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Complementary Effects of Marketing Network and Structure holes on Supplier’s Perceived New Product Development Performance of Buyer: Moderating Effect of Technological Uncertainty
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Complementary Effects of Marketing Network and Structure holes on Supplier’s Perceived New Product Development Performance of Buyer: Moderating Effect of Technological Uncertainty

Marketing networks are critical competitiveness in terms of firm’s resource acquisition ability; however, their impact on new product development performance remains uncertain, especially under technological uncertainty. This study examines how complementary effects of marketing networks, network embeddedness and structural holes, influence new product development performance under conditions reflecting technological uncertainty. The empirical test was conducted with a Korean engineering firm’s major first-tier suppliers in the context of internal network entities, manufacturer–supplier–subsupplier relationships. Construct measures were based on existing measures and previous research. The survey results indicate that only network embeddedness influences major first-tier suppliers’ perception of buyer’s new product development performance. To ensure empirical support for marketing network effects on new product development performance, cultural aspect such as collectivism, which reflects unique Korean business to business marketing relationships, should be considered for future research.

Key words: Network embeddedness, Structural holes, Technological uncertainty, New product development performance

Firms in many industries experience markets in which more frequent innovation and higher quality are necessary (Ragatz et al., 2002), particularly new product development (NPD) in technology-intensive industry. These firms require not only extensive cooperation among entities of the network but external interaction for NPD performance, which is one of their core competencies (Brown & Eisenhardt, 1995; Song & Montoya-Weiss, 1998). For example, engineering firms, which offer consulting and technical services to clients, with finished products supplied by first-tier subcontractor needs enormous amount of communication and collaboration between the exchange partners and acquisition of new information.

Interactions between buyers and first-tier suppliers during product development have been broadly studied (Ragatz et al., 1997; Petersen et al., 2003; Koufieros et al.; Parker et al., 2008; Mishra & Shah 2009). Recently, researchers have moved their focus from buyer-supplier dyadic relationship to network studies. There is a growing body of evidence that the network embeddedness and structural holes have a pivotal role in interfirm relationships. The network embeddedness which reflects how close a firm’s relations are with its transaction partners (Uzzi, 1997) allows firms to access key resources such as information and technology through cooperation (Gulati et al., 2000) and has a great effect on firm performance (Uzzi, 1997).

Structural holes are brokerage opportunities created by disperse ties (Burt, 1992, 1997). Relatively few empirical approaches have been attempted to examine marketing networks effect on NPD performance. In particular, effects of network embeddedness and first-tier supplier’s structural holes on buyer’s NPD performance have not been discovered.
Network studies have also discovered their distinctive information sharing mechanisms. The network embeddedness increases knowledge sharing which already exists within the network, whereas structural holes allow firms to acquire new information which increases network’s adaptability under uncertain circumstances from outside network. However, advantage of structural holes does not necessarily provide benefits to the network because new information from the external ties requires network members’ willingness of cooperation and joint problem solving to be shared within the network (Burt, 2000). On the contrary, an embedded network lacking structural holes may not have flexibility under environmental uncertainty. Thus, complementary effects of the marketing networks might alleviate negative effects of technological uncertainty on firm’s NPD performance.

The principal objective of this research is to provide a better understanding of the complementary effects of marketing networks on first-tier supplier’s perceived performance of NPD that contributes to profits of both parties under conditions reflecting varying levels of technological uncertainty. No empirical study has examined the way in which how one influences its performance regarding NPD in the face of volatile technology. More specifically, this research examines the moderating effect of technological uncertainty on the relationship between marketing networks and NPD performance.

This paper’s specific contribution to literature, then, is in two ways. First, the study empirically examines complementary effects of the marketing networks on buyer’s NPD performance under technological uncertainty, which contributes to both buyer and supplier. Burt (2000) highlighted complementary relationship of network embeddedness and structural holes for the network, yet little empirical research has examined the effects on NPD performance. Second, the study empirically explains how different levels of technological uncertainty influence technology-intensive firm’s NPD performance. The study proposes that technology-intensive firms experiencing high levels of technological uncertainty tend to maintain strong relationships with other members in the network and exchange information with firms outside the network as well for strategic choice.

In the following sections, we present theoretical foundations for a research model, and propose effects of complementary effects of marketing networks on NPD performance under technological uncertainty. We then describe the research design and the analysis method. Finally, we present the conclusion and discuss our limitations of study.

**Theoretical Background and Hypotheses**

**Resource Based View and Performance**

Many scholars have examined influence of marketing networks on a firm’s performance with resource base view (Gargiulo & Benassi, 2000; Rodan & Galunic, 2004; Uzzi, 1996). A basic premise in resource-based theory is that firms enjoy sustainable competitive advantages with rare, hard to trade, and imitable competencies (Barney, 1991). Subsequent literatures have also emphasized the pivotal role of intangible resources, which are tacit, complex, and firm specific, rendering them imitable to rivals (Henderson & Cockburn, 1994; Kogut & Zander, 1992; Reed & DeFilippi, 1990). Interorganizational network serve as path for the transfer or flow of resources (Wasserman, 1994), which fosters firm’s capabilities for competitive advantage.

In addition, the dynamic capabilities approach, which is built upon basic assumptions of resource-based theory, supports the positive influence of marketing networks on performance. According to dynamic capability theory, firms are able to improve their performance with accumulated resources through organizational learning, which is occurred as they interact with each other, develop commonality in communication, and seek procedures from both inside and outside network (Deeds et al., 1999).

**Marketing Networks and Performance**

With regard to marketing networks studies (Burt, 1992; Granovetter, 1973; Uzzi, 1996), firms benefit from their network embeddedness and structural hole, but their beneficial aspects which are driven by flow of resources result from somewhat different mechanism.

Uzzi (1996) finds that embeddedness which is distinct from arm’s-length ties provides exchange opportunity that forms motives and expectations and fosters coordinated adaptation for higher survival chances. An embedded network can be considered as a strategic resource related to the firm’s expected capability and performance (Andersson et al., 2002). For example, Japanese automobile industry is well known for dedicated manufacturer-supplier relationships and affiliation. Each automobile manufacturer stands at the top of a pyramid of suppliers through which they effect operational coordination via a system of vertical contractual dependence. The Japanese automobile industry structure allows greater technological diffusion within a network, and also facilitates the tighter coordination for JIT operation (Turnbull et al., 1992). Thus, the strong relational ties of the Japanese automobile industry within a network played a pivotal role in its profitability.

More specifically, an embedded network facilitates fine-grained information exchange (Gulati et al., 2000), which includes tacit and strategic know-how that increase a firm’s efficacy in interfirm relationship under environmentally change (Uzzi, 1996), between the network members. Because firms maintain strong ties have more capability to exchange information, and are able to learn more from each other (1996; Uzzi, 1996; Hansen, 1999). This fine-grained information exchange allows entities to increase network’s know-how, and reduce its problems.

Many studies have discovered that firms enjoy marketing networks benefit not only from information exchange in a network but also from information inflow from external ties, and made clear distinction between the advantage of network embeddedness and advantage of a non-
redundant ties that results from a strong brokerage position in a network (Burt, 1992).

Structural holes which work as the bridge between a network and other networks allow firms to discover business opportunities through nonredundant contacts (Burt, 1992). These holes generate gaps in information flows between more than two firms linked to the same firm but not linked to each other (Ahuja, 2000), and indicate that the people on either side of the hole can acquire information from different flow (Hargadon & Sutton, 1997). More specifically, the structural holes are positively related to organization’s ability to learning, refers to “the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen & Levinthal, 1990 p.128). Thus, increasing the structural holes is important aspect to construct an efficient and information rich network (Burt, 1992).

From the perspective of structural holes, by occupying the holes, a firm is able to share new information from external sources with its network members, which are belong to the same embedded network, for its network performance. On the other hand, firms might use or manipulate new information only for their interests. For instance, according to Burt (2000), network closure is critical to realize value of structural holes. As evidence, structural hole is more valuable to entities of network in which few competitors and closely interconnected relationship exist (Burt, 2000). Powell et al. (1996) discover biotechnology firms with more kinds of activities in alliances with more kinds of partner firms tend to have high earnings and survival chances. Thus, network embeddedness and structural holes show complementary relationship necessary for firms’ performance.

Marketing Networks and NPD Performance

A firm’s continuous NPD and market introduction capability is critical determinant for a firm’s sustainable performance (Blundell et al. 1999; Chaney and Devinney 1992; Urban and Hauser 1993). NPD requires an interaction with suppliers in terms of cumulative process of information exchange and joint problem solving efforts (Fujimoto, 1999).

The relational literature suggests that the network embeddedness enhances collaboration and allow rich and complex information exchange (Hansen, 1999; Rindflieisch and Moorman, 2001; Sivadas & Dwyer, 2000). In the network embeddedness, the relational norms of firms foster the extent of fine-grained information sharing which increases the network’s know-how. In particular, strong ties based on trust and reciprocity can facilitate the thick information exchange between partners (Coleman, 1989; Larson, 1992; Uzzi, 1997). Thus, the network embeddedness between a buyer and its suppliers and among suppliers is significant to determine buyer’s NPD performance which contributes to economic profits of channel members.

Previous literatures have also provided empirical supports for the positive influence of strong embedded ties on NPD. For example, buyer–supplier collaboration helps to enhance product quality, speeds up development and reduce costs (Hoegl & Wagner, 2005). Similarly, Mishra and Shah (2009) show that the positive relationship between performance of buyer’s NPD and suppliers’ involvement in its NPD process. Petersen et al. (2003) also find that suppliers’ involvement in buyer’s decision making is positively related to project performance related to overall satisfaction and goal achievement. Thus, the network embeddedness which increases the extent of collaboration that allows fine-grained information sharing is positively related to buyer’s NPD performance. In this regard, we propose the following hypothesis:

H1: There is a positive relationship between the network embeddedness and buyer’s performance of new product development.

Previous studies have shown that knowledge from external ties is critical to innovation (Mansfield 1988; Rosenberg and Steinmuller 1988; Saxenian 1990). In other words, innovation is largely influenced by firm’s ability to attain new information from the external ties (Deeds et al., 1999). This new information inflow usually builds basis for development of capabilities (Teece et al., 1992), which evolve as new knowledge application ability increase (Deeds et al., 1999). In particular, absorptive capacity, firm’s ability to evaluate and assimilate external knowledge (Cohen & Levinthal 1990), allows firm to recognize and acquire valuable new information, and apply it to the refinement of dynamic capabilities (Deeds et al., 1999). Thus, interaction with the external organization is important to firms’ dynamic capabilities, which allow them to enhance performance with accumulated resources such as knowledge or knowledge through organizational learning.

With regard to the structural holes theory, firms can increase new information from external ties by occupying the holes. This information is shared by entities of an embedded network, and transforms into knowledge or know-how, which is necessary for innovation of technology-intensive industry. Thus, in an embedded network, first-tier supplier’s structural holes which allow new information inflow from the external ties play a significant role to determine NPD performance of buyer. In this regard, we propose the following hypothesis:

H2: There is a positive relationship between the structural holes of first-tier supplier and buyer’s performance of new product development in an embedded network.

Technological Uncertainty

According to literatures regarding resource dependence theory, human actors in organization can perceive, interpret, and evaluate technological environment (Daft, 1992; Weick, 1979). In terms of NPD efforts, firms have perceptions of technological uncertainty regarding the application of technology to the project or regarding impending changes in that technology (Song & Montoya-Weiss, 2001). Thus, we assume that the extent to which firms’ perception of the technological uncertainty results in their decisions and actions associated with NPD project distinctively. For exam-
ple, when technological uncertainty is high, firms should face unanticipated difficulties such as R&D cost increases and high-failure rates of NPD project (Auster, 1992; Teece, 1986).

In the similar vein, Wang and Fang (2012) explore effects of marketing networks on start-up venture companies’ innovative performance regarding patents under environmental uncertainty, market and technological uncertainty. Their study is limited to technology intensive start-up companies which significantly require patent creation for their survival. Furthermore, Song and Montoya-Weiss (2001) suggest specific attribution of uncertainty should be considered in terms of external influence study.

Given the fact that no network member has an appropriate capability to cope with problems related to technological uncertainty, the network will be damaged by greater extra coordination costs and project delay (Oh & Rhee, 2008). Under adverse circumstance where technological environment is predictable or stable, firms might not experience problems in their NPD project because the external environment does not harm their capability to manage it. Therefore, technological uncertainty may negatively moderate the positive influence of network embeddedness and structural holes on NPD performance (hypothesis 1 and hypothesis 2). In this regard, we propose the following hypothesis:

**H3:** When technological uncertainty is high, the new product development performance is weakened in the both network embeddedness and structural holes.

In terms of marketing networks and performance, although both the network embeddedness and structural holes can facilitate fine-grained information sharing, their basic mechanisms are distinctively different. The network embeddedness enhances knowledge sharing which already exists within the network, whereas structural holes allow firms to acquire new information from external environment. Thus, different information sources should have distinctive influences on firms’ performance under environmental uncertainty situation, which might be considered an exogenous factor that influences organization’s critical strategies (Wang & Fang, 2012).

In the same vein, “networks lacking structural holes may lack the flexibility required to develop the new ties necessary to maintain the value of their social capital after significant changes in their task environment (Gargiulo & Benassi, 2000, p. 186).” With regard to buyer’s NPD performance, under technological uncertainty circumstance, the absence of structural holes may diminish NPD performance. On the contrary, the network enjoying complementary effects of network embeddedness and structural holes which fosters new information inflow from outside the network and sharing it within network might experience less NPD performance decrease or performance increase due to the fact that new information from external ties helps to adapt to technological uncertainty situation. Thus, technological uncertainty is less likely to influence on NPD performance of buyer, which belongs to an embedded network that benefits from first-tier supplier’s structural holes, compared to a network where only embeddedness exists. In this regard, we propose the following hypotheses:

**H4a:** The negative moderate effects of technological uncertainty on the relationship between the supplier’s structural holes in an embedded network and new product development performance is less than the positive relationship between network embeddedness and new product development.

**H4b:** As technological uncertainty increase, the positive effect of complementary relationship between network embeddedness and structural holes on NPD performance increases and the negative effect of network embeddedness increases.

**Methodology**

**Research Setting and Data Collection**

We considered the relationships between a manufacturer, its major first-tier suppliers, and the suppliers’ business partners and subsuppliers to test the hypotheses about the effects of first-tier suppliers’ marketing networks and their perception of buyer’s NPD performance. Since manufacturers are largely dependent on their suppliers for successful NPD performance, there are substantial interactions between them to increase cooperation and information exchange. We selected the research set based on the theory that major suppliers reflect the most intensive interaction with a manufacture and the highest level of dependence.

We selected major first-tier suppliers through systematic random sampling from a mailing list of Samsung Engineering, a major engineering firm in Korea. Samsung Engineering provided consulting and technical services to clients, with finished products supplied by first-tier suppliers. We verified the fact that first-tier suppliers’ procurement activities reflected buyer’s NPD efforts and played pivotal roles through in-depth interviews with industry experts and managers. We surveyed procurement managers of first-tier suppliers who were appropriate candidates for responding to items regarding their firms and transaction partners because they not only have relationships with second-tier suppliers and business partners but also can reflect intense interaction with Samsung Engineering in terms of NPD. By surveying first-tier suppliers that had various relationships with their transaction partners (i.e., buyer, second-tier suppliers, and other business partners), we examined influence of their marketing networks on NPD performance under technological uncertainty situation.

We contacted the procurement manager of each firm by telephone and mailed them or her a questionnaire. The procurement managers were in charge of securing parts and materials from subsuppliers, and thus, we expected them to have close relationships with subsuppliers with expert knowledge about procurement items (Hutt & Speh, 2000) and also reflect interaction with the buyer in terms of its needs. After further phone calls and a second mailing, we
collected a total of 133 responses out of 520 delivered (a response rate of approximately 26%).

**Nonresponse Bias**

We examined non-response bias in two ways. First, we compared early respondents with late respondents (Armstrong & Overton, 1977). In addition, we compared the mean values for each scale (i.e., network embeddedness, structural holes, technological uncertainty, and NPD performance). No significant differences were found between the groups, implying that non-response bias does not appear to be a critical problem.

**Measure Development**

We developed the measurement scale in two stages. First, we obtained existing measures of the focal variables from previous studies and developed measures for structural holes, based on theories. Second, we conducted in-depth interviews with three procurement managers to assess the relevance of the collected measures and revised the wording of some items based on the assessment result, considering the research setting. In addition, we hired three experts who hold doctoral degrees in marketing to check the face validity of the items, and they concluded that the items well reflected network embeddedness, structural holes, technological uncertainty and NPD. All items were measured using a seven-point Likert-scale ranging from “strongly agree” (7) to “strongly disagree” (1). Since the items were in English, we developed a Korean version of the questionnaire for the research setting. To ensure that the Korean version of questionnaire was identical to the English version, a bilingual speaker of English and Korean backtranslated the questionnaire from Korean to English. The two translators resolved few discrepancies identified through a discussion.

We used network embeddedness to measure the closeness of first-tier suppliers’ relationship with their manufacture and sub suppliers (Uzzi, 1997). As the level of network embeddedness increases, close working relationship and collaboration with the entities in the network increase. We obtained the items for NETEMB from Wuyts and Geyskens (2005) and modified for the research setting.

We used structural holes to measure the benefits from social capital stem from the first-tier suppliers’ brokerage opportunities created by disperse ties (Burt, 1997). As the level of structural holes increases, information inflow from the outside network increases. We developed items for STRHOLE, based on studies of Burt (1997) and Ahuja (2000) for our research context.

We used technological uncertainty to measure the first-tier suppliers’ perception of technological volatility (Heide & John, 1990). As the level of technological uncertainty increases, the inability to forecast accurately the technological requirements for the product increases. We adapted the items for TUNCER from Heide and John (1990) and modified for the research setting.

We used NPD performance to measure the first-tier suppliers’ perception of buyer’s NPD performance which contributes to economic profits of channel members (Song & Parry, 1997). We also obtained the items for NPD from them and modified for the research setting.

**Construct Validity**

We assessed the validity of the constructs—network embeddedness (NETEMB), structural holes (STRHOLE),

<table>
<thead>
<tr>
<th>TABLE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary of Measurement Results</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Measurement Items</th>
<th>Standardized A</th>
<th>C.R</th>
<th>Construct Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Embeddedness</td>
<td>NETEMBED1</td>
<td>.86</td>
<td>13.40</td>
<td>.92</td>
<td>.88</td>
</tr>
<tr>
<td></td>
<td>NETEMBED2</td>
<td>.87</td>
<td>13.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NETEMBED3</td>
<td>.90</td>
<td>14.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NETEMBED4</td>
<td>.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STRHOLES1</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural Holes</td>
<td>STRHOLES2</td>
<td>.93</td>
<td>17.80</td>
<td>.91</td>
<td>.94</td>
</tr>
<tr>
<td></td>
<td>STRHOLES3</td>
<td>.95</td>
<td>22.96</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STRHOLES4</td>
<td>.94</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TUNCER1</td>
<td>.64</td>
<td>8.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TUNCER2</td>
<td>.51</td>
<td>6.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technological Uncertainty</td>
<td>TUNCER3</td>
<td>.91</td>
<td>13.94</td>
<td>.74</td>
<td>.75</td>
</tr>
<tr>
<td></td>
<td>TUNCER4</td>
<td>.92</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NPD1</td>
<td>.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Product Development</td>
<td>NPD2</td>
<td>.91</td>
<td>15.01</td>
<td>.88</td>
<td>.87</td>
</tr>
<tr>
<td>Performance</td>
<td>NPD3</td>
<td>.80</td>
<td>10.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NPD4</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: χ²(71) = 113.76 (p = .00); goodness-of-fit index = .89; adjusted goodness-of-fit index = .83; comparative factor index = .97; root mean square error of approximation = .068. SFL = standardized factor loading, CR=composite reliability, AVE=average variance extracted. Items deleted from further analysis because of low factor loadings or high cross-loading.
We conducted an item-total correlation test to eliminate ill-fitting items. We then subjected the remaining items to a confirmatory factor analysis using AMOS. Finally, we measured Cronbach’s alpha for each construct for reliability. Based on this procedure, we identified the measurement model with acceptable fit indices, \( \chi^2(71)=113.76 \) (p=.00), GFI =.89, AGFI =.83, CFI=.97, RMSEA=.068. All factor loadings were significant (p<.01), indicating sufficient convergent validity and the unidimensionality of the measures (Anderson & Gerbing1988).

We evaluated the discriminant validity of all four latent variables through AVE values (Fornell & Larker, 1981). We calculated all the AVE values of constructs to determine whether the values are greater than squared values of coefficient of correlations between variables. The results indicated that discriminant validity was acquired (AVE values ranged from 0.75 to 0.94).

Finally, we measured construct reliability and found that each factor showed a satisfactory level of reliability. Collectively, these results indicate sufficient reliability and validity for the measures. Table 1 indicates that the factor loadings, reliability measures for each construct, and goodness-of-fit indices, and AVE values. Table 2 shows inter-construct correlations.

### TABLE 2
Means, Standard Deviations and Correlations

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Network Embeddedness (NETEMBED)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Structural Holes (STRHOLES)</td>
<td>-.018</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Technological Uncertainty (TUNCER)</td>
<td>.028</td>
<td>-.032</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>4. New Product Development Performance (NPD)</td>
<td>.584</td>
<td>-.211</td>
<td>.270</td>
<td>1.00</td>
</tr>
</tbody>
</table>

| M | 2.18 | 4.24 | 3.90 | 2.85 |
| SD| .97  | 1.44 | 1.16 | 1.15 |

Note: sample size = 130

We calculated all the AVE values of constructs to determine whether the values are greater than squared values of coefficient of correlations between variables. The results indicated that discriminant validity was acquired (AVE values ranged from 0.75 to 0.94).

### TABLE 3
Hypothesis Testing of H1 and H2

<table>
<thead>
<tr>
<th>Description</th>
<th>Hypotheses</th>
<th>Sign</th>
<th>coefficient</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NETEMBED → NPD</td>
<td>H1</td>
<td>+</td>
<td>.74</td>
<td>6.72**</td>
</tr>
<tr>
<td>NETEMBED → STRHOLES</td>
<td>H2</td>
<td>+</td>
<td>-.02</td>
<td>-.19</td>
</tr>
<tr>
<td>STRHOLES → NPD</td>
<td>H2</td>
<td>+</td>
<td>-.09</td>
<td>-1.45</td>
</tr>
</tbody>
</table>

\( \chi^2(32) = 48.37, p = .032 \). NETEMBED = network embeddedness; NPD = new product development; STRHOLES = structural holes. Goodness-of-fit index = .92; comparative factor index = .98; incremental fit index = .98; root mean square error of approximation = .063. *p<0.05; **p<0.01

### TABLE 4
Hypothesis Testing of H3 and H4

<table>
<thead>
<tr>
<th>Description</th>
<th>Hypotheses</th>
<th>High technological uncertainty Group</th>
<th>Low technological uncertainty Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>coefficient</td>
<td>t value</td>
<td>coefficient</td>
</tr>
<tr>
<td>NETEMBED → NPD</td>
<td>H3 &amp; H4</td>
<td>.74</td>
<td>4.85**</td>
</tr>
<tr>
<td>NETEMBED → STRHOLES</td>
<td>H3 &amp; H4</td>
<td>-.01</td>
<td>-1.10</td>
</tr>
<tr>
<td>STRHOLES → NPD</td>
<td>H3 &amp; H4</td>
<td>-.12</td>
<td>-1.14</td>
</tr>
</tbody>
</table>

\( \chi^2(64) = 101.75, p = .032 \). NETEMBED = network embeddedness; NPD = new product development; STRHOLES = structural holes. Goodness-of-fit index = .87; comparative factor index = .97; incremental fit index = .97; root mean square error of approximation = .068. *p<0.05; **p<0.01
Analysis and Results

Hypotheses Test

We used structural models to test the hypotheses. We used network embeddedness (NETEMBED) as an exogenous variable and structural holes (STRHOLES) and new product development performance (NPD) as endogenous variables. Network embeddedness had influence on a manufacturer’s new product development performance (γ11 = .74, t = 4.85), providing no support for H1. However, a mediating role of structure holes between network embeddedness and new product development performance was statistically not significant.

To assess the moderating effect of technological uncertainty (i.e., H3 and H4), we conducted a unique multisample analysis using AMOS, based on Jaccard and Wan (1996). We divided the sample firms into two groups (TUNCERH and TUNCERL) at the median of network technological uncertainty and then ran these two groups through a nested structural model in which NETEMBED was an exogenous variable and STRHOLES and NPD were endogenous variables.

In order to evaluate moderating effect, we adopted two-step approach (Jaccard & Wan, 1996) structural model by using pooled data from the two groups (i.e., the pooled sample model). We first estimated the ssed its fit before testing of the multi-sample structural model. The pooled sample model provided a fine fit to the data (χ2=101.75, df =64), indicating the appropriateness of the multisample model for hypothesis testing. We then estimated the multisample model (i.e., TUNCERH and TUNCERL) by constraining the path coefficients for both groups to put in the same condition for limited interaction effects. We expected that if technological uncertainty had a moderating effect, then the multi-sample model (constrained coefficients) would provide a inferior fit compared with pooled-sample model (unconstrained coefficients) (Jaccard & Wan, 1996). The result for the χ2 difference between the pooled-sample model (χ2 = 101.75, df =64), and the multi-sample model (χ2 = 138.60, df =67) indicate the moderating effect of technological uncertainty (χ2 = 36.85, df = 3, p<.01).

We tested the multisample model to determine whether marketing networks and NPD would have significant correlations for these two groups (Jaccard & Wan, 1996; Mendenhall & Sincich, 1996). Technological uncertainty had no significant effect on the positive association between network embeddedness and NPD performance for the group with a high level of environmental uncertainty (γ11 = .74, t = 4.85), whereas there was marginally negative moderation effect for the group with a low level of technological uncertainty (γ11 = .66, t = 4.37), providing no support for H3. The rest tests were not statistically significant.

Discussion

The study examined the complementary effects of marketing networks, network embeddedness and structural holes, on new product development performance under technological uncertainty situation. Our findings indicate that network embeddedness which increases the extent of collaboration to allow fine-grained information sharing was positively related to buyer’s NPD performance. In addition, contrary to the previous network studies, the research indicates that network embeddedness marginally decreased NPD performance when technological volatility is low.

Complementary effects of network embeddedness and structural holes were not found. The effects of structural holes could be dampened by collectivistic culture for ‘in-group’ preference (Xiao and Tsui 2007), the degree to which an individual tends to offer priority in decision making to whom s/he is familiar with, controls opportunism and nurture B2B trust in a collectivist culture such as Korea (Chung and Jin 2011). Thus, even if new information in-flow from the outside network is active, the information might not be critical to new product development performance for in-group preference based on collectivism.

Limitations and Future Research

The theoretical scope of our study is limited in that the study focuses only on the moderating effect of technological uncertainty in the relationship between marketing networks and NPD performance. However, there might be other considerable network dimensions as determinants of NPD performance. Coopetition, horizontal cooperation with competitors, elicit both synergy and market efficiency (Wu & Choi, 2005). Thus, the supply chain network in which coopetition exits is likely to enjoy NPD performance.

Another limitation involves the collectivistic organizational culture. We obtained the data from Korean domestic firms. Although the business environment in Korea has adjusted to global standard in recent decades, Korean firms are still influenced by high collectivistic culture. In this regard, future research should consider cultural aspects when research model building.

In this study, we collected data from sub contractors of Samsung Engineering. Plant engineering industry has distinctive characteristics such as long term project and turn-key base system, which require extensive collaboration with suppliers. The distinctiveness of engineering industry might limit the generalizability of the results. Thus, future research should consider a wider range of industries.

REFERENCES


