

The Dynamic Roles of Government, Higher Education, Large Enterprises, and Communities in SME Collaboration: Mediating Effect of Knowledge and Innovation Exchange

Sunday Noya^{1,2,*}, Armanu Thoyib¹, Risna Wijayanti¹, Ananda Sabil Hussein¹

¹Department of Management, Brawijaya University, Indonesia

²Industrial Engineering Study Program, Universitas Ma Chung, Indonesia

*Corresponding author: sundaynoya@student.ub.ac.id

ABSTRACT. This study examines the impact of SMEs' multidimensional strategic collaboration with government agencies, higher education institutions, large enterprises, and SME communities on performance, with inter-organizational knowledge exchange and innovation as mediating factors. Utilizing data from 411 managers of food and beverage SMEs in the Greater Malang Area, Indonesia, the research employs structural equation modelling through WarpPLS to assess the relationships among four key constructs: SME multidimensional strategic collaboration, inter-SME knowledge exchange, inter-SME innovation, and SME performance. The findings reveal that collaboration with government entities has the most significant direct and mediated effects on performance, while partnerships with universities and large enterprises produce more conditional results, depending on the SMEs' capacity to absorb and apply external knowledge and innovations. Additionally, collaboration with SME communities has a meaningful impact on knowledge exchange, which partially mediates performance outcomes, highlighting the value of peer-to-peer learning and shared experiences within SME networks.

1. Introduction

In the intricate web of contemporary economies, small and medium-sized enterprises (SMEs) are pivotal pillars of national and global economic systems. Their adaptability, innovation, and resilience make them indispensable drivers of economic growth, employment generation, and sectoral innovation. Their ubiquity and flexibility enable them to effectively navigate economic fluctuations, strengthening national economies' stability and resilience.

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Despite their significant role, SMEs are not immune to challenges that impede their performance and growth. Financial vulnerability and limited access to capital, particularly in developing countries, pose a significant hurdle to their expansion. The European Commission [1] also noted a weakening performance of SMEs in Europe, especially during the COVID-19 pandemic, underscoring their struggle to maintain stability in dynamic environments. Additionally, SMEs in regions like ASEAN face lower productivity compared to larger firms [2], a situation exacerbated by limited access to resources such as human capital, knowledge, and expertise, which affects all aspects of their operations, from production to research and development [3].

The existing literature on Resource Dependency Theory (RDT), as introduced by Pfeffer and Salancik [4], emphasizes the power dynamics arising from resource control, where organizations seek to either minimize their dependence on others or maximize the dependency of others by controlling key resources. Traditionally, this power-driven perspective has dominated the discourse on interorganizational relationships. However, recent shifts in practice highlight a move towards collaboration, where organizations, rather than exploiting power imbalances, work together to address resource limitations through cooperation [5].

The research gap lies in further exploring the role of strategic collaboration as a critical mechanism for overcoming resource constraints, particularly for SMEs. While collaboration has been acknowledged as a solution for resource limitations, there is a limited empirical exploration of how strategic partnerships benefit SMEs by enabling access to external knowledge, technology, and complementary resources [6]. Moreover, despite recognizing SMEs' heightened need for external resources [7], more research is required to investigate how these collaborations enhance SMEs' ambidexterity and competitiveness [8,9]. This study aims to fill this gap by examining how collaboration fosters SMEs' ability to adapt and thrive in competitive environments.

2. Literature Review and Hypotheses Development

2.1. SME Multidimensional Strategic Collaboration and Performance

RDT underscores the necessity for organizations, including SMEs, to engage in strategic interactions with other entities to mitigate their inherent resource limitations. This framework suggests that no organization is self-sufficient in acquiring all the resources needed for sustained growth. As such, SMEs, often constrained by limited access to capital, knowledge, and technology, rely on external partnerships to enhance their operational capacities. Noya et al. [10] advocate for multi-organizational collaboration, which involves engaging with various actors such as government bodies, higher education institutions, large enterprises, and SME

communities—an approach encapsulated in the quadruple helix concept. This collaborative framework is not just a necessity but a powerful tool that empowers SMEs to tap into broader knowledge pools and complementary resources that would otherwise be inaccessible within their organizational boundaries. The relationship between the breadth of these networks and the positive outcomes for SMEs has been empirically supported, with Love et al. [11] indicating that the wider the network, the more significant the performance gains.

Governments play a pivotal role in the success of SMEs, particularly in their capacity as regulators, policymakers, and economic facilitators. In many countries, government agencies actively develop SMEs by providing critical resources, such as funding, and crafting policies that foster innovation and competitiveness [12]. Furthermore, due to their extensive networks and influence, governments are well-positioned to initiate and sustain collaborative efforts between SMEs and other key stakeholders [13]. These collaborations, initiated and sustained by governments, help SMEs navigate regulatory frameworks and provide them with access to public funding and infrastructure necessary for scaling operations [14]. Moreover, the ability of governments to facilitate partnerships between SMEs and larger entities, such as universities and large corporations, further amplifies the potential for innovation and growth within the SME sector [15].

Higher education institutions and large enterprises also play crucial roles in enhancing SME performance through collaboration. Universities offer a unique advantage by providing access to specialized knowledge and research capabilities – elements often beyond SMEs' reach [16]. Collaborations between SMEs and universities have been shown to improve their innovation processes, market intelligence and efficiency, as Lundberg and Öberg [17] highlighted. Similarly, partnerships with large enterprises enable SMEs to leverage more established companies' resources, expertise, and market reach, accelerating their innovation and growth [18].

Similarly, partnerships with large enterprises enable SMEs to leverage more established companies' resources, expertise, and market reach, accelerating their innovation and growth [18]. The importance of SME communities should be noticed, as they provide a supportive environment where knowledge and resources can be shared, fostering a culture of mutual growth and improving performance [10]. Learning through these collaborative networks is crucial, as it equips SMEs with the tools needed to improve their performance and remain competitive in a dynamic market [19].

Based on the above discussion, the following hypotheses are proposed:

Hypothesis 1a: Strategic collaboration with the government positively and significantly impacts SME performance.

Hypothesis 1b: Strategic collaboration with higher education institutions positively and significantly impacts SME performance.

Hypothesis 1c: Strategic collaboration with large enterprises positively and significantly impacts SME performance.

Hypothesis 1d: Strategic collaboration with SME communities positively and significantly impacts SME performance.

2.2. Inter-SME Innovation

The significance of external networks in driving innovation has been well-established, as innovation is not merely an internal endeavour but a process enriched by collaborative efforts with external partners [11]. In recent years, innovation models have increasingly highlighted organizations' need to open their research and development activities to external inputs. This shift has resulted in a growing trend toward building collaborative networks where entities pool resources and knowledge to co-create new solutions [20]. One prominent example of this approach is crowdsourcing, where all members of a network or community contribute their ideas and resources to collectively develop innovations [21,22]. This collaborative approach offers hope, reducing the barriers to innovation that smaller entities, like SMEs, often face due to limited internal resources, and allowing them to tap into external expertise and capabilities.

The concept of collective innovation, a key focus in this study, emphasizes the role of networks in generating ideas through the interaction of multiple organizations. Based on Chesbrough's [23] open innovation framework, collective innovation highlights the importance of external collaborations to drive the innovation process. Dossou-Yovo and Keen [24] argue that SMEs, which often suffer from resource constraints, particularly benefit from building networks that link them with other SMEs or larger entities capable of filling resource gaps. These networks not only enhance access to critical resources but also provide a platform for knowledge exchange and collaborative problem-solving, making them crucial for innovation. SMEs play a vital role in this dynamic interaction, transforming external knowledge into competitive advantages and developing innovative products and services that would otherwise be unattainable on their own.

2.3. Strategic Collaboration and Inter-SME Innovation

Due to limited internal resources and expertise, SMEs need collaboration to foster innovation. Fukugawa [25] highlights that SMEs can accelerate innovation and gain access to critical resources by engaging in collaborative relationships with external partners. The need for external collaboration not only drives SMEs to co-create new knowledge and capabilities with their partners but also opens up opportunities for growth and success, enabling them to overcome

internal constraints [26]. By pooling resources and knowledge with external entities, SMEs can develop new value-added products and services that better meet market demands [27].

Collaboration within the triple helix model, which involves partnerships between government, universities, and large enterprises, particularly benefits SMEs. According to Brink and Madsen [28], such collaborations can significantly strengthen the innovation capabilities of SMEs by providing them with access to diverse knowledge bases and technological expertise. As a mediator, the government is crucial in initiating and facilitating these collaborative networks [29]. Moreover, universities serve as vital partners in these collaborations due to their role in knowledge creation and dissemination. Meng et al. [30] and Zeng et al. [31] emphasize the importance of university partnerships, noting that collaboration with academic institutions significantly enhances SME innovation outcomes.

Furthermore, the role of SMEs in fostering innovation is not limited to their interactions with government, universities, and large enterprises; collaborations among SMEs themselves create a sense of community and mutual benefit that is equally vital. Guerrero and Urbano [32] underscore the importance of interaction with various stakeholders in driving innovation, while Ueasangkomsate and Jangkot [33] affirm that such collaborations significantly contribute to improved innovation performance. Additionally, Kallmuenzer and Scholl-Grissemann [34] and Kang and Park [35] demonstrate that partnerships between SMEs positively influence their innovation capabilities. By forming networks with other SMEs, these businesses can collectively overcome resource limitations and achieve greater innovation success, fostering a sense of community and mutual benefit.

Based on the analysis above, the following hypotheses are proposed:

Hypothesis 2a: Strategic collaboration with the government positively and significantly correlates with SME innovation.

Hypothesis 2b: Strategic collaboration with higher education institutions positively and significantly correlates with SME innovation.

Hypothesis 2c: Strategic collaboration with large enterprises positively and significantly correlates with SME innovation.

Hypothesis 2d: Strategic collaboration with SME communities positively and significantly correlates with SME innovation.

2.4. Inter SME Knowledge Exchange

Knowledge exchange enables SMEs to enhance innovation by tapping into external resources such as industry best practices, academic research, or technological advancements. While knowledge within an SME is essential, it is often insufficient to drive substantial

innovation, necessitating exchanging knowledge and information from these external sources [36]. Collaboration among SMEs creates opportunities for this knowledge exchange, crucial for gaining diverse perspectives and fostering co-creation. Nonaka and Takeuchi [37] define knowledge exchange as the flow and transformation of knowledge between individuals, groups, and units within an organization. Over time, this concept has expanded to include inter-organizational knowledge sharing, which is fundamental in collaborative partnerships [38, 39]. As SMEs increasingly engage in strategic collaborations, these exchanges are no longer limited to internal processes but extend to external networks, enhancing their capacity for innovation.

In the context of open innovation, SMEs play a crucial role in leveraging external knowledge and integrating it with internal expertise, thereby remaining competitive [40]. The open innovation model emphasizes that innovation is not merely an internal process but is strengthened by exchanging ideas, experiences, and resources across organizational boundaries. However, much of the existing research has primarily focused on knowledge management within individual SMEs, overlooking the importance of inter-SME knowledge sharing in communities or networks [41]. This gap highlights the need for more studies to examine how SMEs within collaborative networks exchange knowledge to build competitive advantages, promote innovation, and address their resource constraints more effectively. This study emphasizes that the dynamics of inter-SME knowledge exchange in networks can serve as a critical enabler of innovation and growth, with SMEs at the forefront of this transformative process.

2.5. Strategic Collaboration and Inter-SME Knowledge Exchange

Strategic collaboration is crucial for fostering knowledge exchange among SMEs, enabling them to overcome limitations by leveraging their partners' strengths. Collaborative partnerships create a foundation of trust and commitment essential for substantive knowledge sharing. This environment allows for open dialogue and exchanging insights that might remain inaccessible, particularly in less cooperative settings [42]. Such collaborations are not merely transactional but are deeply integrated processes where knowledge is translated, stored, and shared within a network, thereby enhancing the collective intellectual capacity of the involved entities [43]. By engaging in these strategic networks, SMEs can effectively acquire and integrate a broader range of knowledge, which is critical for sustaining competitiveness and fostering innovation [44].

Empirical evidence supports the notion that SMEs significantly benefit from collaborative knowledge exchange. Ferreras-Méndez et al. [45] found that SMEs engaged in partnerships with industry and non-industry entities experience a marked improvement in their absorptive capacity for knowledge. This fact suggests that collaboration not only facilitates knowledge acquisition but also enhances the ability of SMEs to assimilate and apply this knowledge to their

operations. Additional studies further corroborate the positive impact of collaboration on knowledge exchange, underscoring the importance of strategic partnerships in the SME sector. Given these insights, it is evident that strategic collaboration plays a crucial role in enhancing SMEs' competitiveness and preparing them for the market.

Based on the above elaboration, the following hypotheses are proposed:

Hypothesis 3a: Strategic collaboration with the government plays a positive and significant role in knowledge exchange among SMEs.

Hypothesis 3b: Strategic collaboration with higher education institutions plays a positive and significant role in knowledge exchange among SMEs.

Hypothesis 3c: Strategic collaboration with large enterprises plays a positive and significant role in knowledge exchange among SMEs.

Hypothesis 3d: Strategic collaboration with SME communities plays a positive and significant role in knowledge exchange among SMEs.

2.6. Mediation Role of Inter-SME Knowledge Exchange

Collaboration and networking are vital drivers of innovation, yet their effectiveness largely depends on the quality of knowledge exchange within these partnerships. Knowledge is critical for advancing innovation, requiring integrating and transferring insights from external sources to unlock its full potential [36]. In the context of SME collaboration, knowledge exchange becomes an empowering mechanism for overcoming internal resource limitations and enhancing innovation capacity. Collaboration efforts may fall short of producing meaningful innovation without effective knowledge sharing, but with the right knowledge exchange, even resource limitations can be overcome.

In addition, robust knowledge management frameworks are crucial for inter-organizational innovation collaboration. This study positions knowledge exchange as a key mediator in the dynamics of collaborative innovation ecosystems, particularly in the context of SME networks. Multiple studies have underscored the importance of knowledge exchange in fostering innovation through collaboration, enlightening us about its crucial role. Najafi-Tavani et al. [46] identified absorptive capacity and knowledge sharing as central to the collaboration-innovation relationship. Similarly, Martínez-Costa et al. [47] emphasized that organizational learning, driven by the acquisition and dissemination of knowledge, plays a pivotal mediating role in achieving innovation success. Kim and Shim [48] further affirmed the significance of knowledge exchange in strengthening collaboration and promoting innovative outcomes among SMEs.

Based on the elaboration above, the following hypotheses are formulated:

Hypothesis 4a: Inter-SME knowledge exchange mediates the correlation between strategic collaboration with the government and innovation among SMEs.

Hypothesis 4b: Inter-SME knowledge exchange mediates the correlation between strategic collaboration with higher education institutions and innovation among SMEs.

Hypothesis 4c: Inter-SME knowledge exchange mediates the correlation between strategic collaboration with large enterprises and innovation among SMEs.

Hypothesis 4d: Inter-SME knowledge exchange mediates the correlation between strategic collaboration with SME associations and innovation among SMEs.

2.7. Mediation Role of Inter-SME Innovation

The role of innovation as a critical driver of company performance has been widely recognized, with extensive research underscoring its transformative impact on competitiveness and growth. However, much of the existing literature focuses on innovation as an isolated factor, overlooking its potential role as a conduit through which strategic collaboration influences firm performance. The strategic alignment between innovation and collaboration is a key area of interest. It warrants deeper exploration, particularly given the growing complexity of inter-organizational networks and the increasing reliance on external knowledge to fuel innovative processes. Firms engaged in strategic collaboration with external partners, such as government bodies, higher education institutions, large enterprises, and SME communities, can leverage this dynamic interplay to enhance their innovation capabilities, which, in turn, should lead to improved performance outcomes.

Building on this premise, we argue that strategic collaboration stimulates inter-SME innovation and is a critical enabler of enhanced organizational performance. This mediation framework aligns with the findings of Ozgun et al. [49], which validated that innovation activities act as a mediating mechanism linking social capital and organizational performance. Through exchanging knowledge, resources, and expertise within collaborative partnerships, SMEs are better positioned to integrate innovative practices that contribute to higher productivity, operational efficiency, and long-term success. Thus, this study posits that innovation is pivotal in the relationship between strategic collaboration and performance. The innovation creates a pathway through which firms can translate collaborative synergies into tangible business outcomes.

Based on the elaboration above, the following hypotheses are formulated:

Hypothesis 5a: Inter-SME innovation mediates the correlation between strategic collaboration with the government and SME performance.

Hypothesis 5b: Inter-SME innovation mediates the correlation between strategic collaboration with higher education institutions and SME performance.

Hypothesis 5c: Inter-SME innovation mediates the correlation between strategic collaboration with large enterprises and SME performance.

Hypothesis 5d: Inter-SME innovation mediates the correlation between strategic collaboration with SME associations and SME performance.

Figure 1 illustrates the conceptual framework outlining the correlation among the variables.

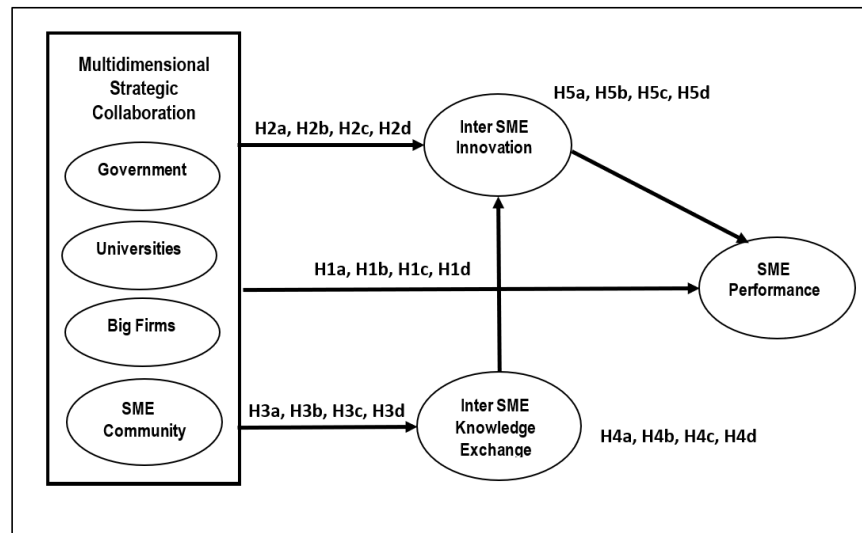


Fig. 1. Conceptual Framework

3. Method

This study adopts a quantitative research approach using a structured survey to collect data from SME managers in the Food and Beverage sector in the Greater Malang Area, a region known for its high SME concentration in East Java, Indonesia. The survey focused on several vital constructs: strategic collaboration with government (govt), universities (univ), large enterprises (ent), and SME communities (com). Strategic collaboration was measured using indicators like product promotion, training, collaboration facilitation, information providing, infrastructure facilitation, research application, academia assistance, mentoring, experience sharing, technology sharing, discussion session, and motivation enhancement, adapted from [10, 32, 33]. Inter-SME knowledge exchange was assessed using indicators such as information sharing, idea sharing, experience sharing, technology sharing, and learning, adapted from [27, 50, 51, 52]. For inter-SME innovation, indicators such as innovation collaboration, product development collaboration, process development collaboration, innovation sharing, partner's idea utilization, and

knowledge acquisition are drawn from [53, 54, 55, 56]. Finally, business performance was measured using indicators such as sales, profit, and customer satisfaction, adapted from [9, 57, 58, 59].

Respondents evaluated the constructs using a 5-point Likert scale, and the survey yielded 411 valid responses, surpassing the minimum sample size needed for Structural Equation Modeling Partial Least Squares (SEM PLS) analysis. According to Hair et al. [60], SEM PLS requires a minimum sample size of ten times the highest number of indicators for any construct, which in this case was six, confirming the adequacy of the sample size. To ensure its relevance and clarity, the questionnaire was first reviewed by two experts and an SME manager. It was followed by a pilot test involving thirty-one managers who provided feedback on its readability and comprehension. The final version of the questionnaire drew upon established measurement items from previous studies, adapting them to the context of this research, thereby ensuring the reliability of the measurement tools.

For data analysis, the study employed Warp Partial Least Squares-Structural Equation Modeling (WarpPLS-SEM), chosen specifically for its ability to assess mediating variables [61]. The analysis followed three key phases. First, the outer model was evaluated to confirm the reliability and validity of the measurement tools, assessing discriminant validity through the Average Variances Extracted (AVE) and convergent validity through factor loadings, both exceeding the recommended thresholds of 0.5 and 0.7, respectively. Composite reliability and Cronbach's Alpha also met the required values above 0.7, confirming the robustness of the measurement model. The second phase assessed the structural model's quality through fit indices, while the final phase focused on path analysis to examine the correlation between variables and the mediating role of knowledge exchange and innovation. The significance level was set at 5% and mediation effects were measured using the Variance Accounted For (VAF) method, with VAF values indicating the degree of mediation. VAF values above 80% indicate full mediation, those between 20% and 80% are categorised as partial mediation, and values below 20% signify no mediating effect [60].

4. Result

The first stage of analysis was a meticulous evaluation of the robustness of the outer model. We focused on assessing both discriminant and convergent validity with great care. Discriminant validity, which determines the degree to which a measurement tool can differentiate between distinct constructs, was confirmed as the Average Variance Extracted (AVE) values exceeded the threshold of 0.5. Additionally, the square roots of AVE values were greater than the correlations between constructs, satisfying Fornell and Larcker's criterion [62].

This indicates that the measurement items appropriately capture the intended constructs without overlapping with others. Convergent validity was also affirmed, as all factor loadings exceeded the recommended threshold of 0.7. This result suggests that the respondents consistently interpreted the items as intended, aligning with the conceptual design of the constructs [61].

In addition to validity assessments, we measured reliability using Composite Reliability and Cronbach's Alpha, which are widely accepted indicators for evaluating internal consistency. Both values surpassed the critical level of 0.7, affirming that the instruments used in the study exhibit strong reliability [63, 64]. These results collectively indicate that the measurement model is valid and reliable, providing a robust foundation for further structural analysis. This comprehensive evaluation ensures that the data accurately reflects the measured constructs, paving the way for a reliable interpretation of the correlation among variables.

Evaluating the inner model's overall fit, guided by Model Fit and Quality Indices [61], confirms its robustness and suitability for hypothesis testing. As can be seen in Table 1, key indicators such as the Average Path Coefficient (APC) and Average R-squared (ARS) were both statistically significant at the 1% level, underscoring the strength of the relationships between latent variables and highlighting meaningful connections between exogenous and endogenous variables. A substantial Tenenhaus GoF index of 0.693 further supports the model's explanatory power, indicating that it effectively captures the key interactions. Additionally, the Average Full Collinearity VIF (AFVIF) of 2.834 exceeded the standard threshold, signifying full collinearity among latent variables without redundancy. These results affirm that the designed model is well-structured, valid, and ready for hypothesis testing, ensuring a strong foundation for the study's analytical framework.

Table 1. Model Fit and Quality Indices

Goodness of Fit	Value	Cut-off	Inference
Average Path Coefficient (APC)	< 0.001	0.05	Significant (good)
Average R-Squared(ARS)	< 0.001	0.05	Significant (good)
Average Block VIF (AVIF)	2.693	≤ 5: Acceptable ≤ 3,3: ideal	Ideal
Average full collinearity VIF (AFVIF)	2.834	≤ 5: Acceptable ≤ 3,3: ideal	ideal
Tenenhaus GoF (GoF)	0.693	≥ 0,1: small ≥ 0,25: medium ≥ 0,36 big	Big

The analysis employed Partial Least Squares Structural Equation Modeling (PLS-SEM) using WarpPLS version 8.0, as illustrated in Table 2. The results reveal that all exogenous variables positively correlate with the endogenous variables. However, the p-values associated with each equation vary, indicating differing significance levels across the correlation examined in this study.

Table 2. Statistical Analysis Result

Hypo-thesis	Path	Direct effect		Indirect effect		Total effect	VAF
		Coeff.	P-Value	Coeff.	P-Value		
H1a	govt → perform	0,172	<0,001				
H1b	univ → perform	0,052	0,145				
H1c	ent → perform	0,002	0,481				
H1d	com → perform	0,076	0,061				
H2a	govt → innov	0,047	0,169				
H2b	univ → innov	0,011	0,411				
H2c	ent → innov	0,184	<0,001				
H2d	com → innov	0,070	0,076				
H3a	govt → KE	0,200	<0,001				
H3b	univ → KE	0,224	<0,001				
H3c	ent → KE	0,084	0,043				
H3d	com → KE	0,436	<0,001				
H4a	govt → KE → innov			0,125	<0,001	0,172	0,727
H4b	univ → KE → innov			0,141	<0,001	0,152	0,927
H4c	ent → KE → innov			0,053	0,064	0,237	0,223
H4d	com → KE → innov			0,273	<0,001	0,343	0,796
H5a	govt → innov → perform			0,077	0,013	0,273	0,282
H5b	univ → innov → perform			0,063	0,035	0,160	0,394
H5c	ent → innov → perform			0,049	0,080	0,099	0,495
H5d	com → innov → perform			0,147	<0,001	0,303	0,485

Drawing on the data from Table 2, the hypothesis testing results, as presented in Table 3, show that nearly all correlations between the dimensions of SME strategic collaboration partners and SME performance are statistically insignificant, except for collaboration with government entities. Similarly, the correlations between these partners and inter-SME innovation are predominantly unsupported, except in the case of collaboration with large enterprises.

Table 3. Hypothesis Result

Collaboration partner (dimension)	Direct correlation to:			Correlation to innovation, mediated by knowledge exchange	Correlation to performance, mediated by innovation
	Inter-SME knowledge exchange	Inter-SME innovation	SME performance		
Government	Supported	Not supported	Supported	Supported (partial mediation)	Supported (partial mediation)
University	Supported	Not supported	Not supported	Supported (full mediation)	Supported (partial mediation)
Large enterprises	Supported	Supported	Not supported	Not supported	Not supported
SME Communities	Supported	Not supported	Not supported	Supported (partial mediation)	Supported (partial mediation)

An intriguing observation from the analysis is that collaboration with all types of partners – government, universities, large enterprises, and SME communities – significantly impacts inter-SME knowledge exchange. Furthermore, when considered a mediating variable, inter-SME knowledge exchange effectively mediates the relationships between collaboration and innovation across all partners, except for large enterprises. Likewise, inter-SME innovation can mediate the relationships between collaboration and performance, except for large enterprises.

5. Discussion

This study's findings complement the RDT, highlighting the importance of leveraging power dynamics to access critical external resources. For SMEs, which often have limited bargaining power, forming strategic collaborations proves to be an essential strategy for acquiring the necessary external resources to enhance their performance. The results show that while collaboration with government entities directly and significantly impacts SME performance, other forms of collaboration, such as with universities, large enterprises, and SME communities, could be more consistent in their direct impact. This significant variance highlights each partner's differentiated value to the SME ecosystem. Collaboration strategies must carefully align with SMEs' specific goals and resource needs.

Collaboration with government entities emerges as the most influential factor in directly enhancing SME performance, with additional impacts through partial mediation by inter-SME

knowledge exchange and innovation. This finding aligns with Vrgovic et al. [12], who assert that government collaboration provides SMEs with critical infrastructure, funding, and policy-related advantages essential for fostering innovation and improving performance. The partial mediation by knowledge exchange and innovation highlights the government's role in creating an environment that supports operational efficiency while promoting creative problem-solving within SMEs.

In contrast, collaboration with universities presents a more complex and nuanced relationship. The direct impact of university collaboration on both performance and innovation is found to be insignificant. This finding contradicts the results of Lundberg and Öberg [17], who claim that collaboration between SMEs and universities enhances innovation processes, improves market intelligence, and increases operational efficiency. The present study reveals a gap between the academic knowledge generated by universities and its practical applicability to the operational realities SMEs face, known as the 'research-practice gap' [65]. While universities are valuable sources of knowledge, their contributions do not necessarily result in immediate innovations for SMEs. This gap underscores the difficulty SMEs encounter when attempting to leveraging academic research, which is often more theoretical and may not align with small businesses' immediate, practical needs. Interestingly, the mediation effect through inter-SME knowledge exchange is significant, demonstrating full mediation. This result suggests that knowledge exchange among SMEs is crucial in absorbing academic knowledge from universities and transforming it into a valuable resource for fostering collaborative innovation.

Collaboration with large enterprises, as noted in the research by Cristo-Andrade and Franco [18], demonstrates a strong direct correlation with inter-SME innovation. This finding highlights the inspiring role of large enterprises in stimulating innovation within the SME ecosystem. However, it fails to impact performance, either directly or through mediation significantly. This finding reflects the common challenge of asymmetric partnerships, where large enterprises and SMEs operate in vastly different environments, making it difficult for innovations from larger firms to be easily transferred to the SME context. Large enterprises typically possess sophisticated technologies and processes that are often too resource-intensive or complex for SMEs to adopt effectively [66]. Consequently, while collaboration with large enterprises stimulates innovation, the lack of a significant performance impact suggests that SMEs face difficulties scaling or adapting these innovations into concrete performance improvements.

While not significant in driving innovation, collaboration with SME communities, which are informal networks of small and medium-sized enterprises, has a meaningful direct impact on knowledge exchange and a partial mediation effect on performance. This finding emphasizes the

value of peer-to-peer learning and shared experiences within SME networks. Unlike collaborations with universities or large enterprises, which often involve substantial knowledge or technology gaps, SME communities provide a contextually relevant and more accessible platform for knowledge exchange [67]. These communities facilitate the diffusion of practical knowledge that can be immediately applied to operational improvements. The partial mediation through knowledge exchange implies that while these communities may not directly spur innovation, they play a critical role in disseminating best practices and operational strategies that enhance SME performance.

The connections between the direct effects of collaboration and the mediating roles of knowledge exchange and innovation reveal essential insights into how different types of partnerships function within the SME ecosystem. The partial mediation of knowledge exchange and innovation for government collaboration suggests a holistic support system where the government provides immediate resources and fosters long-term growth through innovation. However, for universities, the mediation is only entirely significant through knowledge exchange, which indicates that universities are better suited for capacity-building and knowledge enhancement rather than immediate innovation. While effective in fostering innovation, large enterprises fail to deliver a performance boost, highlighting the challenges of scaling innovations in resource-constrained SMEs.

One unanticipated insight from these findings is the underperformance of large enterprise collaborations in improving SME performance. Conventional wisdom suggests that partnerships with large firms should be highly beneficial due to access to superior resources, technologies, and market networks [10]. However, the data reveals a stark reality: the complexity of innovations and the operational differences between large firms and SMEs create barriers to effective knowledge transfer and practical application. This insight suggests that for SMEs to truly benefit from large enterprise collaborations, intermediaries such as innovation hubs or industry-specific accelerators may be needed to bridge this gap, helping SMEs adapt and integrate large-scale innovations into their more constrained operational environments [66].

The analysis also points to the pivotal role of knowledge exchange as a mediator across multiple collaborations. Whether with government entities, universities, or SME communities, the knowledge exchange is a significant mediator, enhancing innovation and performance outcomes. This fact underscores the importance of fostering robust knowledge-sharing networks within SME ecosystems. Governments and policymakers could enhance these outcomes by encouraging more structured knowledge exchange programs, such as collaborative platforms, workshops, and training that facilitate continuous learning and knowledge transfer between

SMEs and their partners. This emphasis on structured knowledge exchange programs provides the audience with informed strategies for enhancing collaboration and improving SME performance.

6. Conclusion

In conclusion, this study underscores the intricate dynamics of SME collaborations and their diverse impacts on performance, influenced by knowledge exchange and innovation. Notably, collaboration with government entities emerges as consistently advantageous, both directly and through mediation. In contrast, partnerships with universities and large enterprises present more conditional benefits, contingent on the SMEs' ability to absorb and apply the knowledge and innovations provided. The nuanced nature of these relationships necessitates more targeted approaches in fostering SME collaborations, leveraging different partnership types for specific strategic outcomes—capacity building, innovation, or operational efficiency. This analysis underscores the critical importance of designing collaboration strategies that align with SMEs' unique needs and constraints, ensuring they not only access external knowledge and innovation but also effectively translate these resources into performance gains.

6.1. Theoretical Implications

The theoretical implications of this study provide valuable insights into the application of Resource Dependency Theory, highlighting the critical role of collaboration in directly enhancing SME performance through resource provision and fostering innovation. The study also underscores the pressing need for theoretical frameworks that better bridge the 'research-practice gap' in university collaborations, where academic knowledge is not easily transformed into practical innovation. Additionally, the findings affirm the absorptive capacity challenges SMEs face when collaborating with large enterprises, as the complexity of innovations from large firms often exceeds the capacity of SMEs to adopt them effectively. Finally, the significant mediating role of inter-SME knowledge exchange emphasizes the importance of knowledge-based theories, suggesting that peer learning and collaborative networks are essential for turning external resources into performance gains within the SME ecosystem.

6.2. Practical Implications

From a practical standpoint, the study emphasizes the need for tailored collaboration strategies that align with the specific needs of SMEs. Government programs should focus on providing resources and fostering long-term innovation and knowledge exchange environments that support SMEs' operational efficiency. For SMEs partnering with universities, collaborations should be aimed at capacity-building and long-term knowledge development, while university-industry programs should be redesigned to meet SMEs' practical needs better. The challenges in

leveraging large enterprise collaborations suggest that innovation hubs or intermediary institutions are necessary to help SMEs adapt large-scale innovations to their contexts. However, the study also highlights the crucial role of fostering robust peer-to-peer knowledge exchange through collaborative platforms, workshops, and training programs. This is not just a suggestion, but a necessity for enhancing SME performance and driving collective innovation.

6.3. Limitations

This study has several limitations that should be considered. First, the findings may be specific to the geographic region or industry context, limiting their generalizability to other settings with different economic or policy environments. Second, the study primarily focuses on the direct and mediated effects of collaboration, potentially overlooking the quality and depth of interactions, which can vary significantly and influence outcomes differently. Additionally, the cross-sectional design may miss time-lag effects, as some collaborations, particularly with universities or large enterprises, may take longer to produce measurable impacts on innovation and performance. The focus on formal collaborations also excludes the potential contributions of informal networks, which can be critical for SMEs. Furthermore, the study needs to deeply examine the absorptive capacity of SMEs, which plays a crucial role in determining how effectively external knowledge and innovations are integrated. Addressing these limitations in future research would provide a more nuanced and comprehensive understanding of the dynamics of SME collaborations and is therefore recommended for further academic exploration.

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