Core Competences, Supply Chain Partners' Knowledge-Sharing, and Innovation: An Empirical Study of the Manufacturing Industry in Taiwan

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ABSTRACT

One of the most significant changes in the paradigm of business management is the fact that individual businesses no longer compete as solely autonomous entities, but rather as partners in supply chains. Supply chain integration has been elevated to a strategy level for sustainable competitive advantage. Within a supply chain, an enterprise must first understand how to use its core competences to increase innovation. Knowledge-sharing within the supply chain could then be used to strengthen the effect of core competences on innovation. This study surveyed the manufacturing industry in Taiwan in order to examine the research model using hierarchical regression analysis (HRA). Results showed that: (1) threshold capabilities, critical capabilities, and cutting-edge capabilities positively affect innovation; (2) the level of knowledge reception among supply chain partners positively affects innovation; (3) the level of knowledge reception could strength the effect of threshold capability on innovation; and (4) a high level of knowledge reception could weaken the positive effect of critical capabilities and cutting-edge capabilities on innovation.

Keywords: Resource-based view, core competences, innovation, knowledge-sharing

1. INTRODUCTION

In a knowledge-based economy, the environment is changeable. To deal with such a changeable environment, firms connect with one another to form a supply chain to ensure that they can obtain core resources and related knowledge, which can then be transformed into core competences that create competitive advantages.

In the international industrial arena, where competition is fierce, innovation is the key to success. To overcome the challenges and difficulties of such intense competition, firms are advised to make an effort to apply innovations and to extend value chain activities in order to construct new positions in the supply chain. Many studies [O'Driscol, Carson and Gilmore, 2001; Wu, Lin, and Hsu, 2007; Loewe and Chen, 2007] demonstrate that the core competences of firms can positively influence innovation.

A supply chain is a network of firms connected in value chain activities. Knowledge-sharing among supply chain partners allows the firms to achieve learning competence in the chain [Wadhwa, and Saxen, 2007]. Alavi [1999] indicated that knowledge shared with supply chain partners is one of the important sources of knowledge for companies. Knowledge delivery and reception facilitate information flow and knowledge-sharing, and the influence of these factors is one of expectation. Using cross-organizational knowledge-sharing, participants in the chain can enhance their competitiveness. Research by Caloghirou, Klihirou and Tsakanikas [2004] and Thompson and Heron [2006] demonstrates that knowledge-sharing positively influences innovation. In a supply chain, firms rely not only on their core competences, but also on knowledge-sharing and information flow among members in the chain. Knowledge-sharing in a supply chain can increase knowledge among the firms, as well as pose an obstacle to rivals seeking to enter the chain. In a study on enterprises in Europe, Caloghirou et al. [2004] found that interaction between business competence and knowledge-sharing could result in innovation on the part of the firms involved.

According to the literature review, studies have been done on the influence of core competences on innovation, but they do not discuss knowledge-sharing among partners [Wu et al., 2007; Loewe and Chen, 2007]. Although some studies focus on cross-organizational knowledge-sharing [Caloghirou et al., 2004; Wadhwa, and Saxena, 2007], they mostly refer to horizontal integration such as

strategic alliance and chain stores and rarely explore knowledge-sharing between upstream and downstream firms or among members in a supply chain.

In Taiwan, medium-sized and small enterprises predominate, and, in comparison with foreign companies, they rely more on knowledge-sharing and flexibility in operation. This study aims, therefore, to examine the influence that core competences and knowledge-sharing among supply chain firms in Taiwan has on innovation. In this examination, knowledge-sharing among members is treated as the mediating variable in order to determine whether knowledge-sharing changes the relationship between core competences and innovation.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

This section discusses (1) the resource-based view (RBV), (2) core competences and innovation, (3) knowledge-sharing and innovation, and (4) core competences, knowledge-sharing, and innovation.

2.1. The Resource-Based View (RBV)

In order to construct business strategies, analyses of strategic management in the 1980s focused on industrial structure and competitive positions, the external environment of firms, opportunity and threat, and the advantages and disadvantages of firms. Since the 1990s, however, scholars have shifted the focus of strategic analysis to the firms themselves. Wernerfelt [1984], after reviewing the business growth theory put forth by Penrose in 1959, proposed the resource-based view (RBV), suggesting that, in order to obtain benefits, a firm must have prominent resources and the "unique competence" to effectively use those resources. Wernerfelt [1984] further stated that firms produce effective products using special resources so as to obtain benefits. Under this scenario, the main task of firms is to create or seize the advantages of resources that cannot be directly or indirectly obtained by other companies.

With the advent of serious changes in the business environment in recent decades, firms seek to achieve persistent competitive advantages by adjusting their competences according to the latest change in environment. Many scholars suggest that dynamic integration competence allows firms to gain persistent competitive advantages [Grant, 1996; Zott, 2003; Jantunen, 2005; Wu, Lin, and Hsu, 2007]. Establishment of a supply chain and development of the network both rely on the long-term cooperation of the members. For rivals, a supply chain has valuable core resources that cannot be imitated and replaced [Gulati, Nohria

and Zaheer, 2000]. Through their supply chain, firms can obtain the resources needed to deal with changes in the environment and can increase their own core competences by learning from, and cooperating with, other members of the chain.

Wadhwa and Saxena [2007] suggested that, in developing strategies to respond to environmental change, firms should establish a flexible supply chain. Members in the supply chain should have interactive learning and dynamic integration competences. A flexible supply chain not only allows firms to achieve these two characteristics, but also serves as their resource base.

2.2. Core Competences and Innovation

Hamel and Prahalad [1994] initially proposed the concept of "core competence," which refers to the knowledge-learning effect accumulated by firms from past to present. The concept of core competence is applied to learning, integration, technology, and sharing. Collis and Mongemery [1995] defined core competences as activities of a firm that are better than those of its rivals, that are needed by the market, and that serve as the base of persistent competences for the firm. In other words, business core competences translate into advantageous resources in a firm's overall business strategy. Sabourin and Pinsonneault [1997] suggested that the term *core competences* refers to the technique and management system used by a firm to create special competitive advantages. According to Hafeez, Zhang, and Malak [2002], core competences are drives transformed by corporate resources and corporate potential. Based on prior research, the current study defines core competences as various critical capabilities that ensure a firm's survival and that develop and enhance a firm's competitive advantages.

Resource-based theory emphasizes that persistent resources that cannot be imitated or transferred are important factors in business operation. Moreover, it has been shown that firms can enhance organizational core competences by controlling precious, rare, and different resources that cannot be replaced in order to enhance their competitive advantages and profit-making base [Prahalad and Hamel, 1990]. Core competences with regard to resources can positively influence innovation. In research on the electronics information industry, for example, Wu et al. [2007] indicated that the dynamic core competences of firms directly influenced innovation.

Through a supply chain, firms can obtain the core resources they need and then transform them into core competences that give them competitive advantages in an environment. The key to corporate performance is not corporate resources, but the competence to adapt to environmental change [O'Driscol et al., 2001; Wu et al., 2007; Loewe and Chen, 2007]. In other words, core competences become outdated when the environment changes, and firms that do not implement innovations in response to the new environment will be eliminated. On the other hand, firms with a high level of innovation possess the core competences to adapt to the new environment and thus survive the change. Based on the competence classification and the categorization of core competences by Long and Vickers-Koch [1995], the current study measures core competences with regard to threshold capabilities, critical capabilities, and cutting-edge capabilities. The study hypotheses are as follows:

H1 Higher core competences of the firms indicate better innovation.

H1.1. Higher threshold capabilities of the firms indicate better innovation.

H1.2. Higher critical capabilities of the firms indicate better innovation.

H1.3. Higher cutting-edge capabilities of the firms indicate better innovation.

2.3. Knowledge-Sharing and Innovation

Nancy [2000] suggested that knowledge-sharing means to share personal information or knowledge with others who would thus have the same information or knowledge. Nonaka, Toyama, and Konno [2000] indicated that knowledge-sharing is the creation and reuse of knowledge. When a person's knowledge is not shared, the effectiveness of that knowledge belongs only to him or her. Knowledge-sharing, therefore, refers to both knowledge delivery and knowledge reception. The process includes individuals, groups, organizations, and even cross-organizations. This study examined knowledge-sharing among supply chain partners at the cross-organizational level.

In a supply chain, firms can use logistics, business flow, cash flow, and information flow to complement the resources of one another, exchange information, and obtain mutual benefits. This knowledge-sharing does not

occur in the case of independent firms. Teece, Pisano, and Shuen [1997] suggested that, as a resource, knowledge cannot be easily obtained, transferred, or imitated by firms. Instead, it is obtained through knowledge-sharing among firms, which then transform it into competences and competitive advantages. Thompson and Heron [2006] suggested that, when firms have a sufficient psychological contract and organizational commitment, knowledge-sharing plays an important role in innovation. In a study of enterprises in seven European countries, Caloghirou et al. [2004] demonstrated that internal and external knowledge-sharing positively influenced corporate performance. According to Ziger [1999], organizations engaged in developing new products should acquire knowledge.

From these studies, it is clear that knowledge is the resource base of firms and the key factor in achieving competitive advantage. Since knowledge-sharing refers to both knowledge delivery and reception [Davenport and Prusak, 1999], the current study used these two indicators to measure knowledge-sharing among supply chain partners. It seems that external knowledge-sharing among firms can enhance their efficacy and innovation. In order to validate these views, this study proposed the following hypotheses:

H2 Higher knowledge-sharing among supply chain partners indicates better innovation.

H2.1. Higher knowledge delivery among supply chain partners indicates better innovation.

H2.2. Higher knowledge reception among supply chain partners indicates better innovation.

2.4. Core Competences, Knowledge-Sharing, and Innovation

In order to obtain advantages with regard to innovation, firms in a supply chain should not only rely on their core competences, but also share useful knowledge with upstream and downstream partners through information flow in the supply chain. Knowledge integration and application can enhance the relationship between core competences and innovation in firms [Pitt and Clarke, 1999]. Caloghirou et al. [2004] examined the influence on innovation by interaction between external sources of knowledge and internal core competences,

and found that interaction between internal competences and external knowledge-sharing positively enhances business innovation. Jantunen [2005] examined organizational knowledge processing from the perspective of dynamic competence, and found that a firm's knowledge integration competence would be reflected in innovation performance. The current study infers, therefore, that the interaction between knowledge integration and core competences of a firm will positively enhance innovation. In other words, external knowledge-sharing among firms can enhance the positive correlation between corporate core competences and innovation.

In terms of knowledge delivery, this study believes that the delivery of useful knowledge such as industrial experiences, market messages, and technical information among supply chain partners both upstream and downstream would help members to develop supportive and basic technical abilities that can be used to develop innovation when they are faced with competitive pressure. By gaining knowledge relating to suppliers and customers, supply chain partners not only would become a positive force in helping a partner seek technical systems that would significantly increase its competitiveness, but also would be of help to partners in maintaining their competitive advantages in the future. Based on these deductions, the current study believes that delivering knowledge to supply chain partners would strengthen the positive correlation of core abilities for innovation, as articulated in Hypotheses 3.1 through 3.3:

H3 Higher knowledge-sharing among supply chain partners enhances the positive correlation between core competences and innovation.

H3.1. Higher knowledge delivery among supply chain partners enhances the positive correlation between threshold capabilities and innovation.

H3.2. Higher knowledge delivery among supply chain partners enhances the positive correlation between critical capabilities and innovation.

H3.3. Higher knowledge delivery among supply chain partners enhances the positive correction between cutting-edge capabilities and innovation.

In terms of knowledge reception, this study believes that companies with high knowledge reception are able to gain more information from suppliers on products and technical issues, and also gain more information on the market and customer needs. Through active control and monitoring of environmental information, companies can better understand industrial techniques and be more closely aligned to market needs. Companies that gain useful knowledge from supply chain partners are better able to sensitively adjust or modify their innovation behavior, especially when using relevant core abilities to develop innovations in competitive products, production procedures, and marketing to satisfy market demands. Companies with high knowledge reception, therefore, can cause core ability conversions for better innovation benefits. Based on the above discursive logic, this study develops Hypotheses 3.4 through 3.6:

H3 Higher knowledge-sharing among supply chain partners enhances the positive correlation between core competences and innovation.

H3.4. Higher knowledge reception among supply chain partners enhances the positive correlation between threshold capabilities and innovation.

H3.5. Higher knowledge reception among supply chain partners enhances the positive correlation between critical capabilities and innovation.

H3.6. Higher knowledge reception of supply chain partners enhances positive correction between cutting-edge capabilities and innovation.

3. RESEARCH METHOD

This section discusses the research framework for the current study, the measurement of variables and questionnaire design, sampling design, data analysis, and the reliability and validity of the data.

3.1. Research Framework

The research framework developed for this study, based on the literature review, is shown in Figure I. First, the study discussed the correlation between

core competences and innovation among firms in a supply chain. Second, it explored the influence of knowledge-sharing on innovation. Third, it used knowledge-sharing as the mediating variable to ascertain whether degrees of knowledge-sharing influence the relationship between core competences and innovation differently, in order to demonstrate the mediating effect of knowledge-sharing between core competences and innovation. Core competences are measured by threshold capabilities, critical capabilities, and cutting-edge capabilities [Long and Vickers-Koch, 1995]. Knowledge-sharing is measured by knowledge delivery and knowledge reception [Davenport and Prusak, 1999].

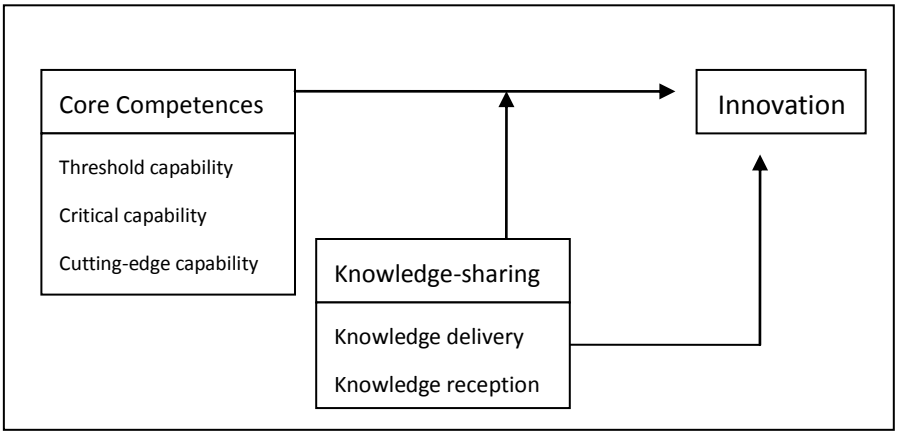

Figure I. Research Framework for the Current Study

3.2. Measurement of Variables and Questionnaire Design

Information on the measurement of variables and design of the questionnaire used in this study is shown in Table 1. All items are measured on a 5-point Likert scale. Questionnaire items on core competences were based on items developed by Long and Vickers-Koch [1995]; items relating to knowledge-sharing were based on the measures of Davenport and Prusak [1999]; and items pertaining to innovation were based on those developed by Wu Su-hua [1998] and Neely [1998]. In social sciences research, the change in dependent variables is totally attributed to independent variables. Control variables can reduce the risk of exaggerating the explained power of independent variables. The number of employees and the amount of capital, therefore, are treated as control variables in this study to avoid the interference of corporate scale on the research findings.

Table 1
Measurement of Variables and Questionnaire Design of Core Competences

Dimensions		Operational Definitions	Item	Scholars
Core competences	Threshold capabilities	These are the supportive capabilities and basic techniques used when firms encounter competitive stress.	4	Long and Vickers-Koch [1995]
	Critical capabilities	These are the techniques or systems that significantly influence corporate competitiveness.	4	
	Cutting-edge capabilities	These are the capabilities that must be developed by firms to maintain future competitive advantages.	4	
Knowledge sharing	Knowledge delivery	The firms deliver immediate and meaningful information to supply chain partners.	6	Davenport and Prusak [1999]
	Knowledge reception	The firms receive the immediate and meaningful information provided by supply chain partners.	6	
Innovation		*Innovation* includes product innovation, manufacturing innovation, and organization innovation	14	Neely [1998], Wu [1998]

In order to more clearly construct items in the questionnaire and to enhance its reliability, pre-tests and in-depth interviews were conducted with experts, using the first draft of the document, before the final version was administered. After business supervisors at 3M and procurement supervisors at China Telecom were interviewed, all items remained the same after the pre-test, except that the wording was modified to reduce the number of academic terms and thus enhance clarity.

3.3. Sampling Design

Professional labor divisions in the manufacturing industry in Taiwan are clearly defined. In recent years, manufacturing companies faced with intense international competition have sought to work closely with supply chain partners in order to gain innovative advantages. The result is a massive, dense supply

chain system within the manufacturing sector. This study focused on knowledge-sharing in a vertical supply chain system. The study treated the mature manufacturing firms in a supply chain as subjects in order to examine the interaction between them and their supply chain partners. Manufacturing companies listed in the database of the Securities and Futures Institute of Taiwan in 2008 were treated as questionnaire subjects. The study conducted quota sampling, using the following statistics on industrial distribution of the manufacturing industry in 2008, which were provided by the Directorate General of Budget, Accounting, and Statistics:

Metal machinery industry	24%
Information and electronics industry	39
Civil chemical industry	37

A total of 1,000 questionnaires were distributed – 400 online and 600 by mail. The investigation lasted four months – from June 1, 2009, to September 30, 2009.

After invalid questionnaires were eliminated, there were 139 valid questionnaires, for a valid return rate of 13.9%. Table 2 is an analysis of the sample structure, showing the number of employees, amount of capital, and type of industries represented in the valid samples. With regard to the type of industries, the distribution was:

Metal machinery industry	25.2%
Information and electronics industry	37.4
Livelihood industry	35.3
Other industries	2.2

In order to validate that the returned samples were representative, a consistency test was conducted on the industries. A chi-square test was conducted on the industrial categories of the main manufacturing industries investigated by the Directorate-General of Budget, Ministry of Economic Affairs, in 2008. The validation result demonstrated that p of statistics did not reach a 0.05 significance level and that there was no significant difference between the returned samples and the industrial distribution of population. It was confirmed, therefore, that the samples were representative.

Table 2
Sample Structure Analysis

Firms' Statistical Variables	Categories	Number of Samples	Valid Percentage (%)
Number of Employees	Fewer than 200 people	38	27.3
	200-399 people	18	12.9
	400-599 people	26	18.7
	600-999 people	21	15.1
	More than 1,000 people	36	25.9
	Total	139	100
Amount of Capital	Less than 80 million	24	17.3
	Above (including) 80 million and below 200 million	20	14.4
	Above (including) 200 million and below 10 billion	28	20.1
	Above (including) 10 billion and below 50 billion	45	32.4
	Above (including) 50 billion	22	15.8
	Total	139	100
Types of Industries	Metal machinery industry	35	25.2
	Information electronics industry	52	37.4
	Livelihood industry	49	35.3
	Others	3	2.2
	Total	139	100

3.4. DATA ANALYSIS

Regression analysis is primarily used to assess which variables can more effectively predict a certain criterion variable. When one is about this, it is possible to use stepwise regression to filter the variables with greater predictive accuracy. Based on past literature, this study sought to examine the composite predictive ability of the selected prediction variables for criterion variables, in order to avoid exaggerating the effect of prediction variable on criterion variable. This study, therefore, used hierarchical regression analysis, with the bases of

theory and hypothetical deduction, to incorporate variables into the regression model, layer by layer, in order to determine the results of the different models.

This study treated innovation as a dependent variable in order to ascertain whether the influences of core competences and knowledge-sharing on innovation are significant. It also determined whether the interaction between core competences and knowledge-sharing significantly influences innovation, and examined the mediating effect of knowledge-sharing between core competences and innovation. The analytical steps were as follows:

In Model 1, the control variable was included in the regression equation.
In Model 2, core competence was included in Model 1.
In Model 3, knowledge-sharing was included in Model 2.
In Model 4, the interaction between core competences and knowledge-sharing was included in Model 3.

Step by step, the related variables were included to examine the difference and similarity of the outcomes for the different models.

3.5. Reliability and Validity

After the questionnaires were retrieved, reliability analysis was conducted on the items. Cronbach's α of the items is as follows:

Threshold capabilities	0.83
Critical capabilities	0.89
Cutting-edge capabilities	0.89
Innovation	0.92
Knowledge delivery	0.91
Knowledge reception	0.90

These data indicate that the scales of this study revealed proper reliability.

Items in the questionnaire were based on the related literature and were modified by experts during the pre-test, thus ensuring a certain degree of content validity. In terms of construct validity, the study used confirmatory factor analysis (CFA) to test the model fit in order to evaluate whether constructs had sufficient convergent validity and discriminate validity. Convergent validity, as shown in Table 3, is the standardized factor loading of the items, which were all higher than 0.6. The t values were all greater than the threshold value of 1.96,

which shows that the dimensions all have good convergent validity. For discriminate validity, chi-square differential testing was used to calculate the amount of chi-square value change when the correlation coefficients of the paired dimensions were set to 1. In the three dimensions of core competences:

Threshold capabilities and critical capabilities are significantly different ($\Delta\chi2$=346.24).

Critical capabilities and cutting-edge capabilities are significantly different ($\Delta\chi2$=140.72).

Threshold capabilities and cutting-edge capabilities are significantly different ($\Delta\chi2$=178.44).

The discriminate validity of the dimensions of knowledge delivery and knowledge reception also reached a level of significance ($\Delta\chi2$=160.12). The chi-square values in the limitation models of computation results are all greater than the chi-squares of unlimited measurement models while reaching the level of significance, which shows that the dimensions all have discriminate validity.

Table 3
Confirmatory Factor Analysis

	Item	Factor Loading	T (>1.96)	Cronbach's α
Threshold Capabilities	1. general support system	0.7673	11.5695	0.83
	2. technology system	0.7914	7.7914	
	3. operating process	0.8596	9.9121	
	4. market reach	0.8811	11.9554	
Critical Capabilities	1. acquire new technology	0.8368	6.5655	0.89
	2. improvement technology	0.8356	6.5654	
	3. supported technology	0.8362	2.5613	
	4. product design	0.8560	6.5331	
Cutting-edge Capabilities	1. strategic planning	0.9009	12.9235	0.89
	2. future technology	0.9000	12.9113	
	3. product forecast	0.8864	12.7311	
	4. Adaptation to new conditions	0.8027	8.1658	

--cont'd

Table 2 *(Cont'd)*

Confirmatory Factor Analysis

	Item	Factor Loading	T (>1.96)	Cronbach's α
Knowledge Delivery	Delivery to Supplier			0.91
	1. industry experience	0.7121	2.8563	
	2. market message	0.7173	3.0342	
	3. technology information	0.7372	7.3359	
	Delivery to Customer			
	1. industry experience	0.6863	7.1676	
	2. market message	0.7099	2.1730	
	3. technology information	0.7073	2.1138	
Knowledge Reception	Reception from Supplier			0.90
	1. industry experience	0.6084	6.6581	
	2. market message	0.7220	8.1486	
	3. technology information	0.7521	8.2734	
	Reception from Customer			
	1. industry experience	09140	12.3219	
	2. market message	0.7999	8.3890	
	3. technology information	0.8273	7.7794	
Innovation	1. various products	0.8773	19.6101	0.92
	2. new product	0.8646	7.5200	
	3. new innovation concept	0.7946	7.4879	
	4. product launch	0.8792	7.4845	
	5. patent	0.8382	18.1070	
	6. manufacturing process	0.8921	10.4559	
	7. quality	0.8560	6.5331	
	8. cost	0.8027	8.1658	
	9. flexibility	0.8239	8.8576	
	10. international experience	0.8256	7.2758	
	11. brand	0.8659	9.1219	
	12. channel	0.9268	13.9123	
	13. selling	0.8695	9.1427	
	14. service	0.7914	7.7821	

4. RESULTS AND DISCUSSION

This section presents a discussion of the descriptive statistics and correlation analysis, and the hierarchical regression analysis.

4.1. Descriptive Statistics and Correlation Analysis

Table 4 shows the mean, standard deviation, and correlation analysis results for the six research variables. The correlation analysis reveals the relative intensity among variables for determining the colinearity. As indicated in the table, correlation among the variables is significant. Moreover, the correlation value among the variables is below 0.7. Thus, there is no colinearity among variables in this study.

Table 4

Outcomes of Correlation Analysis

Research Variables	Threshold capabilities	Critical capabilities	Cutting-edge capabilities	Knowledge delivery	Knowledge reception	Innovation
Threshold capabilities	1					
Critical capabilities	0.673***	1				
Cutting-edge capabilities	0.635***	0.668***	1			
Knowledge delivery	0.442**	0.439**	0.457**	1		
Knowledge reception	0.444**	0.342**	0.349**	0.632**	1	
Innovation	0.561**	0.364**	0.537**	0.572**	0.481**	1

Note:

* indicates p<0.05

** indicates P<0.01

***indicates p<0.001.

4.2. Hierarchical Regression Analysis

Data analysis was based on the hierarchical regression model, and innovation was treated as a dependent variable. The analytical results are shown in Table 5.

Table 5

Analytical Results of Hierarchical Regression Model

Dependent Variable: Innovation	Model 1	Model 2	Model 3	Model 4
Intercept	3.901	3.997	3.144	3.297
INDEPENDENT VARIABLES:				
Core competences				
Threshold capabilities (c1)		0.26**	0.27**	0.18*
Critical capabilities (c2)		0.27**	0.27**	0.59**
Cutting-edge capabilities (c3)		0.18*	0.14*	0.29**
MEDIATING VARIABLES:				
Knowledge-sharing				
Knowledge delivery (k1)			0.23**	0.11*
Knowledge reception (k2)			0.04	0.06
Interaction: core competences				
*Knowledge-sharing				
c1*k1				-0.07
c2*k1				0.04
c3*k1				0.03
c1*k2				0.10*
c2*k2				-0.28**
c3*k2				-0.14*
CONTROL VARIABLES				
Number of employees	0.07*	0.05	0.06	0.08
Amount of capital	-0.02	-0.02	-0.02	-0.02
R^2	0.23	0.87	0.89	0.91
Adj-R^2	0.03	0.74	0.78	0.80
F-Value	2.627	80.47**	71.78**	51.88**

In Model 1, the number of employees and the amount of capital (control variables) are included in the regression model, which shows that capital does not directly influence innovation. The number of employees significantly influences organizational innovation.

Model 2 examines the influence of the firms' core competences on innovation. As shown in Table 5, the firms' threshold capabilities, critical

capabilities, and cutting-edge capabilities positively and significantly influence innovation. The research findings support H1.1, H1.2 and H1.3. First, the firms' basic core techniques and system will enhance innovation. The firms' breakthrough depends on its original techniques, system, and experience. Second, the firms' critical capabilities can effectively lead to innovation. The data show that the firms are innovative because they have significant key techniques or systems. Third, the firms' cutting-edge capabilities give them the techniques and systems needed for future planning and development, which can lead to innovation. These research findings are consistent with past empirical results [such as O'Driscol, Carson and Gilmore, 2001; Wu, Lin, and Hsu, 2007; Loewe and Chen, 2007]. The manufacturing industry in Taiwan is extremely competitive. In order to stand out, firms must have core competences and must possess the techniques and systems related to industrial competition. Thus, when making significant decisions, firms will be able to introduce new manufacturing skills and managerial approaches in response to environmental change. In addition, they will be able to control market trends, reduce costs, increase efficiency, enhance flexibility, and improve their response to customers.

In Model 3, knowledge-sharing is included in order to examine its influence on innovation among supply chain partners. First, the empirical result indicates that there is a significant and positive relationship between knowledge delivery and innovation. In other words, the more knowledge that is delivered from the firms to their supply chain partners, the more significant the innovation will be. H2.1 is supported. The reason is that, in order to deliver useful information to supply chain partners, the firms must effectively comprehend and integrate their own information so that they can share operational knowledge. Before sharing knowledge with supply chain partners, therefore, the firms have integrated the knowledge that will increase corporate innovation. This finding is consistent with Thompson and Heron [2006] and Caloghirou et al. [2004]. Second, it was found that knowledge reception does not significantly influence innovation; therefore, H2.2 is not supported. This finding is inconsistent with related literature [Thompson and Heron, 2006; Caloghirou et al., 2004]. The reason is that, when firms receive information from their supply chain partners, they have to first decode it in order to transform it into useful knowledge. In other words, it takes time for the firms to absorb and apply the information received. The information, therefore, cannot immediately and significantly influence corporate innovation. If

the firms can clearly indicate the related information and enhance the supply chain members' comprehension, their innovation will be more significant.

In Model 4, this study examined the interaction between knowledge-sharing and core competences. The research finding demonstrates that firms' knowledge delivery to their supply chain partners does not significantly influence the positive correlation between threshold capabilities and innovation, critical capabilities and innovation, or cutting-edge capabilities and innovation. The findings do not support H3.1, H3.2 and H3.3. The reason that firms can deliver useful knowledge to supply chain partners is that they can effectively deal with and integrate knowledge. Processing refers to the core competences of firms. Thus, it cannot be reflected in the relationship between core competences and innovation.

This study analyzed the mediating effect of knowledge reception between threshold capabilities and innovation, and found that the interaction will positively enhance corporate innovation. H3.4 is supported. In order to clearly indicate the mediating effect of knowledge reception between threshold capabilities and innovation, this study divided knowledge reception and threshold capabilities into high and low groups. A mean contingency table was constructed, and the interaction is depicted in Figure II. As shown, there is a positive relationship between threshold capabilities and innovation. Moreover, the slope of firms with high knowledge reception is more than those with low knowledge reception. The data indicate that the knowledge reception of supply chain partners can enhance the positive relationship between threshold capabilities and innovation. Therefore, firms with higher knowledge reception and better threshold capabilities will have more prominent innovative benefits. Through knowledge reception, the firms can learn customers' views from supply chain partners and use the information to further modify their basic systems and techniques so as to enhance customer loyalty and construct obstacles to entry by rival firms.

This study also analyzed the mediating effect of knowledge reception between critical capabilities and innovation and found an interactive effect between critical capabilities and knowledge reception. Knowledge reception, however, does not enhance the innovation of firms. H3.5 is not supported (negatively significant). This study also delineated the interaction among knowledge reception, critical capabilities, and innovation, as shown in Figure III.

Mean Contingency Table	Threshold Capabilities			
	Low Threshold Capability Group		High Threshold Capability Group	
Knowledge reception	Mean	Standard Deviation	Mean	Standard Deviation
Low knowledge reception group	3.53	0.71	4.16	0.36
High knowledge reception group	3.58	0.29	4.39	0.32

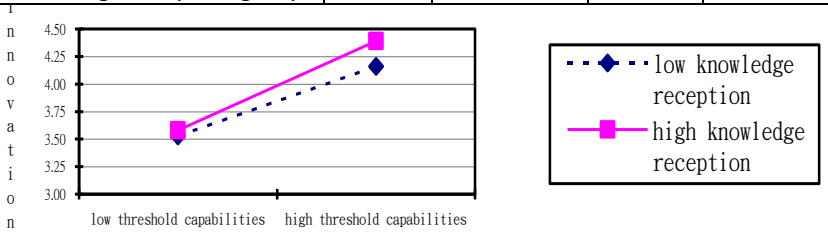

Figure II. Interaction Among Threshold Capabilities, Knowledge Reception, and innovation

Mean Contingency Table	Threshold Capabilities			
	Low Threshold Capability Group		High Threshold Capability Group	
Knowledge reception	Mean	Standard Deviation	Mean	Standard Deviation
Low knowledge reception group	3.26	0.83	4.10	0.27
High knowledge reception group	3.81	0.23	4.26	0.34

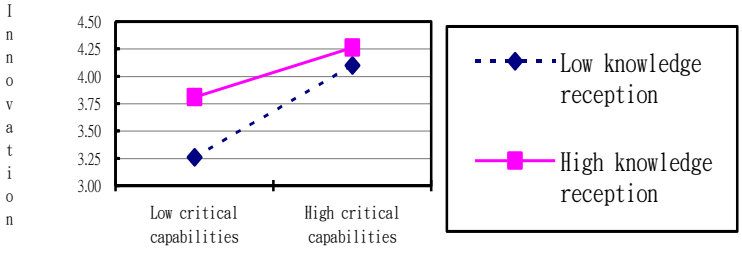

Figure III. Interaction Among Critical Capabilities, Knowledge Reception, and Innovation

As indicated in Figure III, there is a positive correlation between critical capabilities and innovation. However, the slope of firms with low knowledge reception is more significant. In other words, firms' knowledge reception reduces the positive correlation between critical capabilities and innovation. The reason is that the knowledge obtained from supply chain partners cannot be easily imitated and transferred. If the firms are overly optimistic or pessimistic about the knowledge received, without adjusting their competences, they will use the knowledge to reduce innovation by constructing key techniques and systems related to industrial competition.

Finally, this study examined the mediating effect of knowledge reception between cutting-edge capabilities and innovation and found that the higher knowledge reception is, the lower the positive and significant correlation between cutting-edge capabilities and innovation will be. H3.6 is not supported (negatively significant). The contingency table and interaction are shown in Figure IV.

Interaction Mean ContingencyTable	Threshold Capabilities			
	Low Threshold Capability Group		High Threshold Capability Group	
Knowledge reception	Mean	Standard Deviation	Mean	Standard Deviation
High knowledge reception group	3.43	0.83	4.07	0.27
High knowledge reception group	3.86	0.23	4.20	0.34

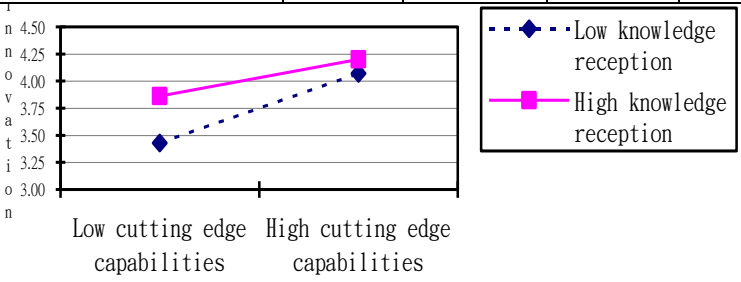

Figure IV. Interaction Among Cutting Edge Capabilities, Knowledge Reception, and Innovation

As shown in Figure IV, there is a positive and significant relationship between cutting-edge capabilities and innovation. However, the slope of firms with low knowledge reception is more significant. This study suggests that

knowledge obtained from supply chain partners should be modified according to the firms' quality. Thus, firms can have core competences to plan, predict, and respond to the future. If firms blindly develop innovation using knowledge received from supply chain partners, the action will negatively influence their future development. They should not, therefore, overly trust external information or be too optimistic about future trends and developments. With regard to the research findings pertaining to the mediating effect of knowledge-sharing, except for H3.4, the rest of the data refutes the view of Caloghirou et al. [2004] that interaction between core competences and knowledge-sharing can enhance innovation performance. The results for H3.5 and H3.6 are very different from past research findings. The reason is that knowledge related to industrial competition or future development is usually not easily transferred. Thus, key or visionary knowledge received from supply chain partners sometimes cannot positively enhance core competences and innovation.

5. CONCLUSIONS AND RECOMMENDATIONS

In order to supplement the dimensions that tend to be neglected in studies on external knowledge-sharing, this study used the manufacturing industry in Taiwan to examine the influence of core competences (threshold capabilities, critical capabilities, and cutting- edge capabilities) on innovation and to determine whether knowledge-sharing (knowledge delivery and knowledge reception) among supply chain partners will enhance or reduce the influence of core competences on innovation.

This study collected 139 valid questionnaires. The hierarchical regression analysis found that the firms' threshold capabilities, critical capabilities, and cutting-edge capabilities will enhance the firms' innovation, and that knowledge delivery to supply chain partners will enhance their innovation. Knowledge reception by supply chain partners, however, does not increase innovation, nor does knowledge delivery to supply chain partners have a mediating effect between core competences and innovation. In contrast to firms with low knowledge reception from supply chain partners, those with high knowledge reception can enhance a positive relationship between threshold capabilities and innovation and reduce positive relationships between critical capabilities and innovation and between cutting-edge capabilities and innovation.

This study found, first, that innovation is based on the core competences of firms. Analytical results reveal that firms' threshold capabilities, critical

capabilities, and cutting-edge capabilities all significantly and positively influence innovation. From a resource-based viewpoint, the firms' core competences must be precious and cannot be imitated and replaced, if the firms are to attain persistent competitive advantages. Threshold capabilities, critical capabilities, and cutting-edge capabilities meet these criteria. Through core competences, firms have the dynamic competence to respond to environmental change, which will give them persistent competitive advantages resulting in product, process, or organizational innovation. In other words, the reason that firms experience positive innovation is that they possess the techniques and systems needed to achieve competitiveness and respond to the future. Because of these techniques and systems, they can deal with the risks and challenges caused by innovation and can remain prominent. In order to perform well in innovation, firms must have positive threshold capabilities, critical capabilities, and cutting-edge capabilities.

Second, this study found that knowledge delivery is the indicator of corporate knowledge internalization. The analytical results show that the firms' information delivery to supply chain partners can possibly enhance innovation. When firms are able to deliver useful information to supply chain partners, this means that they have effectively internalized the knowledge in the organization in a process that leads to immediate and useful information. When firms control knowledge delivery, it usually means that, in comparison with other supply chain members, they have better key knowledge, and can therefore perform well with regard to innovation. Key knowledge delivery allows supply chain partners to have more capabilities to cooperate with firms, and results in innovation benefits for the firms. Corporate managers, therefore, should consider the role of their firms as knowledge deliverers or receivers in the supply chain. Firms that are mostly knowledge receivers are less likely to control knowledge. Firms can consider establishing a knowledge management or information delivery and reception platform in order to enhance the knowledge delivery competence and knowledge control of supply chain partners. Through the general effects of knowledge-sharing, they can enhance innovation so as to achieve persistent operation.

Third, this study found that knowledge-sharing among partners allows firms, in conjunction with their supply chain partners, to construct obstacles to entry by rivals, thus further enhancing the advantages of the supply chain. The study findings show that knowledge reception can enhance the positive influence of threshold capabilities on innovation. Thus, in comparison with a competitive

supply chain, members of another supply chain that have special operational knowledge and that share this knowledge effectively will achieve a general effect of knowledge. The firms in a supply chain can effectively construct entry obstacles for rivals. Regarding individual firms, the firms should construct a system to measure the preciseness, benefit, and immediacy of information received and should use data mining to reduce the implication and ambiguity of information. Integrating the information received with their own threshold capabilities will lead to the advantages of innovation. Regarding the overall supply chain, firms should establish a platform for supply chain partners to share knowledge, thus ensuring knowledge flow. In doing this, however, firms should safeguard the confidentiality of information in order to avoid its imitation and use by rivals. In short, it is important to construct a platform that has external confidentiality and internal rapid flow of knowledge. It is likewise important for firms, in conjunction with their supply chain partners, to establish effective entry obstacles for rivals, which will also lead to innovation advantages.

Finally, this study found that innovation by firms depends on critical capabilities and cutting-edge capabilities, and that firms should not overly rely on external knowledge reception. The analytical results indicate that, when there is interaction among corporate critical capabilities, cutting-edge capabilities, and knowledge reception, innovation performance decreases. With regard to the influence of critical capabilities and cutting-edge capabilities on key competitiveness and future development, this study suggests that the knowledge is more implicit and ambiguous. If external information is relied on overly much for corporate development and planning, the firms' innovation will be reduced. In other words, receiving more knowledge does not guarantee positive outcomes. In order to break through the position limitation in a supply chain and achieve innovation, firms should control key capabilities and cutting-edge capabilities. Over-dependency on the partners' information will lead to high risks and prices for future development.

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