance. For instance, integration combined with other management-controlled, researcher-controlled, and context-specific factors can improve or alleviate new product success.

Further studies have also been conducted on MMI. Researchers have examined the moderating effects of business strategy and demand uncertainty on the relationship between integration of manufacturing and marketing-based decisions and organizational performance. The results supported the relationship between integration of manufacturing and marketing decisions and proved that firm performance is moderated by the firm's business strategy and environmental uncertainty (O'Leary-Kelly & Flores, 2002). Swink and Song (2007) studied the effects of MMI on NPD time and competitive advantage, noting both advantages and disadvantages of MMI on NPD timing and its influence on NPD quality. Also, the impact of MMI on both earlier and later stages of NPD have been examined. Swink and Song (2009) also suggested the need to study how the level of MMI should differ across various stages of new product development for high and low levels of product innovativeness. Relationships among manufacturing and marketing integration, managerial priorities, and business

performance have also been evaluated based on the cumulative capabilities approach (Pavia, 2010). Also, Brettel et al, (2011) investigated the impact of integrating R&D, marketing, and manufacturing functions on the effectiveness and efficiency of new product development. A multi-functional design that considers three functions, including manufacturing, was employed. Furthermore, the study distinguished between two phases of the NPD process, development and commercialization. The results showed that integration between R&D and marketing positively influences efficiency but not effectiveness across different types of projects. Findings on integration between R&D and manufacturing show a strong positive impact on efficiency in the development phase.

On the other hand, many researchers claim that cross-functional integration is not required in every stage of NPD. Also, even though cross-functional integration provides benefits for NPD, it also requires significant costs because building consensus among manufacturing, marketing, and R&D groups who have different perspectives and goals requires extra time and effort (Song et al., 1998). Based on interviews conducted in four of North America's largest multinational computer and telecommunications firms, the study argued that manufacturing's integration into the front end of the NPD process can suppress creative ideas on product design (Gerwin, 1993). In contrast, too much

involvement from marketing can result in technical problems in production enhancement (Atuahene-Gima & Evangelista, 2000).

In this article, we expand the theory describing the influence of MMI on NPD stages. This study makes important contributions by considering other variables that affect the relationship between MMI and NPD. Demand and supply uncertainty will be considered as moderating factors to determine whether they enhance or mitigate the impact of MMI on NPD and, thus, the innovativeness and competitive advantage of new products.

## **2.2 Uncertainty**

A significant amount of research has been carried out on uncertainty in relation to product and process innovation. For example, Gerwin and Tarondeau (1982) examined uncertainty and innovation processes by evaluating adoption and implementation of new manufacturing processes. Uncertainty was then considered in new product development. Structural models of the impact of the strategic orientation of the firm on new product performance were proposed. For example, Gatignon and Xuereb (1997) showed that a competitive orientation was

useful in market innovations when demand is not too uncertain, but it must be less emphasized in highly uncertain markets. Also, firms operating in uncertain environments adopt higher levels of integrated product development practices than firms operating in lower uncertainty (Koufteros et al., 2002). Zhou (2006) also compared the effects of innovation and imitation strategies on new product performance. Here, the benefits of an innovation strategy became stronger when market demand grew increasingly uncertain.

In addition, demand uncertainty has been studied in relation to marketing issues. Jaworski and Kohli (1993) showed a firm connection between market orientation and performance across environmental conditions such as shifting degrees of market uncertainty. Using the Asian economic crisis in Thailand as a research sample, market orientation was found to be useful for managing crises in conditions of high demand uncertainty. However, economic crises tend to slow down the competition on new product innovation, as innovation results in extra costs (Grewal & Tansuhaj, 2001).

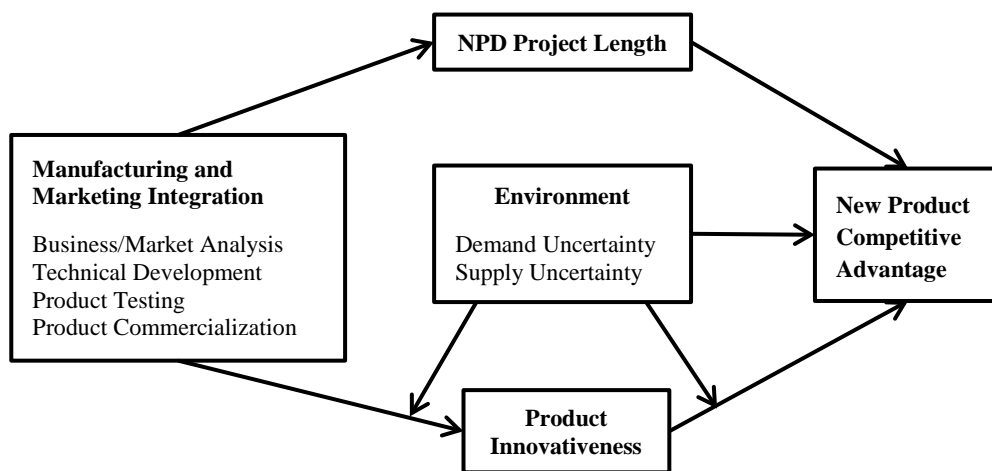
Uncertainty about demand is also crucial for the responsive supply of innovative products. To design a responsive supply process, managers must

understand the demand uncertainty and seek solutions that are right for the firm's situation (Fisher, 1997).

Lee (2002) expanded Fisher's framework to include supply uncertainty. Also, the study identified three distinct sources of uncertainty that pester a flexible supply chain: suppliers, manufacturing, and customer (Davis, 1993). The relative impact of supply, process, and demand uncertainty on supply chain competitiveness was evaluated by Bhatnagar and Sohal (2005). These uncertainties had negative effects on supply chain performance, supporting the earlier research of Davis (1993). Ho, Chi, and Tai (2005) applied a structural approach to measure demand, supply, and manufacturing uncertainty. The results provided a confirmed uncertainty scale that helps in interpreting supply chain problems. Also, Paulraj and Chen (2007) studied the direct effect of supply chain uncertainties on strategic supply management, along with the following influence of strategic supply management on both buyer and supplier performance.

### 3. Theory Development

Figure 1 shows how the elements of the NPD process tie together.



**Figure 1. Framework for evaluating effects of MMI in NPD on Product Innovativeness and Competitive Advantage under Uncertainty**

#### **Marketing-manufacturing integration in NPD stages**

In this paper, MMI is defined as the coordination of marketing and manufacturing when performing functional strategies and development activities in new product development (Swink & Song, 2007).



The effects of MMI are examined according to four stages in NPD. These four stages are divided based on the work of Urban and Hauser (1993); the impact of MMI on these stages was examined by Swink and Song (2007):

- Business/market analysis: The objective of this stage is to understand the new product's place in the market relative to competition, make connections between new product features and potential customers' needs, and forecast the required investment and risk associated with the NPD project.
- Technical development: This stage includes product and process engineering studies, establishing game designs and specifications, prototyping the product, and approving final designs.
- Market testing: Key customers are selected, and markets are tested and then results are analyzed.
- Product commercialization: Product commercialization encompasses the activities required to launch the product, including manufacturing and marketing planning, production ramp-up, and product promotion and distribution.

**Demand uncertainty** in this paper means variation in customer demand, which involves the unknowns of product characteristics and environments. Failure to deliver as required by the customer due to a malfunctioning production process at the supplier or late delivery will be considered **uncertainty in supply**. Uncertainty in supply/manufacturing encompasses product quality and manufacturing lead time (Ho, Chi, & Tai, 2005). For NPD performance, **product competitive advantage** will also be considered under product performance. Product competitive advantage is suitable to represent NPD performance because it connotes a product's desirability to customers along the points of marketing and performance, conformance, and reliability in a manufacturing concern (Song & Swink, 2007). **Product innovativeness** in this paper refers to the level of product newness to the firm (Song & Parry, 1999). This includes the innovativeness of a product's technology, the effect of the product in the industry, and the newness of the product's class to the firm (Song & Parry, 1997). Based on previous studies on NPD speed (Griffin, 1997), **NPD length** in this paper is considered to be the total number of weeks involved in all four stages of the new product development to be completed: business/market analyses stage, technical development stage, product testing stage, and product commercialization stage.

### **3.1 Effects of MMI on product innovativeness and NPD length**

Teams with low superordinate identity are less likely to discover complex and novel linkages among market needs, technology, and the company's resources whereas high superordinate identity in a team can override the adverse effects of interfunctional biases and stereotypes (Ashforth & Mael, 1989). Therefore, the level of superordinate identity in a cross-functional product development team is positively related to new product innovativeness (Sethi, Smith, & Park, 2001). In a similar context, we can expect that MMI has a positive effect on product innovativeness. Previous research has also provided evidence of a positive effect of cross-functional collaboration on product innovation performance (Griffin & Hauser, 1996; Luo, Slotegraaf, & Pan, 2006; Song & Parry, 1997).

Furthermore, achieving cross-functional integration increases the costs of NPD efforts. To determine whether firms can achieve NPD success in a more cost-saving manner, uncertainties were considered as moderators. A suitable degree of cross-functional integration can be examined according to the level of uncertainty discerned. The moderating effects of technical and market uncertainty on the relationship of R&D/marketing integration and R&D/customer integration and NPD effectiveness were studied by Souder, Sherman, and Davies-Cooper (1998). Their results suggested that technical and demand uncertainty influence some aspects of NPD effectiveness. Therefore,

whether both demand and supply uncertainties moderate the relationship between MMI and project performance will be examined. The study hypothesizes the following:

**Hypothesis 1-1. Demand uncertainty in NPD projects moderates the relationship between MMI in NPD and product innovativeness.**

Hypothesis 1-1a. Demand uncertainty in NPD projects moderates the relationship between MMI during the business/market analysis stage of NPD and product innovativeness.

Hypothesis 1-1b. Demand uncertainty in NPD projects moderates the relationship between MMI during the technical development stage of NPD and product innovativeness.

Hypothesis 1-1c. Demand uncertainty in NPD projects moderates the relationship between MMI during the product testing stage of NPD and product innovativeness.

Hypothesis 1-1d. Demand uncertainty in NPD projects moderates the relationship between MMI during the product commercialization stage of NPD and product innovativeness.

Based on the work of Fisher (1997) and Lee (2002), it is clear that managing demand and supply uncertainties is crucial in manufacturing. Therefore, supply uncertainty must be considered in MMI because reducing problems from supply uncertainty enables firms to earn a competitive advantage (Lee, 2002). The moderating effects of supply uncertainty on the relationship between MMI and project performance will be considered similarly to the case of demand uncertainty. The study hypothesizes the following:

**Hypothesis 1-2. Supply uncertainty in NPD projects moderates the relationship between MMI in NPD and product innovativeness.**

Hypothesis 1-2a. Supply uncertainty in NPD projects moderates the relationship between MMI during the business/market analysis stage of NPD and product innovativeness.

Hypothesis 1-2b. Supply uncertainty in NPD projects moderates the relationship between MMI during the technical development stage of NPD and product innovativeness.

Hypothesis 1-3c. Supply uncertainty in NPD projects moderates the relationship between MMI during the product testing stage of NPD and product innovativeness.

Hypothesis 1-4d. Supply uncertainty in NPD projects moderates the relationship

between MMI during the product commercialization stage of NPD and product innovativeness.

Ragatz, Handfiel, and Petersen (2002) found that new product cycle time can be improved by greater use of team processes. Previous researchers have provided evidence that projects with dedicated team members are completed faster (Maber, Muth, & Schmenner, 1992) and time to market can be significantly reduced if cross-functional and well-integrated teams are established (Calantone & Di Benedetto, 2000). Based on this research, it is likely that increased MMI in NPD stages will shorten overall project length. Thus, the study hypothesizes the following:

**Hypothesis 2. Increased MMI in NPD projects is positively associated with project lead time.**

Hypothesis 2a. Increased MMI in the business/market analysis stage of NPD is positively associated with project lead time.

Hypothesis 2b. Increased MMI in the technical development stage of NPD is positively associated with project lead time.

Hypothesis 2c. Increased MMI in the product testing stage of NPD is positively associated with project lead time.

Hypothesis 2d. Increased MMI in the product commercialization stage of NPD is positively associated with project lead time.

### **3.2 Effects of product innovativeness on new product competitive advantage**

Innovation and competitive advantage are connected by complex and multidimensional relationships. Lengnick-Hall (1992) examined product and market choices that emphasize high-value factors and exclude low-value factors/differentiations.

Under the assumption that product innovation takes place with the aim of creating a competitive product, the advantage of offering a superior product to competitors will stem from the innovativeness of the offered product. Past research has shown that product innovativeness is positively related to product advantages (Holak & Lehmann, 1990; Kleinschmidt & Cooper, 1991; Henard & Szymanski, 2001). Earlier research has argued that initial screening and in-depth market assessments and studies are required for innovativeness to yield positive results for firm performance (Kleinschmidt & Cooper, 1991). Also, demonstrating a sustainable competitive advantage requires longitudinal data as the competitive environment influences firm performance; Dreyer and Gronhaug (2004) empirically examined the sustained competitive advantage in a highly uncertain environment, including raw materials and product volume. Thus, it is

expected that demand supply uncertainty will moderate the positive relationship between product innovativeness and competitive advantage. Therefore, the study hypothesizes the following:

**Hypothesis 3-1. Demand uncertainty moderates the relationship between product innovativeness and competitive advantage.**

**Hypothesis 3-2. Supply uncertainty moderates the relationship between product innovativeness and competitive advantage.**

### **3.3 Effects of NPD length on product competitive advantage**

Rigorous research has been conducted on time-oriented competition, first-mover strategy, fast-follower strategy, fast product development cycle time, and on-time schedule performance (Lambert & Slater, 1999; Chowdhury & Lukas, 2002). The leading companies manage time in NPD to represent the most powerful new sources of competitive advantage (Stalk, 1988).

In a study of 692 NPD projects, Chen, Reilly, and Lynn (2005) examined the relationship between speed to market and new product success under different conditions of uncertainty. The results indicated that speed to market is generally



positively associated with overall new product success, and market uncertainty moderates the direct effect. Supply uncertainty will be also considered with demand uncertainty as this paper seeks to understand the overall influence of MMI on firm performance. Therefore, this study hypothesizes the following:

**Hypothesis 4-1. Demand uncertainty moderates the relationship between project length and product competitive advantage.**

**Hypothesis 4-2. Supply uncertainty moderates the relationship between project length and product competitive advantage.**

## **4. Research Method**

### **4.1 Measurement development process**

In administering the survey, we followed the design method for survey research (Dillman, 1978). Specifically, measurement items for MMI in NPD stages, product innovativeness, product competitive advantage, and control variables were adapted predominantly from Swink and Song (2007). Items of product innovativeness were based on the previous work of Song and Parry (1997), Booz et al. (1982), and Song and Xie (2000) and the scales for product competitive advantage were based on the work of Song et al. (1997).

Measures of product competitive advantage are as follows:

1. Compared to competitive products, this product offers unique features to the customer (PCA1).
2. This product is clearly superior to competing products in terms of meeting customer needs (PCA2).
3. This product is of higher quality than competing products (PCA3).
4. This product has technical performance that is superior to competing

products (PCA4).

The level of MMI has been evaluated in each NPD stage: business/market analyses stage, technical development stage, product testing stage, and product commercialization stage (see Table 1).

**Table 1. Measure of MMI on NPD stages**

<b>Factors</b>	<b>Measures</b>
<b>The level of MMI in conducting business and market opportunity analysis activities (BMA)</b>	Analyzing potential competition (BMA1). Conducting detailed market research (BMA2). Determining the desired product features (BMA3). Analyzing potential customer needs (BMA4). Assessing the required investment, time, and risk of the project (BMA5).
<b>The level of MMI in conducting technical development activities (TD)</b>	Preliminary engineering, technical, and manufacturing assessments or studies (TD1). Building the product to designated specifications (TD2). Establishing criteria for judging product performance and market acceptance (TD3). Approving the final product design (TD4).
<b>The level MMI in conducting product-testing activities (PT)</b>	Planning testing sites, methods, schedules, responsibilities, and costs (PT1). Executing prototype testing with customers (PT2). Selecting customers for test marketing (PT3). Testing marketing/trial selling prior to launch (PT4). Analyzing findings from the pretests (PT5).

<b>The level of MMI in conducting product commercialization activities (PC)</b>	Completing detailed plans for manufacturing (PC1).
	Completing detailed plans for marketing (PC2).
	Launching the product in the market, including selling, promoting, and distributing (PC3).
	Establishing overall direction for commercialization of the product (PC4).

**Table 2. Measure of product innovativeness**

<b>Product innovativeness</b>	This product relies on technology that has never before been used in the industry (PI1).
	This product creates significant changes in the whole industry (PI2).
	This product is one of the first of its kind introduced into the market (PI3).
	This product is highly innovative—totally new to the market (PI4).

Measurements for uncertainty were devised based on previous research (Davis, 1993; Ho, Chi, & Tai, 2005). In addition, measurement items for demand uncertainty only were also adopted from Jaworski and Kohl (1993) and Gatigon and Xuereb (1997); see Table 3.

**Table 3. Measures of Uncertainty**

<b>Factors</b>	<b>Measures</b>
<b>Demand Uncertainty</b>	Customers' product preferences alter as time goes by (DU1).
	Customers tend to look for new products all the time (DU2).
	Customers are sensitive to prices change from time to time (DU3).
	Customers' tastes can be assessed accurately (DU4).
	Demand is fairly easy to predict (DU5).

<b>Supply/manufacturing Uncertainty</b>	Variance in material supply lead time (SU1).
	Supplier accuracy in filling orders (SU2).
	Stability in quality of critical material (SU3).
	Length of relationships with suppliers (SU4).

A 5-point Likert scale with end points of “strongly disagree” and “strongly agree” was used to measure the items. To assure content validity and reliability, a pretest of the questionnaire was conducted with three NPD experts in the industry.

To control the effects caused by different properties of the industry and projects, the following control variables were considered in this paper:

1. Ease of entry: The likelihood of a new competitor being able to earn satisfactory profits in the principal served market segment within three years after entry.
2. Project size: The number of full-time equivalent team members in the project.
3. Project budget: The total budgeted investment for the project.

## **4.2 Sample and Data collection**

We surveyed 300 Korean firms across different industries. Contact information was extracted from the commercial research firm database and FKI (Federation of Korean Industries) Center for Large and Small Business Cooperation (FKIsc). All companies satisfied the standard by having both developed and commercialized at least two new physical products. An online survey questionnaire was used to collect data. Followed by countless personal contacts and two follow-up letters, 180 surveys were sent and 143 samples were received. Five samples were eliminated due to incomplete or inaccurate responses. As a result, a 76% response rate was achieved. The project members for a recently developed product were the main informants for this survey.

The final products represented the following industries: computer-related products; electronic and electrical equipment; pharmaceuticals, drugs, and medicines; chemicals and related products; industrial machinery and equipment; transportation equipment; food-related products; and machinery.

Table 4 shows the characteristics of firms that participated in the survey.

**Table 4. Sample Characteristics**

<b>Sample Characteristics</b>		
<b>Annual revenue</b>	Mean (KOR, Won)	3780234664
	Standard deviation (Won)	29844306329
	Maximum (Won)	3.5E+11
	Minimum (Won)	-5000000000
<b>Number of employees</b>	Mean	32
	Standard deviation	81
	Maximum	500
	Minimum	2
<b>Project Lengths</b>	Mean	30 (weeks)
	Standard deviation	21
	Maximum	144
	Minimum	3

The number of full-time employees participating in the NPD teams for all projects ranged from 2 to 500, with an average of 32 per project. The time taken to complete the four NPD stages was 30 weeks on average.

## **5. Data Analyses**

### **5.1 Measurement model validation**

Confirmatory factor analysis (CFA) was used to test whether measures of constructs were consistent with a previous researcher's understanding of the nature of that construct, thus assuring unidimensionality and convergent and discriminant validity. The maximum likelihood (ML) technique was used for parameter estimation. Table 5 shows the results of the CFA for the measurement model and provides standardized estimations. Each item loading is significant on the respective construct, suggesting that the measure scales for each construct show high convergent validity. Composite reliability (CR) values range from 0.85 to 0.93, exceeding general acceptance of 0.70. As average variance extracted (AVE) values go beyond general acceptance of 0.50, discriminant validity was proved (Fornell & Larker, 1981) as well. The overall model fit was satisfactory as  $CFI > 0.903$ ,  $RMSEA = 0.064$ , and normed  $\chi^2 < 2$ . All the analyses were conducted using SPSS and AMOS 20.



**Table 5. Confirmatory Factor Analysis Results**

<b>Variable</b>	<b>Item</b>	<b>Standardized Estimation</b>
<b>MMI in business/market analysis, CR= 0.91, AVE= 0.68</b>	BMA1	0.781
	BMA2	0.830
	BMA3	0.869
	BMA4	0.793
	BMA5	0.717
<b>MMI in technological development, CR= 0.91, AVE= 0.71</b>	TD1	0.810
	TD2	0.843
	TD3	0.811
	TD4	0.788
<b>MMI in product testing, CR= 0.90, AVE= 0.64</b>	PT1	0.766
	PT2	0.795
	PT3	0.822
	PT4	0.789
	PT5	0.804
<b>MMI in product commercialization, CR= 0.92, AVE= 0.73</b>	PC1	0.691
	PC2	0.884
	PC3	0.851
	PC4	0.842
<b>MMI in product innovativeness, CR= 0.87, AVE= 0.64</b>	PI1	0.702
	PI2	0.844
	PI3	0.784
	PI4	0.836
<b>MMI in product competitive advantage, CR= 0.93, AVE= 0.77</b>	PCA1	0.849
	PCA2	0.736
	PCA3	0.800
	PCA4	0.859
<b>Demand uncertainty, CR= 0.90, AVE= 0.63</b>	DU1	0.75
	DU2	0.839
	DU3	0.759
	DU4	0.629
	DU5	0.714
<b>Supply uncertainty, CR= 0.85, AVE= 0.59</b>	SU1	0.754
	SU2	0.646
	SU3	0.739
	SU4	0.688

<b>Model statistics</b>	$\chi^2$	842.493
	<i>d.f.</i>	536
	Normed $\chi^2$	1.572
	CFI	0.903
	RMSEA	0.064
	N	141

### Control variables

Ease of entry, project budget, and project size were considered control variables. As the results show, the p-value of ease of entry is smaller than 0.05. However, project budget and project size are not significant for product competitive advantage; thus, these variables will not be taken into account as control variables.

**Table 6. Control Variables**

	Estimate	Standardized estimation	S.E.	C.R.	P
<b>PCA &lt;--- Project</b>	0	-0.079	0	-0.863	0.388
<b>PCA &lt;--- Ease of</b>	0.122	0.272	0.041	2.948	<b>0.003</b>
<b>PCA &lt;--- Project size</b>	0	-0.069	0.001	-0.754	0.451

### 5.2 Path analysis

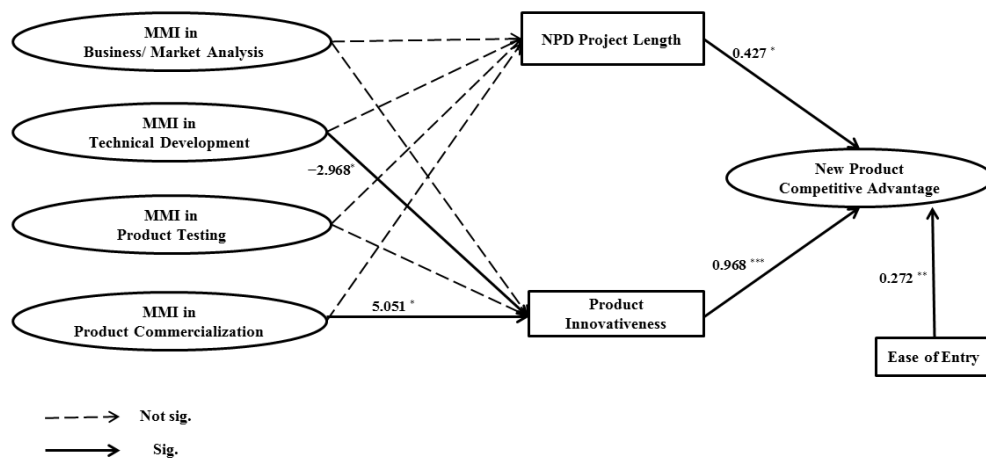
Shown in Table 7, CMIN/DF (normed $\chi^2$ ) is less than 2 and the values of IFI and CFI are larger than 0.90 Also, REMEA is smaller than 1; thus, this model is

accepted.

**Table 7. Model fit for the framework**

Model	CMIN	DF	P	CMIN/ DF	IFI	RMSEA	CFI
Unconstrained	360.01	199	.000	1.809	0.92	0.077	0.914

Path analysis was conducted prior to applying the moderating value to certain significant relationships. Result of path analysis is shown in Figure 2.



**Figure 2. Results of Path Analysis**

Figure 2 shows that not all hypotheses are significant. Of those that are significant, increased MMI in the product commercialization stage encourages product innovativeness as predicted, whereas MMI in the technical development stage of NPD discourages product innovativeness. Even though both NPD project length and product innovativeness act positively on new product competitive advantage, product innovativeness tends to have a stronger effect on competitive advantage.

Detailed information on the path analysis is presented in Table 8.

**Table 8. Results of Path Analysis**

	<b>Estimate</b>	<b>Standardized estimation</b>	<b>S.E.</b>	<b>C.R.</b>	<b>P</b>	<b>Result</b>
<b>BMA → PI</b>	-1.138	-0.937	0.796	-1.429	0.153	not sig
<b>TD → PI</b>	-3.508	-2.968	1.770	-1.982	0.047	<b>Sig.</b>
<b>PT → PI</b>	-0.841	-0.936	0.573	-1.468	0.142	not sig
<b>PC → PI</b>	6.366	5.051	2.680	2.375	0.018	<b>Sig.</b>
<b>BMA → Project length</b>	38.332	1.073	54.755	0.700	0.484	not sig.
<b>TD → Project length</b>	289.328	7.777	179.266	1.614	0.107	not sig
<b>PC → Project length</b>	73.608	2.818	52.385	1.405	0.160	not sig
<b>TD → Project length</b>	-394.572	-10.514	247.247	-1.596	0.111	not sig
<b>Project length → PCA</b>	0.006	0.427	0.002	2.307	0.021	<b>Sig.</b>
<b>PI → PCA</b>	0.613	0.968	0.101	6.044	***	<b>Sig.</b>

### **5.3 Moderation analysis**

Moderation analysis is conducted using different methodologies depending on whether the moderating variable is metric or nonmetric (Hair et al., 2006). As the moderating variable is nonmetric in this paper, moderator analysis was fulfilled based on the differences in chi-squared of the constrained (cross-group equality constraint) and unconstrained model.

Multi-group analysis was used to determine whether parameter estimates of one group are equal to the other group's parameter estimates in structural equation models (Bollen, 1989). The model is considered significant if the difference between the chi-squared of unconstrained and constrained models is greater than 3.84 ( $p < 0.05$ ) or 2.71 ( $p < 0.1$ ).

Demand and supply uncertainty were examined using 5-point Likert scales, but we classified each uncertainty into two groups, low uncertainty and high uncertainty. The average value of the scale, 3.5, was the standard for dividing uncertainty groups.

**Table 9. Demand Uncertainty as a moderator**

$\Delta X_{crit.}^2 = 3.84$ ( $\Delta df = 1$ , $p < 0.05$ ), $2.71$ ( $\Delta df = 1$ , $p < 0.1$ )					
<b>Result of moderating effect of demand uncertainty on MMI in NPD - product innovativeness</b>					
Moderating Effect	$X^2$	$\Delta X^2$	Standardized estimation		Result
			LOW	HIGH	
Unconstrained	576.924	-	-	-	-
TD → PI	577.050	0.126	-3.135	-1.970	not sig.
PC → PI	578.226	1.176	4.107	3.122	not sig
<b>Result of moderating effect of demand uncertainty on product innovativeness - competitive advantage</b>					
Moderating Effect	$X^2$	$\Delta X^2$	Standardized estimation		Result
			LOW	HIGH	
Unconstrained	82.944	-	-	-	-
PI → PCA	98.344	15.4	1.000	0.910	<b>Sig.</b>
<b>Result of moderating effect of demand uncertainty on project length - competitive advantage</b>					
Moderating Effect	$X^2$	$\Delta X^2$	Standardized estimation		Result
			LOW	HIGH	
Unconstrained	647.345	-	-	-	-
Length → PCA	649.600	2.255	0.657	0.268	not sig

Demand uncertainty was considered a moderating variable for the relationships that were significant in path analysis. According to the results, demand uncertainty does not moderate the relationship between MMI in NPD and product innovativeness or the relationship between project length and competitive advantage. However, the relationship between innovativeness and competitive advantage is moderated by demand uncertainty. As the standardized estimation of the low demand uncertainty group is higher, demand uncertainty controls this relationship in a negative sense (see Table 9).

**Table 10. Supply Uncertainty as a moderator**

$\Delta X_{crit.}^2 = 3.84$ ( $\Delta df = 1, p < 0.05$ ), $2.71$ ( $\Delta df = 1, p < 0.1$ )					
<b>Result of moderating effect of supply uncertainty on MMI in NPD - product innovativeness</b>					
Moderating Effect	$X^2$	$\Delta X^2$	Standardized estimation		Result
			LOW	HIGH	
Unconstrained	582.034	-	-	-	-
TD → PI	582.484	0.45	-8.916	-24.488	Not sig
PC → PI	582.703	0.219	-9.514	-32.312	Not sig
<b>Result of moderating effect of supply uncertainty on product innovativeness - competitive advantage</b>					
Moderating Effect	$X^2$	$\Delta X^2$	Standardized estimation		Result
			LOW	HIGH	
Unconstrained	86.271	-	-	-	-
PI → PCA	97.245	3.268	0.895	0.993	<b>Sig</b>
<b>Result of moderating effect of supply uncertainty on project length - competitive advantage</b>					
Moderating Effect	$X^2$	$\Delta X^2$	Standardized estimation		Result
			LOW	HIGH	
Unconstrained	570.272	-	-	-	-
Length → PCA	572.782	2.51	0.490	0.862	not sig.

Supply uncertainty was also considered a moderating variable on the relationships that are significant. According to the results, it does not moderate the relationship between MMI in NPD and product innovativeness or the relationship between project length and competitive advantage. However, the relationship between innovativeness and competitive advantage is affected by supply uncertainty. As the standardized estimation of the high supply uncertainty group is higher, supply uncertainty controls product innovativeness for competitive advantage in a positive sense (see Table 10).

## **6. Conclusion**

This paper contributes to previous research for the following reasons. First, this study provides further evidence considering environmental conditions in marketing and manufacturing integration. Supply uncertainty is especially taken into account as manufacturing is involved in cross-functional integration. Second, uncertainties were considered moderating effects to examine the relationships between MMI in NPD and product innovativeness, product innovativeness and competitive advantage, and project length and competitive advantage. Third, the product innovativeness and competitive advantage were distinguished and have been used as elements of a single new product performance. This paper links the influence of MMI in NPD stages and the following effect on product performance.

Previous research has shown that cross-functional integration improves product innovativeness and NPD performance. Swink and Song (2007) also showed that MMI enhances the competitive advantage of new products. However, the results in this paper showed rather different results. MMI in some NPD stages yields negative results on product innovativeness. In particular, integration in product commercialization has a positive effect on product innovativeness whereas MMI in technical development discourages it. This can result from the two disciplines,



manufacturing and marketing, having different opinions, for example, on the final product design. As marketing and manufacturing represent opposing functional perspectives in NPD (Kahn & Mentzer, 1994), any additional antithetical concepts or opinions in the NPD stages will diminish the positive effects on product innovativeness. Also, the technical development stage requires detailed assessments and knowledge of engineering, both technical and manufacturing. Therefore, the more marketing is involved, the less realistic and practical the product design can be because marketers are not experts in this area.

Previous studies have shown that shorter project length, or NPD speed, has a positive effect on product competitive advantage. However, my results contradict these findings: The longer the NPD length, the better the product competitive advantage. Such results may be attributed to sample characteristics. Longer project length means that more budget is required for the project. Therefore, in the case of some of Korean companies, project length is restricted to meet the budget; thus, the project ends without having had sufficient time to develop a strong competitive advantage for the new product. In such cases, even though the project length is short, fast NPD speed does not extend to higher competitive advantage. Also, such results might be because the longer the team members put their efforts into a new product development project, the more research on technology and design for new product production takes place; thus, a stronger

competitive advantage is induced.

Product innovativeness positively affects competitive advantage, supporting previous research. Using uncertainty as a moderating variable, both demand and supply uncertainty moderate the relationship between product innovativeness and competitive advantage. The competitive advantage becomes stronger when demand uncertainty is lower, supporting previous studies. On the other hand, competitive advantage becomes stronger when supply uncertainty is high. This can be interpreted as the result of extra effort to overcome any deficiencies within the supply/manufacturing process in NPD.

### **Managerial Implications**

Examining the analysis above, several managerial implications can be derived that are useful in the real business world. Investigating effects of MMI on NPD according to NPD stage enables managers to determine the exact stage where integration acts negatively or relatively less positively on project performance. Institutional strategy can be provided in the stage where cross-functional integration causes reverse effects on performance. Also, a shorter NPD length should not be the only critical factor for achieving competitive advantage. Faster NPD speed definitely enhances the competitive advantage of new products, but only when other conditions are satisfied as well. Finally, product innovativeness

and competitive advantage must be considered simultaneously at all times. If the company is to maintain a distinct and sustainable competitive advantage over competitors, product innovativeness is critical; thus, the importance of new product development is once again demonstrated.

### **Limitations and Future Research**

This research has several limitations. In survey-based research, participants in the survey should be constrained with thorough criteria. For instance, surveys should be conducted with managers of new product development projects who are well aware of the overall process. Also, a questionnaire on product competitive advantage should be administered to people who can evaluate the products with an objective view, such as customers. Second, future research can cover larger sets of supply issues. For instance, the conceptualization of uncertainty can be expanded to supply chain uncertainty where manufacturing, supply, and demand uncertainties are clearly classified and examined in detail. Finally, some control variables may have been neglected with respect to product innovativeness and length of NPD project.

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## Appendix

과거 또는 현재 참여중인 프로젝트의 신제품에 관한 질문입니다.

1. 제품의 경쟁우위/경쟁력을 다음의 항목별로 1-5점으로 평가해 주세요.  
(1점: 매우 아니다/5점: 매우 그렇다)

	매우 낮음      매우 높음				
경쟁사의 제품과 비교할 때, 이 제품은 차별화되는 특징을 갖고 있다.	1	2	3	4	5
이 제품은 고객의 니즈 (요구)를 만족시킨다는 측면에서 경쟁사의 제품에 비해 뛰어나다.	1	2	3	4	5
이 제품은 경쟁사의 제품보다 품질이 좋다.	1	2	3	4	5
이 제품은 경쟁사의 제품보다 기술적인 성능이 뛰어나다.	1	2	3	4	5

2. 프로젝트 기간: 새로운 상품 개발 과정 4 단계(비즈니스/시장 분석 단계, 기술 개발 단계, 제품 테스트/평가 단계, 제품의 상품화 단계)를 아우르는 총 기간을 기입해 주세요.  
(년, 월, 주 등 기간단위도 같이 기입해 주세요)

약 ( )

3. 투자 수익률: 제품 출시 후 초기 12개월 동안의 투자 수익률을 기입해 주세요. 투자 수익률 = (순이익/총투자액, 총자본) \* 100.

약 ( )



**\*\*MMI: Marketing-Manufacturing Integration.** 생산과 마케팅 부서의 연계, 협력.

4. 비즈니스와 시장 분석을 조사하는 단계에서 MMI(manufacturing-marketing integration)의 정도: 다음과 같은 신제품 개발 업무 수행 시 마케팅과 생산 부서가 어느 정도 협력하였는지를 1-5점으로 평가해 주세요. (1점: 매우 낮음/5점: 매우 높음)

	매우 낮음    매우 높음				
잠재적인 경쟁사 분석	1	2	3	4	5
세부적인 시장 조사 실행	1	2	3	4	5
시장 반응이 좋은 제품 특징 판단, 규정.	1	2	3	4	5
고객의 잠재적인 니즈 분석, 파악	1	2	3	4	5
프로젝트에 드는 투자비용, 기간 및 위험성(리스크) 측정	1	2	3	4	5

5. 기술 개발 단계에서의 MMI 정도: 다음과 같은 신제품 개발 업무 수행 시 마케팅과 생산 부서가 어느 정도 협력하였는지를 1-5점으로 평가해 주세요. (1점: 매우 낮음/5점: 매우 높음)

	매우 낮음    매우 높음				
신제품 개발에 필요한 엔지니어링, 기술 및 제조에 관한 사전 조사	1	2	3	4	5
지정된 사양에 맞는 제품 설계	1	2	3	4	5
제품 성과 및 시장 수용성을 판단하는 기준 설립	1	2	3	4	5
최종적인 제품 제조과정 승인	1	2	3	4	5

6. 제품 테스트/평가 단계에서의 MMI 정도: 다음과 같은 신제품 개발 업무 수행 시 마케팅과 생산 부서가 어느 정도 협력하였는지를 1-5점으로 평가해 주세요. (1점: 매우 낮음/5점: 매우 높음)

	매우 낮음    매우 높음				
고객들에게 원형 시험* 실행	1	2	3	4	5
제품 테스트/시험하는 지역, 방법, 스케줄, 책무 및 비용 등 계획	1	2	3	4	5
테스트 마케팅*을 위한 고객 선발	1	2	3	4	5
제품 개시 이전에 테스트 마케팅 수행	1	2	3	4	5
테스트 마케팅을 통한 결과 분석	1	2	3	4	5

\*원형: 샘플처럼 새로운 제품의 설계 또는 성능, 구현 및 운용 가능성을 평가하거나 요구 사항을 좀 더 잘 이해하고 결정하기 위하여 전체적인 기능을 간략한 형태로 구현한 초기 모델.

\*\* 테스트 마케팅: 신제품을 판매할 때, 미리 특정 지역을 골라 소비자의 선호도 등을 조사·분석하여 전체의 경향을 예측하는 일.

7. 제품 상품화 단계에서의 MMI 정도. 다음과 같은 새로운 상품 개발 활동에서 마케팅과 생산 부서가 어느 정도 협력하였는지를 1-5점으로 평가해 주세요. (1점: 매우 낮음/5점: 매우 높음)

	매우 낮음    매우 높음				
상품 제조를 위한 세부적인 계획 완성	1	2	3	4	5
마케팅을 위한 세부적인 계획 완성	1	2	3	4	5
상품 개시 - 홍보, 판매 및 유통 과정 포함.	1	2	3	4	5
제품의 상품화의 전반적인 방향성 설정	1	2	3	4	5

공급사슬 불확실성. (Supply Chain Uncertainty)

8. 주요 불확실성에 관한 질문으로, 본사가 속한 산업 전체에 대한 질문입니다. 다음의 항목을 각각 1-5점으로 평가해 주세요. (1점: 매우 아니다/5점: 매우 그렇다)

	매우 낮음    매우 높음				
시간이 지남에 따라 상품에 대한 고객의 선호도가 자주 바뀐다.	1	2	3	4	5
고객들은 항상 신제품 출시를 기대한다.	1	2	3	4	5
시간의 지남에 따라 가격에 대한 고객들의 민감성이 달라진다.	1	2	3	4	5
고객들의 선호도/기호를 비교적 정확하게 측정하고 판단할 수 있다.	1	2	3	4	5
수요예측이 비교적 쉬운 편이다.	1	2	3	4	5

9. 공급 불확실성에 대한 질문입니다. 현재 (또는 과거) 개발 중인 신제품과 관련된 협력업체/공급업체에 관한 질문을 다음의 항목별로 1-5점으로 평가해 주세요. (1점: 매우 낮음/5점: 매우 높음)

	매우 낮음    매우 높음				
주요 부품 조달의 지연 정도를 평가해주세요.	1	2	3	4	5
공급업체들은 본사가 요구하는 수요량을 비교적으로 잘 맞춘다.	1	2	3	4	5
공급자들이 제공하는 부품 품질은 획일적이다.	1	2	3	4	5
주요 부품업체들을 자주 교체한다.	1	2	3	4	5

10. 공급 불확실성에 대한 질문입니다. 현재 (또는 과거) 개발 중인 신제품과 관련된 부품업체들의 개수를 적어주세요.

약 (                      ) 개

**통제변수.**

11. 제품의 혁신성을 다음의 항목별로 1-5점으로 평가해 주세요.  
(1점: 매우 아니다/5점: 매우 그렇다)

	매우 낮음    매우 높음				
이 제품은 해당 산업에서 사용한 적 없는 기술을 바탕으로 만들어졌다.	1	2	3	4	5
이 제품은 산업에 상당한 변화를 일으켰다.	1	2	3	4	5
이 제품은 비교적 선발 주자로 시장에 도입되었다.	1	2	3	4	5
이 제품은 매우 혁신적이다.	1	2	3	4	5

12. 시장 진입의 정도: 새로운 경쟁사가 시장 진입 후 3년 내에 만족스러운 수입창출을 할 가능성을 1-5점으로 평가해주세요. (1점: 매우 낮음/5점: 매우 높음)

	매우 낮음    매우 높음				
새로운 경쟁사가 시장 진입 후 3년 내에 만족스러운 수입창출을 할 가능성	1	2	3	4	5

13. 프로젝트 크기: 프로젝트에 임한 (정직원) 팀 멤버 수.

(                      ) 명

14. 프로젝트 예산: 프로젝트에 드는 총 투자예산.

약 (                      ) 원

## 국문 초록

# 마케팅-생산관리의 협력이 신제품 혁신성과 경쟁우위에 미치는 영향과 불확실성의 조절효과

이경선

경영학과 생산관리 전공

서울대학교 대학원

신제품의 개발과 성공이 기업의 장기적인 경쟁우위와 존속에 영향을 미친다는 인식에 따라 신제품의 성공요인에 대한 학계의 관심이 집중되어 왔다. 특히 신제품 개발에 긍정적인 효과를 주는 부서간의 통합이 신제품의 성공에 기여하는 요인으로 주목받고 있으며, 이 중에서도 마케팅과 생산관리의 협력에 대한 관심이 증대되고 있다. 본 연구는 Swink and Song (2007)의 프레임워크를 바탕으로 각 신제품 개발 단계에서 마케팅과 생산관리의 협력이 제품 혁신성과 경쟁우위에 미치는 영향을 알아보고자 한다. 한국 제조기업 138업체의 신제품 개발 프로젝트에 대한 설문조사 자료를 바탕으로 측정이 이루어졌으며, 경로 분석을 통해 기술 개발 단계에서의 마케팅-생산관리의 협력은 제품 혁신성에 유의 영향을 미치는 것으로 판단되었다.

또한, 마케팅-생산관리의 협력이 신제품 개발을 위한 도구적인 요소로 인식되는 한계점을 극복하고자 마케팅-생산관리의 협력 내에서 존재하는 불확실성의 개념도 함께 고려되었다. 본 연구는 수요 및 공급 불확실성이 기존 프레임워크에서 사용된 변수들의 사이에서 조절적 역할의 여부를 측정하였다. 다중집단 분석을 통해 수요 및 공급 불확실성이 제품 혁신성과 경쟁우위의 관계에 조절효과를 미치는 것으로 판단되었으며, 특히 공급 불확실성은 혁신성이 경쟁우위에 미치는 영향을 증대시키도록 조절하는 것으로 확인되었다.