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Effects of Embeddedness and Structural Holes on Innovation Performance: The Moderating Role of Environmental Uncertainty

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Abstract

Purpose: The ability of a firm to acquire resources through marketing networks is crucial for its competitiveness. Nonetheless, the influence of these networks on the performance of a firm's innovation is still uncertain, particularly in the face of environmental uncertainty. This research investigates the impact of marketing networks, specifically network embeddedness and structural holes, on the performance of innovation in situations characterized by environmental uncertainty. **Research design, data and methodology:** The empirical examination was carried out within the framework of internal network entities, specifically the manufacturer-supplier-sub supplier relationships, involving the primary suppliers of a Korean engineering firm. Construct measures utilized in this study were derived from existing measures and prior research. A questionnaire survey was conducted with a major first-tier supplier of a Korean engineering firm. Proposed hypotheses were tested using structural equation modeling. **Results:** The survey findings suggest that only network embeddedness has an impact on the perception of major first-tier suppliers regarding the buyer's innovation performance. **Conclusions:** To strengthen the empirical evidence regarding the effects of marketing networks on innovation performance, future research should take into account cultural factors such as collectivism, which is indicative of the distinctive business-to-business marketing relationships observed in the Korean context.

Keywords : Structural Hole, Embeddedness, Environmental Uncertainty, Innovation Performance, Marketing Network

JEL Classification Code: C42, D3, D81, D83

1. Introduction

In numerous industries, firms face markets that demand more frequent innovation and enhanced quality as highlighted by Ragatz et al. (2002). These firms rely on both internal collaborations within their network entities and external interaction to excel in innovation performance, which is regarded as a fundamental capability according to Brown and Eisenhardt (1995) and Song and Montoya-Weiss (2001). To illustrate, engineering firms that provide consulting and technical services to clients, relying on finished products from first-tier subcontractors, necessitate extensive communication and collaboration among exchange partners to facilitate the acquisition of new information.

Extensive research has been conducted on the engagement between purchasers and top-level suppliers throughout the process of innovation (Ragatz et al., 1997; Petersen et al., 2003; Koufteros et al., 2007; Parker et al., 2008; MIshra & Shah 2009). In recent times, scholars have shifted their attention from examining the connections

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between buyers and suppliers to exploring the dynamics of networks (Anderson et al., 1994). A wealth of research now indicates that the degree to which a company is embedded within a network and the presence of structural holes play a crucial role in shaping relationships between firms. Network embeddedness refers to the proximity of a firm's relationships with its transactional partners, indicating the level of closeness. This proximity enables firms to gain valuable resources, such as information and technology, through cooperative efforts (Gulati et al., 2000), ultimately influencing firm performance significantly.

Structural holes refer to opportunities for intermediation that arise due to fragmented connections (Burt, 1992, 1997). Despite the importance of understanding the impact of marketing networks on innovation performance, there have been limited empirical investigations conducted. Specifically, the effects of network embeddedness and the presence of structural holes among first-tier suppliers on the innovation performance of buyers have yet to be explored. Furthermore, network research has revealed unique mechanisms for information sharing. Network embeddedness enhances the sharing of existing knowledge within the network, while structural holes enable firms to acquire new information from external sources, enhancing the network's adaptability in uncertain conditions (Hutt & Speh, 2000). Nevertheless, the presence of structural holes in a network does not automatically guarantee network benefits, as the dissemination of new information from external connections relies on the willingness of network members to cooperate and engage in joint problem-solving, facilitating knowledge sharing within the network (Burt, 2000). Conversely, an embedded network without structural holes may lack the flexibility required to navigate environmental uncertainty. Hence, the synergistic impacts of marketing networks could potentially mitigate the detrimental consequences of environmental uncertainty on a firm's performance in terms of innovation.

The main aim of this study is to enhance our comprehension of how marketing networks exert complementary influences on the perceived performance of innovation among first-tier suppliers. This research seeks to elucidate how such effects can positively impact the profitability of both parties involved, particularly in scenarios characterized by diverse degrees of environmental uncertainty. To date, there has been a lack of empirical investigations exploring the influence of a volatile environment on performance outcomes in terms of innovation. This study, in particular, aims to examine the moderating role of environmental uncertainty on the connection between marketing networks and innovation performance.

This paper makes two distinct contributions to the existing literature. Firstly, it empirically investigates the complementary impacts of marketing networks on the innovation performance of buyers, considering the presence of environmental uncertainty. This analysis contributes to the interests of both buyers and suppliers involved. While Burt (2000) emphasized the complementary nature of network embeddedness and structural holes within a network, empirical research on their effects specifically on innovation performance remains limited. Furthermore, this study provides empirical insights into the impact of varying levels of environmental uncertainty on a firm's innovation performance. It suggests that firms facing high levels of environmental uncertainty are more inclined to foster strong relationships with network members and engage in information exchange with external firms as a strategic choice. This empirical examination sheds light on how environmental uncertainty influences a firm's innovation performance. Subsequently, this paper introduces the theoretical framework for the research model and puts forward the anticipated impacts of complementary effects arising from marketing networks on innovation performance, particularly within the context of environmental uncertainty. The research design and analysis methodology are subsequently outlined. Finally, the study concludes by presenting key findings and addressing the limitations of the research.

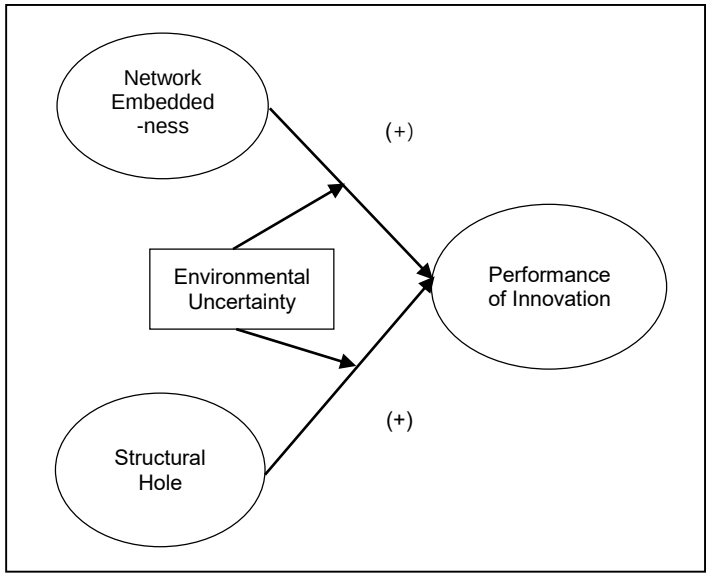

Figure 1: Conceptual Model

2. Literature Review and Hypotheses

2.1. Resource-Based View (RBV) and Performance

Several researchers have explored the impact of

marketing networks on a firm's performance from the perspective of the resource-based view (Gargiulo & Benassi, 2000; Rodan & Galunic, 2004; Uzzi, 1996). The fundamental principle of the resource-based theory suggests that firms attain sustainable competitive advantages through possessing unique, difficult-to-replicate, and enduring capabilities (Barney, 1991).

Follow-up studies have further highlighted the crucial significance of intangible resources, characterized by their implicit nature, intricate composition, and unique alignment to individual firms, making them exceptionally challenging to replicate by competitors (Henderson & Cockburn, 1994; Kogut & Zander, 1992; Reed & DeFillippi, 1990). In this regard, inter-organizational networks play a vital role as conduits facilitating the transfer and flow of resources (Wasserman, 1994), thereby nurturing a firm's capabilities to gain a competitive advantage.

Moreover, the dynamic capabilities framework, which is grounded in the foundational principles of the resource-based theory, provides further support for the favorable impact of marketing networks on performance. Drawing from dynamic capability theory, firms enhance their performance by leveraging accumulated resources through organizational learning, which is fostered through interactions, the development of shared communication practices, and the adoption of procedures from both internal and external sources within the network (Deeds et al., 2000).

2.2. The Relationship Between Marketing Networks and Performance

In the realm of marketing network research (Burt, 1992; Granovetter, 1973; Uzzi, 1996), firms derive advantages from both their network embeddedness and structural holes. However, these beneficial aspects, driven by the flow of resources, stem from slightly different mechanisms.

According to Uzzi (1996), embeddedness, which differs from more distant connections, creates an environment for mutual exchange, generating motives and expectations that facilitate coordinated adaptation and increase the likelihood of survival. An embedded network can be viewed as a strategic resource that is closely tied to a firm's anticipated capabilities and performance (Andersson et al., 2002).

Take, for instance, the renowned Japanese automobile industry, which is characterized by close-knit partnerships and affiliations with its suppliers.

Each automobile manufacturer occupies the apex position in a hierarchical structure of suppliers, enabling operational coordination through vertical contractual interdependence. This industry structure in Japan promotes efficient technological diffusion within the network and facilitates the implementation of just-in-time (JIT) operations, leading to tighter coordination (Turnbull et al., 1992). As a result, the robust relational ties present in the Japanese automobile industry network have played a pivotal role in enhancing its profitability.

In particular, an embedded network fosters detailed and nuanced information exchange (Gulati et al., 2000), encompassing both tacit and strategic knowledge that enhances a firm's effectiveness in interfirm relationships amidst environmental shifts (Uzzi, 1996). The presence of strong ties among firms enables them to exchange information more readily and learn from one another (Uzzi, 1996; Hansen, 1999). This fine-grained information exchange empowers entities to enhance the network's collective knowledge and mitigate its challenges.

Numerous research studies have identified that firms that cultivate marketing networks derive advantages not only from information sharing within the network but also from the influx of information through external connections. These studies have emphasized the distinction between the benefits of network embeddedness and the advantages gained from occupying a strong brokerage position that facilitates non-redundant ties within the network (Burt, 1992).

Structural holes serve as connectors between a network and other networks, enabling firms to uncover business prospects through unique connections (Burt, 1992, 2009). These holes create gaps in information flow among multiple firms connected to the same entity but not directly linked to each other (Ahuja, 2000), indicating that individuals on either side of the hole can access information from distinct channels (Hargadon & Sutton, 1997). In particular, the presence of structural holes is positively associated with an organization's capacity for learning, which encompasses the ability to recognize the value of new external information, integrate it, and effectively apply it to achieve commercial objectives (Cohen & Levinthal, 1990). Consequently, enhancing the existence of structural holes becomes a crucial element in building an effective and knowledge-rich network (Burt, 1992).

When considering the concept of structural holes, by strategically occupying these gaps, a firm can disseminate novel information from external sources to its fellow network members who are part of the same embedded network, thereby influencing the network's performance. However, it is important to note that firms may choose to utilize or manipulate new information solely for their own interests. As illustrated by Burt (2000), the value of structural holes is contingent upon network closure. Supporting this notion, structural holes hold greater significance for entities within a network characterized by minimal competition and tightly interconnected relationships (Burt, 2000). Furthermore, Powell et al. (1996) find that biotechnology firms engaging in diverse activities and forming alliances with a wide range of partners tend to

exhibit higher earnings and increased survival prospects. Therefore, network embeddedness and structural holes demonstrate a complementary relationship that is essential for firm performance.

2.3. Marketing Networks and Innovation Performance

A firm's ability to continuously engage in innovation and successfully introduce products to the market is a crucial factor in ensuring its long-term performance sustainability (Blundell et al., 1999; Chaney & Devinney, 1992). Innovation entails collaborative interactions with suppliers, involving a sequential process of exchanging information and jointly addressing problems (Fujimoto, 1999).

The body of relational literature suggests that network embeddedness promotes collaboration and facilitates extensive and intricate information exchange (Hansen, 1999; Rindfleisch & Moorman, 2001; Sivadas & Dwyer, 2000). Within network embeddedness, firms' relational norms foster a high degree of detailed information sharing, which enhances the network's collective knowledge. Notably, strong ties characterized by trust and reciprocity play a crucial role in facilitating substantial information exchange between partners (Coleman, 1988; Larson, 1992). Consequently, the network embeddedness between a buyer and its suppliers, as well as among suppliers themselves, significantly influences a buyer's innovation performance, thereby contributing to the economic profits of all channel members.

Earlier research has also offered evidence to confirm the beneficial impact of robust embedded connections on innovation (Artz, 1999). To illustrate, when buyers and suppliers collaborate, it improves the quality of products, expedites development, and lowers expenses (Hoegl & Wagner, 2005). Similarly, Mishra and Shah (2009) demonstrate a positive correlation between the innovation performance of buyers and the extent of suppliers' engagement in the innovation procedure. Petersen et al. (2003) additionally discover that when suppliers actively participate in the buyer's decision-making process, it leads to better project performance in terms of overall satisfaction and goal attainment. Consequently, the degree of collaboration facilitated by network embeddedness, which promotes detailed information sharing, is positively associated with the buyer's innovation performance. Based on this, the following hypothesis is presented.

H1: There is a positive relationship between the network embeddedness and the buyer's performance of innovation.

Earlier research has indicated the crucial role of knowledge derived from external connections in driving innovation (Mansfield 1988; Rosenberg and Steinmuller 1988; Saxenian 1990). Stated differently, a firm's capacity to acquire new information through external ties significantly impacts innovation (Deeds et al., 2000).

Typically, the influx of new information serves as the foundation for capability development (Teece et al., 1997), which advances as the firm's ability to apply new knowledge increases (Deeds et al., 2000). Specifically, absorptive capacity, which refers to a firm's capacity to assess and integrate external knowledge (Cohen & Levinthal 1990), enables the firm to identify and acquire valuable new information and utilize it to enhance dynamic capabilities (Deeds et al., 2000). Consequently, engaging with external organizations plays a vital role in the development of a firm's dynamic capabilities, enabling them to improve performance by leveraging accumulated resources such as expertise and knowledge through organizational learning.

In relation to the theory of structural holes, firms have the opportunity to gain access to new information from external connections by occupying these gaps. This information is exchanged among entities within a closely interconnected network and is transformed into knowledge or expertise, which is crucial for innovation in technology-intensive industries. Therefore, within such a network, the structural holes of first-tier suppliers, which facilitate the influx of new information from external connections, play a significant role in influencing the buyer's innovation performance. Based on this understanding, the following hypothesis is put forward.

H2: There is a positive relationship between the structural holes of first-tier suppliers and buyers' performance of innovation in an embedded network.

2.4. Environmental Uncertainty

Based on the resource dependence theory literature, individuals within organizations possess the ability to perceive, interpret, and assess the environmental landscape (Achrol & Stern, 1988). Concerning efforts related to innovation, firms hold perceptions regarding environmental uncertainty, whether it pertains to the implementation of the environment within the project or anticipated changes in the environment itself (Song & Montoya-Weiss, 2001). Therefore, we hypothesize that the impact of firms' perception of environmental uncertainty on their decision-making and actions related to innovation projects is distinct. Specifically, in situations where environmental uncertainty is high, firms are likely to encounter unforeseen challenges such as escalating R&D costs and a higher rate of failure in innovation projects (Auster, 1992; Teece, 1986).

Similarly, Wang and Fang (2012) investigate the impact of marketing networks on the innovative

performance, specifically patent creation, of start-up ventures operating in an environment characterized by uncertainty related to both market dynamics and technological changes. Their study focuses on technology-intensive start-up companies that heavily rely on patent creation for their viability. Additionally, Song and Montoya-Weiss (2001) propose that when studying external influences, it is important to consider the specific attribution of uncertainty.

In situations where no network member possesses the necessary capabilities to address challenges arising from environmental uncertainty, the network will suffer from increased coordination costs and project delays (Oh & Rhee, 2008). However, when the uncertain environment is predictable or stable, firms may not encounter difficulties in their innovation projects as the external environment does not impede their ability to manage it. Thus, environmental uncertainty could potentially have a negative moderating effect on the positive influence of network embeddedness and structural holes on innovation performance (Hypothesis 1 and Hypothesis 2). Based on this rationale, the following hypothesis is put forward.

H3: When environmental uncertainty is high, innovation performance is weakened in both network embeddedness and structural holes.

When it comes to marketing networks and their effectiveness, the ways in which network embeddedness and structural holes operate are fundamentally different, even though both can facilitate detailed information exchange (Abdi & Aulakh, 2017) Network embeddedness promotes the sharing of existing knowledge within the network, while structural holes enable firms to obtain new information from the outside environment. Therefore, the impact of different information sources on a firm's performance in uncertain situations should be considered as an external factor that influences the organization's crucial strategies (Wang & Fang, 2012).

Similarly, networks that lack structural holes may face challenges in adapting to significant changes in their task environment and maintaining the value of their social capital (Gargiulo & Benassi, 2000). In terms of the buyer's performance in innovation, when faced with environmental uncertainty, the absence of structural holes can negatively impact innovation performance. Conversely, networks that benefit from the combined effects of network embeddedness and structural holes, which facilitate the inflow of new information from external sources and its sharing within the network, may experience a lesser decrease in innovation performance or even an increase. This is because the new information obtained through external connections helps in adapting to the challenges posed by environmental uncertainty. Therefore, the impact of environmental uncertainty on the innovation performance of buyers is expected to be less significant in an embedded network that benefits from the structural holes of its first-tier suppliers, compared to a network where only embeddedness exists. In light of this, the following hypotheses are put forward:

H4a: The negative moderate effects of environmental uncertainty on the relationship between the supplier's structural holes in an embedded network and innovation performance is less than the positive relationship between net-work embeddedness and innovation.

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

3. Methodology

3.1. Research Setting and Data Collection

To examine the effects of the marketing networks of major first-tier suppliers and their perception of buyers' innovation performance, the study examined the relationships among a manufacturer, its primary first-tier suppliers, and the suppliers' business partners and sub suppliers. Given that manufacturers heavily rely on their suppliers for achieving successful innovation performance, there are significant interactions between them aimed at fostering cooperation and exchanging information. The research sample was selected based on the premise that major suppliers exhibit the most extensive interaction with a manufacturer and the highest level of dependence.

The research chose significant primary suppliers by utilizing systematic random sampling from a mailing list provided by a prominent Korean engineering company. The Engineering firm offers consulting and technical services to clients, relying on first-tier suppliers to provide the final products. Through in-depth interviews with industry experts and managers, the study confirmed that the procurement activities of these first-tier suppliers accurately represented the innovation efforts of the buyers and held crucial roles in the process. The research involved conducting surveys with procurement managers of first-tier suppliers who were suitable candidates for responding to questions about their companies and transaction partners. These suppliers were chosen because they had connections not only with second-tier suppliers and business partners but also had extensive interactions with engineering firms in terms of innovation. By surveying first-tier suppliers who had diverse

relationships with their transaction partners (such as buyers, second-tier suppliers, and other business partners), the study investigated how their marketing networks influenced innovation performance in an environment of uncertainty.

For the study, the researchers reached out to the procurement manager of each company through telephone communication and sent them a questionnaire by mail. Since the procurement managers were responsible for obtaining parts and materials from subsuppliers, it was anticipated that they would have strong connections with these subsuppliers who possessed specialized knowledge about the items being procured. Additionally, it was expected that the procurement managers would also reflect their interaction with the buyer based on their understanding of its requirements. After additional phone calls and a second round of mailing, a total of 133 responses were collected out of the 520 questionnaires delivered, resulting in a response rate of approximately 26%.

3.2. Nonresponse Bias

The research investigated non-response bias using two approaches. Firstly, it compared the characteristics of early respondents and late respondents, following the method proposed by Armstrong and Overton (1977). Additionally, it compared the average scores for each scale, including network embeddedness, structural holes, environmental uncertainty, and innovation performance. The results indicated no significant differences between the two groups, suggesting that non-response bias does not seem to pose a significant concern.

3.3. Measure Development

The measurement scale for the study was developed in two phases. Initially, existing measures from previous research were collected for the variables of interest, and measures for structural holes were created based on relevant theories. Subsequently, in-depth interviews were conducted with three procurement managers to evaluate the applicability of the collected measures. Based on their feedback and considering the research context, certain items were revised for clarity. Additionally, three marketing experts with doctoral degrees were enlisted to assess the face validity of the items, and they confirmed that the items effectively captured the concepts of network embeddedness, structural holes, environmental uncertainty, and innovation. All items were measured using a seven-point Likert scale, ranging from "strongly agree" (7) to "strongly disagree" (1).

Given that the questionnaire items were originally in English, a Korean version of the questionnaire was created specifically for the research context. To ensure the accuracy and equivalence of the Korean version to the English version, a bilingual individual proficient in both English and Korean performed a back-translation of the questionnaire from Korean to English. The two translators then reviewed the back-translation and discussed and resolved any discrepancies or inconsistencies that were identified.

The research employed network embeddedness as a metric to gauge the proximity of the relationship between first-tier suppliers, their manufacturers, and suppliers. When the degree of network embeddedness rises, there is a corresponding increase in the strength of collaborative working relationships with the various entities in the network. The items for measuring network embeddedness (NETEMB) were derived from Wuyts and Geyskens (2005) and subsequently adjusted to suit the specific research context.

The study utilized the concept of structural holes to assess the advantages derived from social capital resulting from the first-tier suppliers' ability to act as intermediaries through their diverse connections (Burt, 1997). As the degree of structural holes grows, there is an augmentation in the influx of information from external networks. To measure structural holes (STRHOLE), the study adapted and created items based on the research of Burt (1997) and Ahuja (2000) to align with our specific research context.

The research employed the concept of environmental uncertainty to gauge how first-tier suppliers perceive the volatility of their operating environment (Heide & John, 1990). As the level of environmental uncertainty rises, the ability to accurately predict the environmental demands for the product diminishes. The items for measuring environmental uncertainty were adapted from Heide and John (1990) and subsequently adjusted to suit the specific research context.

In order to assess the perception of buyers' innovation performance, which contributes to the economic profits of channel members, the study utilized the measure of innovation performance (Song & Parry, 1997). The items for evaluating innovation were obtained from Song and Parry (1997) and subsequently modified to align with the research setting.

3.4. Construct Validity

The study evaluated the accuracy of the constructs—network embeddedness (NETEMB), structural holes (STRHOLE), and innovation performance (IP). To ensure the quality of the measurement, an item-total correlation test was conducted to identify and eliminate items that didn't fit well. The remaining items were then subjected to confirmatory factor analysis using AMOS. Additionally, Cronbach's alpha was measured for each construct to assess reliability (Hong & Kang, 2022). Following this procedure, the study identified a measurement model that exhibited

acceptable fit indices, $\chi 2(71)=113.76$ ($p=.00$), GFI=.89, AGFI=.83, CFI=.97, RMSEA=.068. All factor loadings were found to be significant ($p<.01$), indicating satisfactory convergent validity and the unidimensionality of the measures (Anderson & Gerbing, 1988).

Table 1: Summary of Measurement Results

Variables	Measurement Items	Standardized λ	C.R	Construct	AVE
Network	NETEMBED1	.87	13.42	.91	.89
Embeddedness	NETEMBED2	.88	13.71		
	NETEMBED3	.91	14.93		
	NETEMBED4	.88	-		
Structural Holes	STRHOLES1	*	*	.92	.93
	STRHOLES2	.91	17.83		
	STRHOLES3	.96	22.98		
	STRHOLES4	.95	-		
Environmental Uncertainty	EUNCER1	.65	8.38	.73	.74
	EUNCER2	.52	6.28		
	EUNCER3	.92	13.92		
	EUNCER4	.93	-		
Innovation Performance	IP1	.92	-	.89	.86
	IP2	.92	15.02		
	IP3	.81	10.72		
	IP4	*	*		

Note: $\chi 2(71) = 113.76$ ($p = .00$), goodness-of-fit index = .89; adjusted goodness-of-fit index = 0.83; 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

The study examined the discriminant validity of the four latent variables by analyzing their Average Variance Extracted (AVE) values (Fornell & Larker, 1981). We calculated the AVE values for each construct to determine if they were higher than the squared values of the correlation coefficients between variables. The results indicated that discriminant validity was achieved, with AVE values ranging from 0.74 to 0.93.

Furthermore, construct reliability was assessed and found to be at satisfactory levels for each factor. These findings collectively demonstrate sufficient reliability and validity of the measures. Table 1 presents the factor loadings, reliability measures, goodness-of-fit indices, and AVE values for each construct. Table 2 displays the correlations between constructs.

4. Analysis and Results

4.1. Hypotheses Test

The research employed structural models to examine the hypotheses. In the investigation, network embeddedness (NETEMBED) was utilized as an independent variable, while structural holes (STRHOLES) and innovation performance (IP) served as dependent variables. The findings indicated that network embeddedness had a significant impact on a manufacturer's innovation performance ($\gamma 11 = .75$, $t = 6.73$), contrary to H1. However, the statistical analysis did not reveal a significant mediating effect of structural holes between network embeddedness and innovation performance.

In order to examine the influence of environmental uncertainty as a moderator (referred to as H3 and H4), the research employed a distinctive multisampling analysis approach using AMOS, following the methodology outlined by Jaccard and Wan (1996). The study categorized the participating firms into two groups, namely EUNCERH and EUNCERL, based on the median value of the network environmental uncertainty. Subsequently, these two groups were subjected to nested structural model analysis, with NETEMBED as an independent variable and STRHOLES and IP as dependent variables.

To assess the moderating effect, the research employed a two-step approach based on Jaccard and Wan's methodology (1996) using a structural model and pooled data from both groups (referred to as the pooled-sample

model). The initial step involved estimating the fit of the pooled-sample model before proceeding to test the multi-sample structural model. The pooled-sample model demonstrated a satisfactory fit to the data ($\chi2$=101.75, df=64), indicating that the multisampling model was appropriate for hypothesis testing. In the subsequent step, the multi-sample model (i.e., EUNCERH and EUNCERL) was estimated by imposing constraints on the path

Table 2: Hypothesis Testing of H1 and H2

Description	Hypothesis	Sign	coefficient	*t* value
NETEMBED → IP	H1	+	.75	6.73**
NETEMBED → STRHOLES	H2	+	-.03	-.18
STRHOLES → IP	H2	+	-.08	-1.44

Note: $\chi2(32) = 48.37$, p = .032. NETEMBED = network embeddedness; IP = innovation performance; 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 3: Hypothesis Testing of H3 and H4

		High uncertainty		Low uncertainty	
Description	Hypotheses	coefficient	*t* value	coefficient	*t* value
NETEMBED → IP	H3 & H4	.73	4.86**	.67	4.38**
NETEMBED →STRHOLES	H3 & H4	-.02	-.10	-.07	-.25
STRHOLES → IP	H3 & H4	-.13	-1.15	-.05	-.68

Note: $\chi^2(64) = 101.75$, p = .032. NETEMBED = network embeddedness; IP = innovation performance; 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

coefficients for both groups to ensure that they were subjected to the same conditions, thereby limiting the interaction effects.

The research hypothesized that if environmental uncertainty had a moderating effect, then the multi-sample model (with constrained coefficients) would exhibit a lower level of fit compared to the pooled-sample model (with unconstrained coefficients), following the approach outlined by Jaccard and Wan (1996). The analysis revealed a significant difference in the $\chi2$ values between the pooled-sample model ($\chi2 = 101.75$, df = 64) and the multi-sample model ($\chi2 = 138.60$, df = 67), indicating the presence of a moderating effect of environmental uncertainty ($\chi2 = 36.85$, df = 3, p < .01).

The research conducted an analysis of the multisampling model to examine the potential significant correlations between marketing networks and innovation for the two groups, following the methodologies of Jaccard and Wan (1996) and Mendenhall and Sincich (1996). The results showed that environmental uncertainty did not have a significant impact on the positive relationship between network embeddedness and innovation performance for the high environmental uncertainty group ($\gamma11 = .73$, t = 4.86).

Conversely, for the low environmental uncertainty group, there was a slightly negative moderating effect ($\gamma11 = .67$, t = 4.38), providing no support for H3. The remaining tests did not yield statistically significant results.

5. Discussions

5.1. General Discussion and Implication

The research investigated the combined impacts of marketing networks, network embeddedness, and structural holes on innovation performance within an environment characterized by uncertainty. The study's findings revealed that network embeddedness, which enhances collaboration and facilitates detailed information sharing, had a positive association with buyer's innovation performance. Interestingly, contrary to prior network-related studies, the research also suggested that network embeddedness marginally decreased innovation performance in situations where environmental volatility was low.

The study did not discover any complementary effects between network embeddedness and structural holes. It was suggested that the impact of structural holes could be diminished by a collectivistic culture, where there is a

preference for prioritizing decisions based on familiarity, controlling opportunism, and fostering B2B trust, as observed in cultures like Korea (Chung & Jin, 2011). Consequently, even if there is a significant inflow of new information from external networks, it may not be considered crucial for innovation performance due to the emphasis on in-group preference rooted in collectivism.

5.2. Limitations and Future Research

The study has a limited theoretical scope as it solely concentrates on examining the moderating effect of environmental uncertainty on the connection between marketing networks and innovation performance. However, there could be other significant network dimensions that influence innovation performance. For instance, coopetition, which involves horizontal cooperation with competitors, can generate both synergy and market efficiency (Wu et al., 2010). Therefore, it is plausible to suggest that supply chain networks that incorporate coopetition are likely to experience enhanced innovation performance.

Another constraint pertains to the presence of a collectivistic organizational culture. The data for the study were collected from domestic firms in Korea. While the business landscape in Korea has gradually aligned with global standards over the years, Korean firms continue to be strongly influenced by a collectivistic culture. Hence, it is essential for future research to take cultural factors into account when constructing models and conducting studies in this context.

References

Abdi, M., & Aulakh, P. S. (2017). Locus of uncertainty and the relationship between contractual and relational governance in cross-border interfirm relationships. *Journal of Management, 43*(3), 771-803.

Achrol, R. S., & Stern, L. W. (1988). Environmental determinants of decision-making uncertainty in marketing channels. *Journal of marketing research, 25*(1), 36-50.

Ahuja, G. (2000). Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative science quarterly, 45*(3), 425-455.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological bulletin, 103*(3), 411.

Anderson, J. C., Håkansson, H., & Johanson, J. (1994). Dyadic business relationships within a business network context. *Journal of marketing, 58*(4), 1-15.

Andersson, U., Forsgren, M., & Holm, U. (2002). The strategic impact of external networks: Subsidiary performance and competence development in the multinational corporation. *Strategic management journal, 23*(11), 979-996.

Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of marketing research, 14*(3), 396-402.

Artz, K. W. (1999). Buyer–supplier performance: the role of asset specificity, reciprocal investments and relational exchange. *British Journal of Management, 10*(2), 113-126.

Auster, E. R. (1992). The relationship of industry evolution to patterns of technological linkages, joint ventures, and direct investment between US and Japan. *Management Science, 38*(6), 778-792.

Ahuja, G. (2000). Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative science quarterly, 45*(3), 425-455.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management, 17*(1), 99-120.

Blundell, R., Griffith, R., & Van Reenen, J. (1999). Market share, market value and innovation in a panel of British manufacturing firms. *The review of economic studies, 66*(3), 529-554.

Brown, S. L., & Eisenhardt, K. M. (1995). Product development: Past research, present findings, and future directions. *Academy of management review, 20*(2), 343-378.

Burt, R. S. (1992), *Structural Holes: The Social Structure of Competition.* Cambridge, MA: Harvard University Press.

Burt, R. S. (1997). A note on social capital and network content. *Social networks, 19*(4), 355-373.

Burt, R. S. (2009). *The contingent value of social capital. In Knowledge and social capital* (pp. 255-286). Routledge.

Burt, R. S. (2000). The network structure of social capital. *Research in organizational behavior, 22*, 345-423.

Chaney, P. K., & Devinney, T. M. (1992). New product innovations and stock price performance. *Journal of Business Finance & Accounting, 19*(5), 677-695.

Chung, J. E., Huang, Y., Jin, B., & Sternquist, B. (2011). The impact of market orientation on Chinese retailers' channel relationships. *Journal of Business & Industrial Marketing, 26*(1), 14-25.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative science quarterly, 35*(1), 128-152.

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology, 94*, S95-S120.

Deeds, D. L., DeCarolis, D., & Coombs, J. (2000). Dynamic capabilities and new product development in high technology ventures: An empirical analysis of new biotechnology firms. *Journal of Business venturing, 15*(3), 211-229.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research, 18*(1), 39-50.

Fujimoto, T. (1999). *The evolution of a manufacturing system at Toyota.* Oxford university press.

Gargiulo, M. and Benassi, M. (2000). Trapped in your own net? Network Cohesion, Structural Holes, and the Ad Aptation of Social Capital, *Organization Science, 11*(2), 183-196.

Granovetter, M. S. (1973). The strength of weak ties. *American journal of sociology, 78*(6), 1360-1380.

Gulati, R., Nohria, N., & Zaheer, A. (2000). Strategic networks. *Strategic management journal, 21*(3), 203-215.

Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits.

Administrative science quarterly, 44(1), 82-111.

Hargadon, A., & Sutton, R. I. (1997). Technology brokering and innovation in a product development firm. *Administrative science quarterly, 42*(4), 716-749.

Heide, J. B., & John, G. (1990). Alliances in industrial purchasing: The determinants of joint action in buyer-supplier relationships. *Journal of marketing Research, 27*(1), 24-36.

Hoegl, M., & Wagner, S. M. (2005). Buyer-supplier collaboration in product development projects. *Journal of management, 31*(4), 530-548.

Hong, J., & Kang, E. (2022). Food Delivery Applications Becoming Alligator of Hotel Supply Chain: An Empirical Analysis. *The Journal of Distribution Science, 20*(9), 97-107.

Hutt, M., & Speh, T. (2000). *Business marketing management: a strategic approach.* New Jersey: Prentice Hall.

Jaccard, J., & Wan, C. K. (1996). *LISREL approaches to interaction effects in multiple regression* (No. 114). sage.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization science, 3*(3), 383-397.

Koufteros, X. A., Cheng, T. E., & Lai, K. H. (2007). "Black-box" and "gray-box" supplier integration in product development: Antecedents, consequences and the moderating role of firm size. *Journal of Operations Management, 25*(4), 847-870.

Larson, A. (1992). Network dyads in entrepreneurial settings: A study of the governance of exchange relationships. *Administrative science quarterly, 37*,76-104.

Mansfield, E. (1988). Industrial R&D in Japan and the United States: A comparative study. *The American Economic Review, 78*(2), 223-228.

Boudreau, N. S., Sincich, T., & Mendenhall, W. (1996). *A Second Course in Statistics: Regression Analysis: Student's Solutions Manual.* Prentice-Hall.

Mishra, A. A., & Shah, R. (2009). In union lies strength: Collaborative competence in new product development and its performance effects. *Journal of Operations Management, 27*(4), 324-338.

Oh, J., & Rhee, S. K. (2008). The influence of supplier capabilities and technology uncertainty on manufacturer-supplier collaboration: A study of the Korean automotive industry. *International Journal of Operations & Production Management, 28*(6), 490-517.

Parker, D. B., Zsidisin, G. A., & Ragatz, G. L. (2008). Timing and extent of supplier integration in new product development: a contingency approach. *Journal of Supply Chain Management, 44*(1), 71-83.

Petersen, K. J., Handfield, R. B., & Ragatz, G. L. (2003). A model of supplier integration into new product development. *Journal of product innovation management, 20*(4), 284-299.

Powell, W. W., Koput, K. W., & Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative science quarterly, 41*(1), 116-145.

Ragatz, G. L., Handfield, R. B., & Scannell, T. V. (1997). Success factors for integrating suppliers into new product development. *Journal of Product Innovation Management: An International Publication of the Product Development & Management Association, 14*(3), 190-202.

Ragatz, G. L., Handfield, R. B., & Petersen, K. J. (2002). Benefits associated with supplier integration into new product development under conditions of technology uncertainty. *Journal of business research, 55*(5), 389-400.

Reed, R., & DeFillippi, R. J. (1990). Causal ambiguity, barriers to imitation, and sustainable competitive advantage. *Academy of management review, 15*(1), 88-102.

Rindfleisch, A., & Moorman, C. (2001). The acquisition and utilization of information in new product alliances: A strength-of-ties perspective. *Journal of Marketing, 65*(2), 1-18.

Rodan, S., & Galunic, C. (2004). More than network structure: How knowledge heterogeneity influences managerial performance and innovativeness. *Strategic management journal, 25*(6), 541-562.

Rosenberg, N., & Steinmueller, W. E. (1988). Why are Americans such poor imitators?. *The American Economic Review, 78*(2), 229-234.

Saxenian, A. (1990). Regional networks and the resurgence of Silicon Valley. *California management review, 33*(1), 89-112.

Sivadas, E., & Dwyer, F. R. (2000). An examination of organizational factors influencing new product success in internal and alliance-based processes. *Journal of marketing, 64*(1), 31-49.

Song, M., & Montoya-Weiss, M. M. (2001). The effect of perceived technological uncertainty on Japanese new product development. *Academy of Management journal, 44*(1), 61-80.

Song, X. M., & Parry, M. E. (1997). The determinants of Japanese new product successes. *Journal of marketing Research, 34*(1), 64-76.

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research policy, 15*(6), 285-305.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal, 18*(7), 509-533.

Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. *American sociological review, 61*(4), 674-698.

Wang, M. C., & Fang, S. C. (2012). The moderating effect of environmental uncertainty on the relationship between network structures and the innovative performance of a new venture. *Journal of Business & Industrial Marketing, 27*(4), 311-323.

Wasserman, S., & Faust, K. (1994). *Social Network Analysis: Methods and Applications.* New York, NY: Cambridge University Press.

Wu, Z., Choi, T. Y., & Rungtusanatham, M. J. (2010). Supplier–supplier relationships in buyer–supplier–supplier triads: Implications for supplier performance. *Journal of Operations Management, 28*(2), 115-123.

Wuyts, S., & Geyskens, I. (2005). The formation of buyer–supplier relationships: detailed contract drafting and close partner selection. *Journal of marketing, 69*(4), 103-117.