Proc. of The Third Intl. Conf. On Advances In Economics, Social Science and Human Behaviour Study - ESSHBS 2015

ISBN: 978-1-63248-085-9 doi: 10.15224/ 978-1-63248-085-9-60

# Role of Supplier Knowledge Development Capability in Product Innovation

Dr. Richard C.M. Yam

*Abstract*— **This study examines the relationship among supplier knowledge development capability, supplier integration, knowledge sharing, and product innovation. Data were collected from a questionnaire survey, and 210 responses from participants were analyzed using structural equation modeling. After the survey, interviews were conducted to obtain a clearer idea about the real-life situation.**

**Results from the questionnaire show that supplier knowledge development capability is positively related to supplier integration and product innovation. Therefore, firms can include supplier knowledge capability as a criterion when selecting suppliers. The results also have two connected conclusions: a higher level of supplier integration can lead to a higher level of product innovation and knowledge sharing, and more frequent knowledge sharing practices can also encourage product innovation.**

***Keywords—new product development, supplier knowledge development capability, supplier integration, knowledge sharing, productiInnovation***

## I. Introduction

With the development of globalization, customers are provided with numerous choices when selecting products. To survive and stay competitive in the diverse market, companies have to develop new products continuously and innovatively with speed (Dension, Hart and Kahn, 1996). Firms have become more aware of the product development cycle time and have been looking for ways to make new product development projects more effective (Clark and Fujimoto, 1991; Eisenhardt and Tabrizi, 1995; Sethi, Smith and Park, 2001; Takeuchi and Nonaka, 1986) and efficient. To achieve this goal, firms are suggested to not work alone but to work as teams (Edmondson and Nembhard, 2009). Research has suggested that embedding with suppliers promotes a collaborative or relational exchange among companies that are committed and are working together for mutual benefits (Chen, Paulraj and Lado, 2004; Kouftero, Cheng and Lai, 2007). Moreover, to be more effective in new product development, firms should cooperate with suppliers with superior product development capability (Koufteros, Cheng and Lai, 2007). In the future, competitive advantages of firms will be determined by their knowledge resources (Drucker, 1993). Therefore, suppliers' ability to develop knowledge should also be considered in supplier integration and new product development projects, as suppliers can act as a source of new knowledge.

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Knowledge development capability is essential to new product development, as knowledge can facilitate new product development. By further developing the knowledge base and combining new and existing knowledge, successful new product development can be achieved. This study explores the effect of supplier knowledge development capability on product innovation. In addition to the relationship between supplier knowledge development capability and supplier integration, this study also examines how supplier integration and knowledge sharing relate to product innovation in new product development.

This study aims to examine the role of supplier knowledge development capability in new product development.

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## II. Research Model Development

This section analyzes the relationship among different constructs and the development of the research model. Figure 1 shows the conceptual model. The hypotheses of the model are presented as follows.

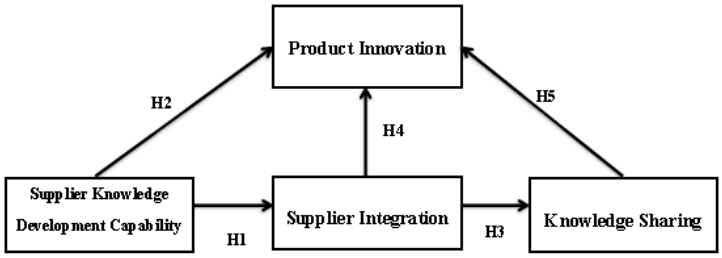


FIG.1 THE RESERCH MODEL

### A. *Supplier Knowledge Development Capability and Supplier Integration*

Prior research has argued that selecting suppliers with higher product development capability can have a significant effect on the team effectiveness of new product development (Petersen et al., 2005). However, as new product development is knowledge centered, the capability of developing knowledge is also important when selecting suppliers for new product development.

Supplier knowledge development capability involves suppliers' learning progression, use of existing knowledge, and organizational memory (Craighead, et al., 2009). The goal of integrating with suppliers is to take advantage of the knowledge and skills possessed by suppliers. By integrating and sharing knowledge with suppliers, on the one hand, firms can acquire new information that could be useful in developing new products. On the other hand, firms can focus on further developing their own competencies and skills. As

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knowledge is important in the process of new product development, suppliers with high knowledge development capability are likely to be able to encourage supplier integration. Therefore, the following is proposed:

H1: Supplier knowledge development capability is positively related to supplier integration.

## B. Supplier Knowledge Development Capability and Product

Existing literature shows that learning is related to innovation (Calantone, Cavusgil, and Zhao, 2002; Hult, Hurley and Knight, 2004) and that the importance of learning is often stressed (Cahill, 1996; Calantone, Cavusgil, and Zhao, 2002; Day, 1991; Demanpour, 1991; Verona, 1999). Demand uncertainty, technological turbulence, and competitive uncertainty are crucial environmental factors of innovation (Cahill, 1996). Moreover, firms that are active in learning usually are better at understanding and anticipating customer needs. Therefore, they are less likely to miss the opportunities created by emerging market demand (Cahill, 1996, Damanpour, 1991). Firms that learn continuously pay attention to competitors' actions (Gatignon and Xuereb, 1997), understand the strengths and weaknesses of rivals, and learn from both their successes and failures (Lant and Montgomery, 1987; Slater and Narver, 1994). These characteristics can be helpful in product innovation.

The exploitation of knowledge is also crucial to innovation. By making use of existing knowledge efficiently, firms can leverage, recombine, and incorporate the knowledge into the process of developing new product or extending the product line (Edmonson and Nembhard, 2009; Yang, 2010). During the process of knowledge exploitation, firms can develop new schema or changes to existing process. Afterwards, firms can convert these changes into product innovation (Nonaka, 1994).

Furthermore, suppliers with higher knowledge development capability are likely to be more capable of developing new knowledge and thus achieving better product innovation. Therefore, the following is proposed:

H2: Supplier knowledge development capability is positively related to product innovation.

## C. Supplier Integration and Knowledge Sharing

Firms working with their supply base are effective in processing uncertain and frequently ambiguous information (Cousins et al., 2011). Liker and Choi (2004) and Cousins et al. (2006) agreed that having deeper supplier relationships could enhance the exchange of knowledge between buyers and suppliers both formally and informally.

Early supplier integration is recommended in the process of new product development (Dyer and Singh, 1998; Handfield et al., 1999; Monczka et al., 1998; Petersen et al., 2003; Petersen et al., 2005). When suppliers are involved in the early stage of product innovation, firms have more opportunities to exchange information with suppliers, and these opportunities can be helpful at the beginning of new product development projects. By building a network with suppliers, organizations can have access to information and knowledge that can be impossible to obtain by other ways (Ilinitch et al., 1996, Kogut, 2000; Powell et al., 1996). Moreover, close ties between organizations can encourage firms to share valuable and intimate information (Koufteros et al, 2007), and organizations can have greater chances of possessing common information and knowledge of others (Gulati, 1998). By working as partners with suppliers and building a more intimate connection, organizations can have a high chance of having deep, two-way communication and a high level of transferring more detailed and richer information to other organizations (Granovetter, 1982; Uzzi, 1996).

Therefore, the following is proposed:

H3: Supplier integration is positively related to knowledge exchange.

## D. Supplier Integration and Product Innovation

By integrating with suppliers and working as teams, firms can take advantage of the knowledge and competencies of suppliers and focus on exploiting their own competencies and skills for new product development at the same time. Information on materials, process capability, quality, performance, features and timing of production of the products is given by suppliers and can be obtained by other partners in the processes of product innovation. These elements are crucial to the success of product innovation. Moreover, suppliers can gives advice to product development teams and suggestions on how to make improvements. The time required for product development can be shortened. Without supplier integration, the achievement of product innovation would be slow.

However, the alternative effect of supplier integration is that firms may achieve innovation in product design by having a mutually beneficial commitment with suppliers. Therefore, the following is proposed:

H4: Supplier integration is positively related to product innovation.

## E. Knowledge Sharing and Product Innovation

Existing literature has argued that the foundation of firm innovation, i.e., product innovation and process innovation (Damanpour and Gopalakrishman, 2001; Utterback and Abernathy, 1975), and competition is becoming more knowledge based (Teece, 1998). Innovation is highly dependent on the knowledge, skills, and experience possessed and their exploitation during the value creation process. Therefore, knowledge sharing can be considered as a high-valued input for innovation because it is firm specific, socially complex, and path dependent (Chiang and Hung, 2010; Dimitris et al., 2007; Gachter et al., 2010; Su-Chao and Ming-Shing, 2008)

Through knowledge sharing, the interaction among organizational members facilitates the dissemination of knowledge. Different knowledge sources can be brought together with a higher frequency of knowledge exchange. By restructuring and merging different knowledge stocks, new knowledge can be created and can help firms to generate more

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novel ideas (Nonaka, 1991). By increasing the frequency and the quality of knowledge sharing, the effectiveness of product innovation will likely increase. Therefore, the following is proposed:

H5: Knowledge sharing is positively related to product innovation.

# III. Research Methodology

## A. Survey Design

A survey was conducted to test the research model and the hypothesis. Questionnaires were sent to different manufacturers based in Hong Kong. Interviews were also conducted with industrialists from Hong Kong to gather more information about the project.

### 1) Questionnaire Design

The questions were designed according to each construct of the finding: supplier knowledge development capability, supplier integration, knowledge sharing, and product innovation. Table 1 presents the reference of each construct of the questionnaire.. In the questionnaire, the seven-point Likert-type measurement scales were used for evaluating supplier knowledge development capability, supplier integration, and product innovation. Participants were asked to give answers from strongly agree (=1) to strongly disagree (=7) or from not at all (=1) to extensive (=7) for these constructs in the questionnaire. For supplier knowledge sharing, the five-point Likert-type measurement scales were used to evaluate this area. Participants were asked to give answers from not at all (=1) to completely (=5) for the questions concerning supplier knowledge sharing. To ensure that the measurement scales is valid, instruments were adopted and modified from existing literature.

Supplier knowledge development capability was measured by 11 items grouped into three parts: learning, use of existing knowledge, and memory. Suppler integration was measured by six items, including level of partnership, length of relationship with suppliers, and suppliers' involvement in the design, manufacturing, testing, and commercialization of products. Knowledge sharing was measured by four items reflecting the satisfaction and sufficiency of knowledge sharing. Three items were used to measure product innovation. The scale reflects firms' capability to develop unique features, new products and features, and a number of new features.

TABLE 1.CONSTRUCTS AND REFERENCES OF THE QUESTIONNAIRE

| Constructs | No. of indicator | Source |
|---|---|---|
| Supplier Knowledge Development Capability | 11 | Craighead, Hult and Ketchen Jr., 2009 |
| Supplier Integration | 6 | Das, Narasimhan and Talluri, 2006 |
| Knowledge Sharing | 4 | Fugate, Stank and Mentzer, 2009 |
| Product Innovation | 3 | Koufteros, Vonderembse and Doll, 2002 |

### 2) Review Questions

To better understand the relationship between the research model and the industry in real life, industrialists were interviewed on a face-to-face basis to collect their opinion. The questions were based on existing literature and this study. Then, the questions on each construct were asked to give the interviewer a clearer idea about the practice of firms in reality. During the interviews, open-ended questions were asked to give the interviewees the chance to express their opinions.

## B. Data Collection and Sampling

Those who were invited to participate in the survey were manufacturers in the material, mechanical, and engineering, electronics and electrical, textiles and apparel, and printing/ packaging industries in Hong Kong. The responses from 210 participants were collected, and the data were analyzed.

## C. Statistical Analysis

After collecting responses from the participants, Microsoft SPSS 21 was used to construct the database of the study. Structural equation modelling was used to test the theoretical framework. Microsoft SPSS Amos was used to develop the models and process the data. The measurement model fit was assessed by evaluating the following: (i) absolute fit measures including the root mean square residual (RMR), goodness of fit index (GFI), and root mean square error of approximation (RMSEA), and (ii) incremental fit measures including the adjusted goodness of fit, normed fit index, and comparative fit index. At least four of these indices needed to be met for the model to be valid. The fit guideline is listed in Table 2.

TABLE 2. FIT INDEX AND FIT GUIDELINES

| Fit Index | Fit Guideline |
|---|---|
| RMR | ≤ 0.08 |
| GFI | ≥ 0.90 |
| AGFI | ≥ 0.80 |
| NFI | ≥ 0.90 |
| CFI | ≥ 0.90 |
| RMSEA | < 0.07 |

# IV. Results

## A. Model Fit

The structural model was tested, and the results of the model fits are as follows:

TABLE 3a. RMR, GFI

| Model | **RMR** | **GFI** | **AGFI** | PGFI |
|---|---|---|---|---|
| Default model | ***.458*** | ***.997*** | ***.969*** | .100 |
| Saturated model | .000 | 1.000 | | |
| Independence model | 9.683 | .722 | .537 | .433 |

TABLE 3b. BASELINE COMPARISONS

| Model | **NFI Delta1** | RFI rho1 | IFI Delta2 | TLI rho2 | **CFI** |
|---|---|---|---|---|---|
| Default model | ***.991*** | .947 | .998 | .987 | ***.998*** |
| Saturated model | 1.000 | | 1.000 | | 1.000 |
| Independence model | .000 | .000 | .000 | .000 | .000 |

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TABLE 3c. RMSEA

| Model | **RMSEA** | LO 90 | HI 90 | PCLOSE |
|---|---|---|---|---|
| Default model | **.039** | .000 | .193 | .367 |
| Independence model | .338 | .292 | .386 | .000 |

TABLE 4. MODEL FIT SUMMARY

| Fit Index | Result | Fit Guideline | Does it fit? (Y/N) |
|---|---|---|---|
| RMR | 0.458 | ≤ 0.08 | Y |
| GFI | 0.997 | ≥ 0.90 | Y |
| AGFI | 0.969 | ≥ 0.80 | Y |
| NFI | 0.991 | ≥ 0.90 | Y |
| CFI | 0.998 | ≥ 0.90 | Y |
| RMSEA | 0.039 | < 0.07 | Y |

The result shows that all six fit indices met the satisfactory level. Therefore, the model fits the data well and can be used to explain the hypotheses.

## B. *Estimate*

TABLE 5 REGRESSION WEIGHTS

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| SI | <--- | SKDC | .241 | .040 | 5.963 | *** | |
| KS | <--- | SI | .090 | .022 | 4.108 | *** | |
| PI | <--- | SKDC | .087 | .022 | 4.001 | *** | |
| PI | <--- | KS | .200 | .101 | 1.988 | .047 | |
| PI | <--- | SI | .259 | .036 | 7.280 | *** | |

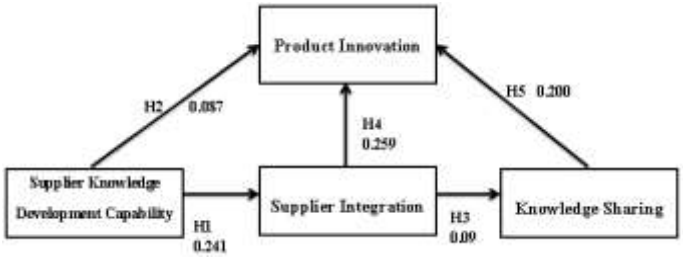


FIGURE2 RESEARCH MODEL AND TESTING RESULTS

Table 5 and Figure 2 show the results of hypothesis testing of the relationship between each construct. For H1, the relationship between supplier knowledge development capability and supplier integration was investigated. Table 5 and Figure 2 show that the effect of supplier knowledge development capability on supplier integration has a value of 0.241 ($p<0.001$). Therefore, H1 is supported. For H2, the effect of supplier knowledge development capability on product innovation was examined. This effect has a value of 0.087 with $p<0.001$. Therefore, H2 is supported. For H3, the relationship between supplier integration and knowledge sharing was investigated. From the result, the effect of supplier integration on knowledge sharing has a value of 0.09 ($p<0.001$). Similar to H1 and H2, H3 is supported. For H4, the effect of supplier integration on product innovation was examined. The value of the effect is 0.259 ($p<0.001$), and thus H4 is supported. For H5, the effect of knowledge sharing product innovation was examined. Although the probability is 0.047, it is smaller than 0.05. Statistically, if the probability of the relationship is smaller than 0.05, the relationship is still considered as significant. Therefore, H5 is supported. In conclusion, all the hypotheses are significant and supported by the result of this research.

# v. Discussion

Product innovation in new product development is a topic that has received considerable attention. Studies have encouraged firms to work with suppliers as a teams. However, as new product development is knowledge centered, the importance of knowledge should not be neglected.

However, prior empirical research has yet to examine the relationship between supplier knowledge development capability and supplier integration, as well as product innovation. This study can fulfill the gap by providing new empirical evidence on the direct and positive relationship among supplier knowledge development capability, supplier integration, and product innovation in new product development.

From the findings, the hypothesis that "supplier knowledge development capability is positively related to supplier integration" (H1) is supported. According to one of the interviewees, firms are willing to collaborate with suppliers that have the ability to develop their knowledge base continuously, thus supporting H1.

Aside from the positive effect of supplier knowledge development capability on supplier integration, the ability of suppliers to develop knowledge also affects product innovation. The hypothesis that "supplier knowledge development is positively related to product innovation" (H2) is supported in the findings. Product innovation determines whether a firm can fulfill customers' desire for newer products. Product innovation depends on how well the organization can combine existing knowledge and incremental learning (Kogut and Zander, 1992). Organizational knowledge creation and its integration with existing knowledge can contribute to product innovation. One of the interviewed industrialists mentioned the importance of supplier knowledge development capability, saying that "the development of the knowledge base of suppliers is very important as they can provide us with information on whether the idea or the concept of our new product will work or not, and sometimes we rely on their innovative ideas." Therefore, unsurprisingly, supplier knowledge development capability is positively related to product innovation.

The findings echo those of past literature that supplier integration is positively related to knowledge sharing (H3). By maintaining a deep supplier relationship, the exchange of information between buyers and suppliers can be enhanced in both formal and informal ways (Liker and Choi, 2004; Cousins et al., 2006). By having a longer and more committed relationship, trust can be built between the two parties and knowledge sharing will be of higher quality and frequency. Therefore, supplier integration can lead to knowledge sharing. This study also supports the importance of supplier integration in product innovation (H4). Suppliers act as sources of valuable information for the success of innovation. To make new product development successful, more attention should be given on knowledge about the materials, quality, performance, and feasibility of new products. Therefore, a higher level of supplier integration will lead to a higher level of product innovation.

This study shows that knowledge sharing is positively related to product innovation. This finding matches with that in

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existing literature that the knowledge-sharing practice is one of the most important processes in achieving product innovation. Within networks of firms and organizations, a higher availability of knowledge sharing will promote innovation.

# VI. Conclusion

## A. *Contributions of the study*

This study aims to examine the relationship between supplier knowledge development capability, supplier integration, knowledge sharing, and product innovation in new product development, and it focuses on the effect of supplier knowledge development capability on supplier integration and product innovation. After collecting data from the questionnaire survey and conducting interviews with industrialists, the data were analyzed and a model was developed to test the hypotheses. As proposed, supplier knowledge development capability is positively related to supplier integration (H1); supplier knowledge capability is positively related to product innovation (H2); supplier integration is positively related to knowledge sharing (H3); supplier integration is positively related to product innovation (H4); and knowledge sharing is positively related to product innovation (H5). The result shows that all the hypotheses are valid and significant.

## B. *Managerial Implications*

This study has managerial implication. As product innovation directly affects the success of firms, firms should put more effort in developing new products and products with new and unique features. This study provides a guide that shows how organizations can achieve better product innovation. The empirical finding shows that supplier knowledge development capability, supplier integration, and knowledge sharing are positively related to product innovation. Therefore, firms should select business partners with higher knowledge development capability. Moreover, supplier integration plays an important part in product innovation. As knowledge can promote product innovation by helping firms generate more novel ideas (Nonaka, 1991), firms should practice knowledge sharing more frequently, efficiently, and effectively.

The findings agree with those in existing literature, i.e., supplier integration is positively associated with knowledge sharing. Firms should practice knowledge sharing with suppliers to obtain more useful and valuable information about product innovation.

## C. *Limitations and Opportunities*

This study also has its limitations, and it provides opportunities for future research. Although the structural model is supported empirically, it is actually simple and contains four constructs only. Moreover, the scale of the survey is small as it only covers a small number of firms that are based in Hong Kong. Future studies should invite more companies from other regions and countries to participate in the survey to obtain more information and understanding about the relationships among supplier knowledge development capability, supplier integration, knowledge sharing, and product innovation. Future studies can also consider the scale of firms and include this factor in the research to determine whether firm size affects knowledge development capability and other constructs.

As this study is focused on knowledge development capability, it may lead to issues about knowledge management. Without knowledge management, the acquired knowledge may not be useful, and thus future studies should examine the relationship between them.

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