The Role of Absorptive Capacity in Moderating the Relationship between Vertical Cooperation and Innovation Performance: A Study on Small and Medium-sized Enterprises

흡수역량의 조절 역할: 수직적 협력과 혁신 성과 간의 관계에 대한 연구 – 중소기업을 중심으로

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Abstract

The Role of Absorptive Capacity in Moderating the Relationship between Vertical Cooperation and Innovation Performance:

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This research investigates the relationship between vertical cooperation, absorptive capacity, and innovation performance in the context of small and medium-sized enterprises (SMEs). While prior studies have extensively examined the impact of vertical cooperation and absorptive capacity on innovation, the role of absorptive capacity as a moderator in the relationship between vertical cooperation and innovation performance remains underexplored, particularly in the context of SMEs. The objective of this study is to examine whether absorptive capacity acts as a moderating factor in the relationship between vertical cooperation and innovation performance within the specific context of SMEs. By analyzing empirical data collected from a sample of SMEs in the industry sector, this study aims to contribute to the existing literature on innovation management and provide practical insights for SMEs and policymakers.

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I. INTRODUCTION

There is a substantial body of prior research on cooperation and innovation performance, primarily focused on large corporations. However, the majority of these studies have neglected the specific context of small and medium-sized enterprises (SMEs). While there is a vast body of research on large corporations, relatively less attention has been given to SMEs. This research gap provides an opportunity to contribute to the existing knowledge by conducting focused studies on SMEs. By exploring the specific issues faced by SMEs, researchers can generate valuable insights and practical implications for this important sector. Therefore, the need arises to concentrate on SMEs in this study. SMEs play a crucial role in the economy of many countries. They contribute to job creation, innovation, and overall economic growth. Understanding the unique challenges, opportunities, and dynamics of SMEs is essential for promoting their sustainable development and supporting economic progress. However, SMEs possess distinct characteristics compared to larger organizations. They often operate with limited resources, face financial constraints, and encounter specific challenges related to scale, flexibility, and adaptability. Examining these unique features can shed light on the strategies, practices, and factors that contribute to the success or failure of SMEs. SMEs are an integral part of many industries, including sectors with significant societal impact such as technology, innovation, and entrepreneurship. Research that directly addresses the challenges and opportunities faced by SMEs can have direct implications for practitioners, managers, and entrepreneurs, providing them with valuable guidance and best practices.

The ability of SMEs to effectively collaborate and leverage external resources through cooperation has been a subject of great interest in the literature. The relationship between cooperation and innovation performance in SMEs has yielded mixed findings, leading to a need for further investigation. This study aims to shed light on the impact of cooperation on the innovation performance of SMEs, with a particular focus on the role of absorptive capacity.

This study seeks to explain the varying results reported in previous studies and provide insights into the factors that shape the outcomes of cooperation in SMEs. The choice of this research topic is driven by the existence of contradictory findings regarding the effects of cooperation on innovation performance among SMEs. Some studies have shown a positive relationship, indicating that cooperation enhances innovation outcomes, while others have found no significant association or even negative effects. This inconsistency suggests that additional factors may influence the nature of the cooperation-innovation performance relationship. To address this research gap, the present study will employ a comprehensive framework that incorporates absorptive capacity as a moderator, which has been selected based on its theoretical and practical significance. This moderator is expected to help explain the underlying mechanisms and contextual factors that shape the cooperation-innovation performance relationship in SMEs. The dependent variable in this study is vertical cooperation, involving collaboration with customers and suppliers. The innovation performance of SMEs will serve as the independent variable, representing the outcomes and effectiveness of the innovation process within these firms. By exploring the role of absorptive capacity as a moderator, this study aims to contribute to the existing body of knowledge on cooperation and innovation in SMEs. The findings of this research will provide a deeper understanding of the conditions under which cooperation positively influences innovation performance, offering valuable insights for practitioners, policymakers, and researchers in the field of entrepreneurship and innovation. In summary, this research seeks to investigate the impact of vertical cooperation on the innovation performance of SMEs by considering the moderating effects of absorptive capacity. Through a rigorous analysis of these factors, this study aims to offer a nuanced understanding of the cooperation-innovation performance relationship and provide practical implications for fostering successful cooperation strategies in SMEs.

II. THEORETICAL BACKGROUD

1. SMALL-TO-MEDIUM ENTERPRISE

It should not be assumed that small and medium-sized enterprises (SMEs) are simply small and do not differ much from large enterprises, since the structure changes significantly as a single enterprise grows (Gronum, 2015). Many researchers including Nooteboom (1993, 1994) investigated the strengths and weaknesses of a single firm and proved that large firms enjoy higher slack resources, market share, and brand recognition than SMEs. In addition, since economies of scope and scale can be utilized, large corporations can show high net profit growth by maximally increasing efficiency and reducing costs (Gronum, 2015). However, at the same time as these strengths, large corporations have problems with bureaucracy and slow information processing systems due to structural complexity (Nooteboom, 1994). On the other hand, SMEs have a much more flexible organizational structure, production technologies, and specialization, and respond quickly to customer needs and environmental changes and make decisions quickly (Gronum, 2015). The problem that arises on a small scale is called the "liability of smallness", which is mainly related to the limitedness of resources including financial and human resources (Nooteboom, 1993) and lack of legitimacy (Aldrich & Auster, 1986). Therefore, although SMEs are experiencing limitations in terms of resources, it can be said that they have an advantage in behavioral aspects (Nooteboom, 1993; Gronum, 2015). However, many studies group SMEs into one category and compare them with large enterprises. The difference between small and medium-sized enterprises is one that cannot be ignored.

Compared to large enterprises, SMEs have less developed core competencies and organizational learning. Although most SMEs have very limited resources and capabilities, they are required to achieve a high level of innovation and rapid growth as it is directly related to their survival. In RBV perspective, when firms become aware of their vulnerability as a diminished competitive advantage or lack of necessary resources, they can work with

competitors who can create greater value through partnerships (Gnyawali and Park, 2009). In particular, SMEs have limited internal resources, so that innovation through cooperation with entities with various competencies is a very important part, and cooperation between organizations with different competencies and resources can be an important factor in improving innovation performance. (De Fuentes and Dutrenit, 2012; Nieto and Santamaria, 2007). Collaboration also allows companies to gain market access faster by allowing them to enjoy an economy of time that allows them to acquire skills and resources in a shorter time than for independent development. Development through cooperation reduces the risk of corporate resource concentration, increases flexibility, and expands the available information and resource base to achieve innovative results (Hagedoorn, 1993; Gulati and Singh, 1998; Ahuja, 2000). In the case of cooperation, in order for SMEs to achieve the goal of cooperation, it is necessary to take action at the organizational level to overcome the limitations of internal resources. A series of processes will be required to form a relationship that can overcome mutual heterogeneity by searching for and selecting an appropriate partner with competencies, and to acquire and utilize the knowledge produced through cooperation to create performance (Bstieler et al., 2017; Steinmo and Rasmussen, 2016).

Since small enterprises have low technological independence and lack of internal resources to utilize, they have greater incentives to utilize external knowledge more widely than their own technology (Kaufmann & Todtling, 2002). It can be seen that small enterprises pursue innovation strategies that exploit various sources of knowledge (Prajogo, McDermott & McDermott, 2013). In other words, it can be predicted that small-scale enterprises will pursue innovation by broadly exploring various external knowledge to compensate for the weaknesses caused by smallness and acquire innovation opportunities. These imperfect resources and structures lead to activeness in exploring and utilizing external knowledge and ideas, which increases the willingness to collaborate with various organizations (Zeng, Xie &

Tam, 2010). However, small enterprises have low technological independence but usually have excellent expertise. Due to these characteristics, there is a disadvantage in that it is vulnerable to knowledge leakage. Therefore, although cooperation with suppliers and customers is maintained, it can be predicted that cooperation with competitors will have a negative impact on innovation performance.

Although medium-sized enterprises lack organizational and marketing resources within enterprises than large enterprises, their technological and organizational capabilities are considerably developed compared to small enterprises (Shy & Stenbacka, 2003). However, since it is still difficult for medium-sized enterprises to secure all necessary technologies through their own investment activities, unlike small enterprises, they pursue a mutually beneficial relationship through formal contracts with external partners with technical skills. In other words, it can be said that a learning routine is formed in which the long-term interaction between existing knowledge and the knowledge possessed by external partners is internalized to some extent in medium-sized enterprises, thereby equipping the company with its own innovation capabilities (Zollo & Winter, 2002). It is not simply increasing the number of partners for technological innovation like small businesses, but trying to form a closer relationship with partners. Looking at this from another perspective, medium-sized enterprises would take an exploratory strategy in an external network to solve technical problems (Prajogo, McDermott & McDermott, 2013)., while cooperating with competitors as a more aggressive strategy.

2. COOPERATION

Cooperation is an external activity in which two or more cooperating entities use each other's resources and information to perform work (Aronson et al., 2001). Through cooperation, companies can reduce costs compared to companies that acquire technology independently,

and technology sources can be obtained more easily from outside the company than from inside the company (Robertson and Gatignon, 1998). In addition, it is possible to achieve economies of scale or to predict the time and outcome of a technological process (Verspagen and Duysters, 2004). In summary, cost reduction, information acquisition, risk aversion, and efficient fund management can be viewed as direct benefits of cooperation. Another reason why firms cooperate is that they can enhance the strategic position of firms in competitive markets while sharing risks and costs with cooperating partners (Lavie, 2006). In other words, a cooperative relationship using complementary resources between companies can improve the competitive advantage of not only companies but also partners. Cooperation is becoming more important as customer demands are diversified and technology is changing rapidly (Sung and Carlsson, 2003). Previous study (Arranz and Arroyabe, 2008) divides cooperation into vertical and horizontal cooperation.

Vertical cooperation is defined as cooperation with customers and suppliers. Such cooperation has merit that it is easy to acquire information as the partners have the necessary technical information and market information. A separate study of SMEs and large enterprises also agree that vertical cooperation is the most frequent type of cooperation and a factor that greatly affects the innovation performance of enterprises. This is because suppliers and customers can provide valuable knowledge and information on the development of new products or improvement of existing products with complementary resources and knowledge that the company does not possess while working in the same industry as the company.(Tomlinson & Fai, 2013; Nieto & Santamaria, 2010). Cooperation with suppliers can enhance product quality, flexibility and market adaptability through improvement of input quality, such as reduction of production cost, development time, product price, and risk mitigation (Hagedoorn, et al. 1993). Furthermore, other researchers (Nieto & Santamaria, 2007) reported that vertical collaboration has a positive effect on both radical and incremental

innovation. This is because the supplier operates in the same or similar industry as the main enterprise, and thus has resources complementary to and complementary to that of the main enterprise that the main enterprise does not possess, but pursues the same purpose. Companies that work with customers can accurately identify customer needs (Von Hippel, 1988), evaluate the potential and future competitiveness of innovative ideas, and efficiently utilize financial resources for time and development (Santamaria & Surroca, 2011). In particular, cooperation with customers is important when the product is very new and complex (Tether, 2002). Knowledge and information from customers is often a source of innovative development ideas, and working with customers can help companies discover the most efficient ways to satisfy their needs.

Horizontal cooperation is defined as cooperation with competitors. Numbers of horizontal cooperation studies postulate that the horizontal cooperation strategy can pursue the advantages of competition and cooperation simultaneously with the goal of superior performance (Gnyawali and Park, 2011; Bouncken and Fredrich, 2012; Bouncken et al., 2018). However, existing studies suggest that horizontal cooperation is very complex to deal with and can cause both positive and negative effects at the same time. Negative performance in horizontal cooperation is due to difficulties in multi-faceted complexity of horizontal cooperation and opportunistic behavior of partners. Typical negative results are technical risks such as leakage of core technology and loss of management control (Gnyawali and Park, 2009). In particular, the risk of horizontal cooperation seems to be greater from the standpoint of small and medium-sized enterprises (SMEs).

Knowledge leakage is more detrimental for SMEs. In the horizontal cooperation process, firms simultaneously share knowledge and protect knowledge leakage (Gast et al., 2019). From the point of view of SMEs, there are risks of core technology and knowledge leakage, technical risks, and loss of management control due to opportunistic behavior of

partner companies (Gnyawali and Park, 2009). Knowledge management is a core factor in the horizontal cooperation process as coopetition allows firms to share and integrate knowledge with competitors (Enberg, 2012). Within the similar or the same industry, firms can increase mutual benefits and grow the market through cooperation with their competitors when they pursue a common goal, and can utilize an opportunity to supplement their limited resources and capabilities (Luo, 2006; Ritala, Golnam, and Wegmann, 2014). In this case, it is easier to share and integrate knowledge between partners as they have similarity in knowledge base, skills, and capabilities (Ritala & HurmelinnaLaukkanen, 2009). On the other hand, the risk of knowledge leakage and opportunistic behavior increases during this process (Estrada et al., 2016). In the case of SMEs, minimizing knowledge leakage is even more significant to gain or maintain a competitive advantage through knowledge sharing and to improve corporate performance (Kogut and Zander 1992). Leaked knowledge can have serious consequences as it can harm a company's innovative technologies and capabilities (Nieto & Santamaría, 2007), which is detrimental to SMEs. Kaur and Mustafa (2013) found that small and medium-sized enterprises (SMEs) compared to large enterprises are easily exposed to threats as they do not implement information security policies due to lack of time and resources despite the important role of information security policies. Knowledge sharing and integration take place even if the resources of competitors are complementary. Even in this case, knowledge protection is essential, as knowledge of each firm are both complementary for the other firm given their firm-specific uniqueness (Ritala & Sainio, 2014).

3. INNOVATION PERFORMANCE

Firms have long been recognized as key actors in innovation, and innovation is an important factor for firms (Romer, 1989; Teece, 1996). Continuous innovation enables the development of new products and services and is directly related to the survival of firms as it

contributes to the creation of new profits (Keizer, Dijkstra, & Halman, 2002; O'Regan, Ghobadian, & Sims, 2006). Innovation can be divided into radical innovation and incremental innovation depending on the degree of innovation. Radical innovation can be seen as the development of a new product or service that is new to the market, or a groundbreaking process that has never existed before (Duguet, 2006). Incremental innovation, on the other hand, refers to the improvement of an existing product or process, or a new product that already exists in the market but is introduced for the first time by a company (Tidd, Bessant & Pavitt, 1997; Duguet, 2006). Radical innovations are risky, but when successful, the economic rewards are generally greater than incremental innovations (Duguet, 2006; Nijstad, Berger-Selman, and De Dreu, 2014). Incremental innovation is characterized by a lower development risk than radical innovation and helps to expand market share and a firm's position in the market (Iyer, LaPlaca, & Sharma, 2006). In addition, innovation can be divided into product innovation and process innovation according to the target. Product innovation refers to innovation that develops new products that meet the needs of users or the market or improves existing products by combining new or existing technologies introduced commercially. Process innovation saves time and money in producing products. It means a new process technique that can reduce waste (Utterback & Abernathy, 1975). From a company's point of view, all innovations, whether radical or incremental product innovation or process innovation, are important. In particular, innovation in SMEs is even more important as it is directly related to the survival of the company. Firms can achieve sustainable growth only when it develops completely new products (radical product innovation) or improves existing products (incremental product innovation) to produce products of superior quality than competitors (Herrmann & Peine, 2011). In the case of the manufacturing industry, after launching a new product, continuous gradual product innovation is achieved through feedback from the market, users, or suppliers, or cost reduction is achieved through process innovation. In the case of the service industry, gradual

process innovation is carried out several times to achieve product innovation (Quinn & Sparks, 2007).

According to Arranz and Arroyabe (2008), small and medium-sized enterprises (SMEs) face difficulties in individually resolving the costs associated with innovation activities. Consequently, these enterprises seek to address the issue by collaborating with external organizations to secure funding and resources. In particular, financial issues can be alleviated through vertical cooperation, as it allows for the shared burden of R&D costs and reduces the overall expenses incurred in technology development (Shaw, 1994). Amara and Landry's (2005) research highlights the importance of interorganizational relationships within the supply chain for product innovation. They emphasize that consumer demands and technological information from suppliers can be gathered through collaborative networks, making the relationships within the supply chain crucial for innovation.

Cooperation with suppliers in R&D helps streamline internal processes by establishing close connections between the company's internal R&D activities and the suppliers. This enables the company to focus on its core competencies by eliminating or shortening unnecessary processes. Consequently, when the R&D process is closely linked with suppliers, it can lead to cost reduction for the company (Tether, 2002). Cooperation with customers in R&D helps mitigate external financial issues. By understanding customer demands through collaboration, companies can minimize unnecessary activities and concentrate their research efforts on technology development that aligns with customer requirements (Shaw, 1994; Savioz & Sannemann, 1999). Vertical cooperation, therefore, integrates the innovation process around core competencies and aims to address financial and resource constraints (Verspagen & Duysters, 2004).

Based on the aforementioned rationale, it can be concluded that vertical cooperation has the potential to alleviate impediments to innovation, specifically financial and resource-related challenges. Therefore, the hypothesis 1 of this study is as follows:

Hypothesis 1: Vertical cooperation in SMEs has a positive impact on innovation performance.

4. ABSORPTIVE CAPACITY

According to Cohen and Levinthal (1990), absorptive capacity is the ability to recognize the value of new information, assimilate it, and apply it for commercial purposes. Zahra and George (2002) further expanded the concept of absorptive capacity and divided it into potential absorptive capacity and realized absorptive capacity. Potential absorptive capacity is knowledge acquisition and absorption, whereas realized absorptive capacity is the use of knowledge through the development of routines that facilitate transformation and exploitation. By defining absorptive capacity based on these existing studies, absorptive capacity is the ability to identify, recognize, and evaluate the value of external knowledge that can contribute to value creation. Absorptive capacity implies an organization's resources and capabilities, and the meaning of learning, and is directly related to innovation performance (Cohen and Levinthal, 1990). Depending on the absorptive capacity of the company, the learning level or innovation activities of the organization show differences, which ultimately lead to differences in innovation performance (Tsai, 2001). Chen, Lin, and Chang (2009) confirmed the relationship between a company's absorptive capacity and innovation performance, and found that the higher the absorptive capacity, the higher the innovation performance. In other words, in order for cooperation to work effectively, companies must first secure the capacity to transform and accept external resources into innovation performance. In

fact, it is possible to hypothesize that absorptive capacity will play an important role in connecting to more effective innovation performance by acquiring and utilizing the knowledge of external companies. Summarizing the above discussion, the following second hypothesis can be derived.

H2: The relationship between vertical cooperation and innovation performance will be moderated by the absorptive capacity.

III. RESEARCH DESIGN

1. Research Model

Vertical Cooperation	→	Innovation Performance

Absorptive Capacity
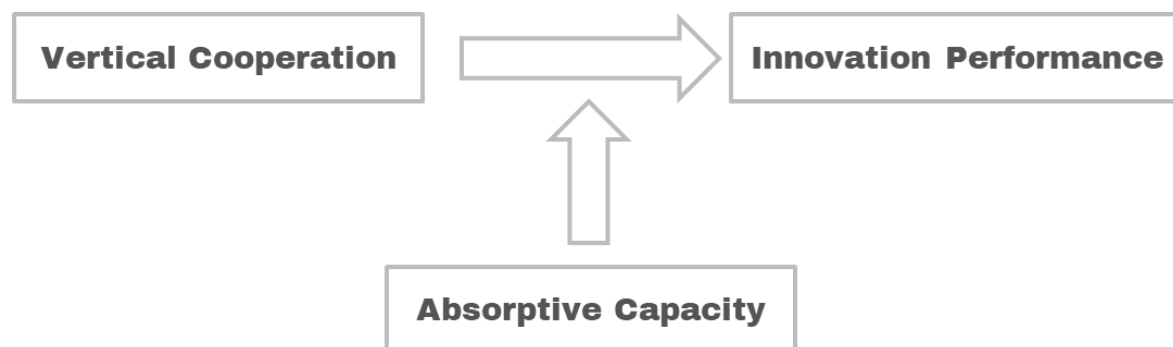
2. Sample and Data Collection

To analyze the moderating effect of absorptive capacity in the effectiveness of vertical cooperation, this study utilized the "2018 Korean Innovation Survey: Manufacturing Industry" conducted by the Science and Technology Policy Institute(STEPI). STEPI employed a stratified sampling method to select a total of 3,500 companies from the population of 51,553 manufacturing firms with 10 or more permanent employees between 2015 and 2017. The sample was stratified based on industry and employment size. Subsequently, an online, telephone, fax, or email survey was conducted to investigate the innovation activities of the

selected companies (STEPI, 2018). In this study, large companies and cases with missing values were excluded from the analysis among the 3,500 companies. As a result, a final sample of 3,409 SMEs was used as the analytical sample.

3. Measures

This study considered the innovation performance of SMEs as radical product innovation and incremental product innovation by referring to the questionnaire used in the Korean Innovation Survey and previous studies (Laursen & Salter, 2006). According to the 2018 manufacturing industry questionnaire, radical product innovation refers to the introduction of completely new products, while incremental product innovation refers to the launch of products significantly improved compared to existing ones (STEPI, 2018). The dependent variable in this study, which is the occurrence of product innovation, is a binary variable, and therefore, a logistic regression model was employed. Regarding the key variables related to vertical cooperation, they were analyzed by distinguishing between collaboration partners, including suppliers and customers. Specifically, companies that reported collaboration with suppliers or customers in innovation activities during the period from 2015 to 2017 were assigned a value of 1, while those that did not collaborate or only collaborated with other organizations were assigned a value of 0. The ratio of research and development personnel to total employees was used as a proxy for absorptive capacity. For the analyzed sample of small and venture businesses, which are heavily reliant on key personnel in determining their capabilities, this method can be particularly useful. This approach has been widely employed in previous studies (Cohen & Levinthal, 1990; Murovec & Prodan, 2009). Both R&D personnel and total employees were based on data from 2017. Several control variables were considered in this study. First, the number of pending patents filed by companies was controlled. Patent applications, which indicate the technological capabilities of firms, are

expected to have a positive influence on innovation performance, such as the development of new products or improvements to existing ones. Second, the operation of company research institutes was controlled. It is presumed that companies with dedicated research institutes or departments for R&D operations, which operate on a regular basis rather than in emergency situations, would have a positive impact on their innovation performance. Lastly, the dummy variable indicating whether the company has received venture or Inno-Biz certification was used as a control variable. The venture certification system introduced in 1998 and the Inno-Biz certification system introduced in 2001 aim to provide benefits to companies that focus on challenging and high-risk R&D activities. Venture-certified companies are known to have higher levels of innovation performance compared to SMEs. Therefore, differences in the achievement of radical or incremental product innovation performance may be observed between SMEs engaged in general innovation activities and venture or Inno-Biz certified companies.

Table 1: Variable Definitions

Variables	Definition
Dependent Variable	
Innovation Performance	Radical Innovation (Success = 1), Incremental Innovation (Success = 1)
Independent Variable	
Vertical Cooperation	Cooperation with suppliers and customers (Cooperation = 1)
Moderator	
Absorptive Capacity	Dedicated R&D personnel / Total permanent employees (as of 2017, %)
Control Variables	
Patent	Number of patents filed between 2015 and 2017
Research Institute Operation	Operation of a research institute or dedicated department
Certified Company	Venture company or INNO-BIZ company (=1), Not applicable (=0)

IV. ANALYSIS

Table 2: Descriptive Statistics of Variables Included in the Model

	N	Missing	Mean	Median	SD	Minimum	Maximum
Radical Innovation Performance	3409	0	0.1094	0	0.3122	0	1
Incremental Innovation Performance	3409	0	0.2056	0	0.4042	0	1
Absorptive Capacity	3409	0	0.2514	0.1900	0.2162	0	1
Vertical Cooperation	3409	0	0.0710	0	0.2568	0	1
Patent	3409	0	1.1106	0	2.5570	0	19
Research Institute Operation	3409	0	0.2563	0	0.4367	0	1
Certified Company Status	3409	0	0.3761	0	0.4845	0	1

Based on the descriptive statistics, logistic regression analysis was conducted to evaluate the relationships between the variables. The analysis was conducted on a sample of 3,409 firms. The variables examined included Radical Innovation Performance, Incremental Innovation Performance, Absorptive Capacity, Vertical Cooperation, Patent, Research Institute Operation, and Certified Company Status. These variables were assessed based on their mean, median, standard deviation, minimum, and maximum values. The results provide insights into the distribution and characteristics of the variables, offering a comprehensive understanding of the dataset used in the study.

Table 3: Moderating Effect of Absorptive Capacity on Radical Innovation Performance

*p < 0.1, **p < 0.05, ***p < 0.01		Model1(A)	Model1(B)
Input Variables	Vertical Cooperation	1.6730***	1.4623***
	Absorptive Capacity	1.1338 ***	1.0158***
Interaction	Vertical Cooperation * Absorptive Capacity		0.8116**
Control Variables	Patent	0.0399**	0.0401**
	Certified Company Status	0.6120***	0.6194***
	Research Institute Operation	0.7643***	0.7659***
Intercept		-3.2192***	-3.194***
Log Likelihood		1044.6	1044.0
LL-Null		1177.1	1177.1
LLR p-value		3.443e-55	1.417e-54
Cox & Shell's Pseudo Rsquared		0.1125	0.1131

The results obtained from the Table 3 provide evidence to support the hypotheses of the study. The coefficient for the variable "Vertical Cooperation" is 1.6730 with high statistical significance (p < 0.01), which indicates that an increase in vertical cooperation is associated with a positive impact on radical innovation performance. The interaction term "Vertical Cooperation * Absorptive Capacity" has a coefficient of 0.8116, which is statistically significant (p < 0.05). This suggests that the relationship between vertical cooperation and radical innovation performance is influenced by the level of absorptive capacity. Furthermore, the control variables also exhibit significant effects on innovation performance. Holding a patent, being a certified company and operating research institute all positively impact radical innovation performance. The log likelihood values for Model1(A) and Model1(B) are 1044.6 and 1044.0, respectively. These values represent the goodness-of-fit of the models in explaining the observed data. The LL-Null values for both models are 1177.1, indicating the log likelihood of the null models. The difference between the LL-Null and the log likelihood of the estimated models (LLR p-value) is highly significant, with values of 3.443e-55 and 1.417e-54 for Model1(A) and Model1(B), respectively. This suggests that the estimated models significantly outperform the null models. Lastly, Cox & Shell's Pseudo R-squared values for Model1(A) and Model1(B) are 0.1125 and 0.1131, respectively. These values indicate the proportion of variance in the radical innovation performance explained by the independent variables in each model. Overall, the results demonstrate that vertical cooperation has a positive effect on radical innovation performance, and the relationship is influenced by the level of absorptive capacity. Additionally, the control variables, including patent ownership, certified company status, and research institute operation, contribute significantly to explaining radical innovation performance.

Table 4: Moderating Effect of Absorptive Capacity on Incremental Innovation Performance

*p < 0.1, **p < 0.05, ***p < 0.01		Model2(A)	Model2(B)
Input Variables	Vertical Cooperation	2.2343***	2.1241***
	Absorptive Capacity	0.9266***	0.8905***
Interaction	Vertical Cooperation * Absorptive Capacity		0.4574**
Control Variables	Patent	0.0903***	0.0902***
	Certified Company Status	0.3961***	0.3982***
	Research Institute Operation	0.6712***	0.6708***
Intercept		-2.3172***	-2.3082***
Log Likelihood		1505.7	1505.6
LL-Null		1732.2	1732.2
LLR p-value		1.200e-95	1.008e-94
Cox & Shell's Pseudo Rsquared		0.1307	0.1308

The coefficient for "Vertical Cooperation" in Model2(A) is 2.2343, and in Model2(B) is 2.1241, both highly statistically significant (p < 0.01). These findings indicate that an increase in vertical cooperation is associated with a positive impact on incremental innovation performance. the interaction term "Vertical Cooperation * Absorptive Capacity" in Model2(B) is 0.4574 (p < 0.05), suggesting that the relationship between vertical cooperation and incremental innovation performance is moderated by absorptive capacity. Also, all the control variables positively contribute to incremental innovation performance. The LL-Null values for both models are 1732.2, representing the log likelihood of the null models. The difference between the LL-Null and the log likelihood of the estimated models (LLR p-value) is highly significant, with values of 1.200e-95 for Model2(A) and 1.008e-94 for Model2(B). This indicates that the estimated models significantly outperform the null models. Cox & Shell's

Pseudo R-squared values for Model2(A) and Model2(B) are 0.1307 and 0.1308, respectively. These values indicate the proportion of variance in the incremental innovation performance explained by the independent variables in each model. In conclusion, the results confirm that vertical cooperation has a positive effect on incremental innovation performance, and the relationship is moderated by absorptive capacity. Additionally, the control variables, including patent ownership, certified company status, and research institute operation, have significant impacts on incremental innovation performance.

The analysis confirmed the hypothesis 1, stating that vertical cooperation has a positive impact on innovation performance in SMEs. The coefficients of the vertical cooperation variable in both Model1(A) and Model2(A) were highly significant ($p < 0.01$), indicating that increased collaboration and partnerships within the supply chain and with customers lead to improved innovation outcomes. This highlights the importance of fostering an ecosystem of collaboration and knowledge exchange to drive innovation in SMEs. The hypothesis 2, which proposed that absorptive capacity moderates the relationship between vertical cooperation and innovation performance, was also supported by the findings. The interaction term "Vertical Cooperation * Absorptive Capacity" in both models showed a significant positive coefficient ($p < 0.05$), indicating that absorptive capacity strengthens the impact of vertical cooperation on both radical and incremental innovation outcomes. SMEs with higher absorptive capacity, characterized by their ability to acquire, assimilate, and apply external knowledge, exhibited enhanced innovation performance. This emphasizes the importance of developing absorptive capacity as a strategic capability in SMEs to fully leverage the benefits of collaborative relationships.

V. CONCLUSION AND DISCUSSION

The findings contribute to the existing literature by shedding light on the relationship between vertical cooperation, absorptive capacity, and innovation performance in SMEs. The results align with previous studies emphasizing the importance of collaboration and knowledge exchange in driving innovation outcomes. However, this research specifically focuses on vertical cooperation within the context of SMEs, providing valuable insights into their unique innovation dynamics. The identified role of absorptive capacity as a moderator expands our understanding of the mechanisms through which collaboration influences innovation. SMEs with higher absorptive capacity are better equipped to absorb and apply external knowledge, leading to superior innovation performance. This highlights the significance of building internal capabilities, such as training programs, knowledge management systems, and organizational learning processes, to effectively assimilate external knowledge gained through collaborative initiatives. The control variables included in the analysis also contribute important implications for SMEs aiming to enhance their innovation performance. The positive effects of having a patent, being a certified company, and operating as a research institute emphasize the value of protecting intellectual property, obtaining formal recognition, and accessing research resources. SMEs should proactively seek intellectual property protection for their innovative ideas and products, leverage certification programs to enhance credibility and reputation, and foster collaborations with research institutes to tap into specialized knowledge and resources. While the results provide valuable insights, it is important to acknowledge the limitations of this study. The models employed in the analysis explain a moderate portion of the variance in innovation performance (11-13% as indicated by Cox & Shell's Pseudo R-squared values). This suggests that there are other unexplored factors and variables that may influence innovation outcomes in SMEs. Future research could consider incorporating additional variables, such as organizational culture, leadership style, and market

conditions, to gain a more comprehensive understanding of the innovation process in SMEs. Also, the data used in this research were cross-sectional, limiting our ability to establish causal relationships. Additionally, the study focused on a specific industry and geographical area, which may limit the generalizability of the findings. Future research should consider longitudinal studies and expand the scope to different industries and regions to further validate and extend these findings. The findings of this study align with prior research emphasizing the positive impact of vertical cooperation on organizational outcomes. Consistent with studies in the field, our analysis shows that increased collaboration among SMEs leads to improved chances of achieving the innovation performance. These findings reinforce the resource-based view and knowledge-based perspectives, which argue that strategic alliances and cooperative networks can enhance firms' innovative capabilities and competitive advantage.

From a practical standpoint, the findings underscore the importance of fostering a collaborative environment among SMEs. Policymakers and industry practitioners should encourage initiatives that promote knowledge sharing, joint research and development, and strategic alliances. By leveraging vertical cooperation, SMEs can enhance their ability to innovate, access new markets, and improve their overall performance. To further advance this line of research, future studies should explore the underlying mechanisms through which vertical cooperation affects the innovation performance. Additionally, longitudinal studies could provide insights into the temporal dynamics and long-term effects of collaborative efforts in the SME context. Furthermore, investigating the potential boundary conditions and contingencies of the relationship between vertical cooperation and innovation performance could provide a more comprehensive understanding of the phenomenon. Overall, this study contributes to the growing body of knowledge on the significance of vertical cooperation in the context of SMEs. The findings highlight the need for proactive collaboration strategies and

provide actionable insights for policymakers, industry practitioners, and SME owners/managers seeking to enhance their innovative capabilities and competitive position.

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국문 초록

본 연구는 중소기업(SMEs)의 맥락에서 수직적 협력, 흡수역량, 그리고 혁신 성과 간의 관계를 탐구한다. 기존 연구들은 수직적 협력과 흡수역량이 혁신에 미치는 영향을 폭넓게 조사해왔지만, 흡수역량이 수직적 협력과 혁신 성과 간의 관계를 조절하는 역할은 아직 충분히 탐구되지 않은 영역이다. 특히, 중소기업의 맥락에서는 더욱 그러한 연구가 부족하다. 본 연구의 목적은 중소기업의 맥락에서 흡수역량이 수직적 협력과 혁신성과 간의 관계를 조절하는 역할을 하는지를 확인하는 것이다. 산업 부문의 중소기업들로부터 수집된 경험적 데이터를 분석함으로써, 본 연구는 혁신 관리에 대한 기존 문헌에 기여하고 중소기업과 정책 결정자들에게 실질적인 통찰력을 제공할 것이다.

주요어: 수직적 협력, 흡수역량, 혁신 성과, 중소기업

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