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**Business clusters and SMEs' sustainable performance in emerging markets: examining the roles of open innovation and digital capacity**

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**Business Clusters and SMEs’ Sustainable Performance in Emerging Markets: Examining the Roles of Open Innovation and Digital Capacity**

**Abstract**

**Purpose:** This study aims to develop a framework for the sustainable performance (SP) of small and medium enterprises (SMEs) that will benefit emerging markets by emphasizing the roles of open innovation (OI) and digital capacity (DC) within a business cluster. Thus, the research investigates how social capital theory (SCT) and diffusion of innovation theory (DOI) within a cluster can facilitate the SP of SMEs.

**Design/Methodology/Approach:** The study employed a confirmatory research design and Partial Least Squares Structural Equation Modelling (PLS-SEM). It analyzed 583 Nigerian SME owners/managers. SP was measured using environmental, social, and economic performance, while coexisting, business support, and knowledge sharing were used to measure cluster support (CS), all of which are essential factors in understanding the overall impact of SMEs on their communities and economies. OI was measured using both inbound and outbound open innovation (OI) methods.

**Findings:** CS, OI, and DC impact SMEs’ SP within clusters. The evidence reveals the innovative potential of SME clusters and the role that SCT and DOI play in helping SP through OI and DC, indicating that CS is critical to OI. The finding highlights the role of clusters in facilitating collaborative innovation, particularly by enabling SMEs to leverage shared resources and knowledge to achieve more innovative outcomes. Findings also indicate that DC is vital for SMEs’ SP.

**Research Implication:** The study provides data to inform decisions on sustainability in SME clusters, benefiting SMEs, researchers, policymakers, and practitioners. SMEs in clusters can leverage the ecosystem’s collaborative potential to enhance OI practices across developing countries. This is significant for policy and practice in developing countries seeking to optimize SMEs’ SP.

**Originality/Value:** This study fills a gap in the literature by exploring how DC and OI can enhance SMEs’ SP within a cluster. The integration of SCT and DOI in clusters for SMEs’ SP is also a novel contribution of the study.

**Keywords:** cluster support, digital capacity, open innovation, SMEs, and sustainable performance.

**Paper type:** Research paper.

## 1.0 Introduction

Small and medium-sized enterprises (SMEs) contribute to global economic growth and poverty reduction by generating employment (Okonta *et al.*, 2024). They also promote entrepreneurship and sustainable development (Egere *et al.*, 2022; Jordão and Novas, 2024). Their flexibility in adopting new technologies often enables higher levels of innovation output than larger firms (Radicic and Petković, 2023), positioning them as drivers of economic growth (Edeh *et al.*, 2024). However, many SMEs prioritize short-term operational gains over long-term strategic objectives, which constrains sustainable performance (SP), particularly where strategic planning remains weak (Zighan and Ruel, 2023; Nakpodia *et al.*, 2024). Nevertheless, engagement in industry-relevant collaborations and stakeholder networks helps strengthen social capital and improve access to helpful resources (Arroyabe *et al.*, 2024). Furthermore, technological innovation can expand SMEs' capacity to connect with partners and provide competitive advantages (Tajeddin *et al.*, 2025).

Indeed, emerging economies face challenges and inadequate business ecosystems that constrain SME growth, including limited access to finance, inadequate infrastructure, and weak regulatory frameworks (Costa *et al.*, 2023). In response, SMEs in these environments rely more on networks and adaptive strategies because formal institutional support remains fragmented (Malekinezhad *et al.*, 2024). Consequently, business clustering becomes a key mechanism for collaboration, enabling resource sharing, the diffusion of innovation, and improved access to market intelligence. SME sustainability in such contexts depends on strengthening economic, social, and environmental performance dimensions (Adekunle and Okuwhere, 2025). Clustering supports this process by helping firms manage institutional volatility, use scarce resources more efficiently, attract investor confidence, and integrate into sustainable global value chains (Hoffmann *et al.*, 2023). As a result, SME sustainability contributes to national economic and inclusive development in emerging economies where large firms and public-sector employment are limited (Nudurupati *et al.*, 2022). In several emerging markets, including Nigeria, business clusters (BC) develop organically rather than through structured industrial policy. This makes them suitable environments for examining open innovation (OI) and digital capability (DC) within network-based SME ecosystems (Egere *et al.*, 2024). BC are geographical concentrations of interconnected enterprises, suppliers, institutions, and infrastructure within a specific industry (Dyba and De Marchi, 2022). The concept suggests that the proximity of firms helps develop localized capabilities and shared institutional frameworks, ultimately influencing competitiveness (Mendes *et al.*, 2023). OI involves the use of both internal and external knowledge, resources, and technologies to drive innovation, while DC reflects the use of digital tools to enhance competitiveness. Within this context, Lagos' Computer Village cluster stands out as a major

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ICT hub in Nigeria and sub-Saharan Africa. Furthermore, Lagos hosts multinational technology firms such as Google, Microsoft, and IBM, reinforcing its position as a leading destination for business activity and investment in Africa (Awoleye, 2022).

This study is framed by Social Capital Theory (SCT) and Diffusion of Innovation (DOI). SCT explains how relationships, trust, cooperation, and network ties within clusters provide SMEs with access to knowledge, resources, and support. DOI explains how innovation spreads across firms through communication channels, perceived usefulness, and adoption capacity. These theories fit the study because SMEs in clusters depend on social relationships and shared knowledge to access innovation, while digital tools shape the speed and quality of innovation adoption. Examining Computer Village through SCT and DOI therefore provides a basis for understanding how CS, OI, and DC influence SMEs' SP in an emerging economy. Existing studies show that SMEs face competition, resource scarcity, and pressure to innovate (Costa *et al.*, 2024). These challenges are more pronounced in developing countries, where infrastructure deficits and limited funding hinder growth (Egere *et al.*, 2022). BC provides supportive ecosystems through which SMEs collaborate, share resources, and innovate (Faeroevik and Maehle, 2024). DC also helps SMEs improve efficiency, access markets, and strengthen competitiveness (Edeh *et al.*, 2024). Although research on SMEs and clusters is well established in developed economies, less is known about their interaction in developing contexts, where distinct economic, social, and technological constraints prevail (Olekanma *et al.*, 2024). In Nigeria, SMEs remain central to employment and economic growth, and government attention to the sector reflects their policy relevance (Okafor *et al.*, 2023). Studying SMEs in this context, therefore, offers evidence for policies on job creation, wealth generation, and sustainable development (Adekunle and Okuwhere, 2025).

Previous research has recognized the potential of SMEs across industries and sectors in developing countries to support development and growth (Egere *et al.*, 2025). However, it remains unclear how BC contributes to SMEs' sustainability through OI and DC. Through BC, SMEs engage in inbound and outbound OI and support communities at social and economic levels (Ben-Hafaïedh *et al.*, 2024). OI is widely studied; however, most research focuses on large enterprises in developed economies (Lee and Roh, 2025). This is because developed economies have better infrastructure and adequate support for digital innovation ecosystems (Al Nuaimi *et al.*, 2024). However, emerging markets differ in institutional configuration, market dynamics, and resource environments, limiting the direct transferability of findings from advanced economies. Although OI helps SMEs improve business processes, sustain competitiveness, and promote growth Coco *et al.* (2024), evidence remains limited on how OI and DC jointly explain SMEs' SP within BC in developing economies. Additionally, studies

on SME SP and BC have largely focused on developed countries Hariram et al. (2023); Larabi, (2026), leaving the emerging economy underexplored.

Thus, the research gap is both empirical and theoretical. Empirically, prior studies have examined SMEs' SP within BC (Fulgence *et al.*, 2023). The roles of OI and DC in this relationship remain unclear. Theoretically, the specific pathway linking BC to SMEs' SP through OI and DC is unclear. The unresolved issue concerns the mechanism linking these constructs. Existing research often treats CS, OI, and DC as parallel or direct predictors of performance (Gentile-Lüdecke et al., 2020; Lee and Roh, 2025). This approach does not adequately explain why SMEs operating within the same cluster achieve different innovation and sustainability outcomes. It also makes the distinction unclear between having access to knowledge and possessing the organizational capacity to transform knowledge into productive action. SCT explains how network resources become available but offers a less complete account of how SMEs convert those resources into digital capabilities and sustainability outcomes. DOI Theory explains how innovations spread and are adopted but gives less attention to the relational conditions through which resource-constrained SMEs gain access to relevant knowledge. This study addresses this theoretical problem by proposing a staged relational-to-capability conversion process. CS represents the relational infrastructure through which SMEs gain access to knowledge, business assistance, and collaborative opportunities. OI represents the mechanism through which firms search for, exchange, and recombine knowledge across organizational boundaries. DC represents the ability to assimilate and deploy the resulting knowledge through digital technologies, skills, routines, and processes. SP represents the economic, social, and environmental outcome of this conversion process.

The study therefore examines whether CS produces SP directly or whether its influence depends on OI and DC development. This distinction is theoretically important because a positive direct relationship would suggest that cluster membership and social capital are sufficient sources of performance. An indirect relationship would indicate that social capital creates potential value whose realization depends on organizational actions and capabilities. By examining these, the study refines SCT, extends DOI, and connects both theories through an ordered process linking relational resources, knowledge mobilization, capability development, and SP. The Nigerian Computer Village provides a relevant setting for examining this process because its clusters developed largely through entrepreneurial interaction rather than formal industrial planning. Infrastructure limitations and fragmented institutional support reduce the likelihood that cluster membership will automatically generate performance benefits. The setting therefore exposes the mechanisms and boundary conditions through which cluster resources become productive, rather than serving only as an additional

geographical application. Furthermore, the study adopts a mediation and moderation approach to explain the pathways through which CS, OI, and DC jointly influence SMEs' SP. Mediation explains how CS enhances OI and how OI, in turn, contributes to DC, while moderation assesses how SMEs' DC conditions the relationship among the study variables. This structure clarifies the indirect and conditional mechanisms linking CS to SP. The study uses CS as a proxy for measuring BC. Subsequently, the study follows this structure: First, the theoretical background is presented to deepen understanding. Second, the authors discuss the hypothesis and the study's methodology. Third, the analysis, findings, and discussion are presented. Fourth, the contribution is presented, including policy implications, recommendations, and future research considerations.

## 2.0 Theoretical Background

### *Social Capital Theory*

Social capital refers to the actual or potential resources associated with an enduring network of institutionalized relationships characterized by mutual acquaintance and recognition, including trust, norms, and networks. Accordingly, SCT suggests that social networks, relationships, and norms significantly contribute to communities' economic and social well-being (Shao and Sun, 2021). In the context of SMEs within clusters, social capital enables firms to share knowledge, resources, and expertise, which are essential for fostering OI. The network ties established within clusters help SMEs access valuable external knowledge that would otherwise be difficult to obtain. By fostering trust and reciprocity among firms, social capital facilitates the exchange of ideas, technologies, and solutions, enabling SMEs to overcome resource constraints and drive innovative outcomes (Orser *et al.*, 2020). CS, as measured by knowledge sharing, business support, and coexistence within the cluster, directly benefits from social capital. The more robust the social networks and trust within a cluster, the more likely SMEs are to engage in OI practices, contributing to their sustainability. Thus, SCT underpins the first part of the model by explaining how CS (through social networks and trust) leads to the adoption of OI practices, which in turn facilitate the enhancement of DC and SP (Amini Sedeh *et al.*, 2021). Social capital enables SMEs to access shared resources, collaborate on innovative projects, and adapt to external changes, thereby improving their long-term viability and performance within a business cluster (Biemans, 2018). Figure 1 below shows the elements of social capital.

### *Insert Figure 1*

SCT explains why OI is likely to thrive in clusters. Firms with strong social networks are more likely to exchange ideas with suppliers, customers, and peers, thereby reducing information asymmetry

and facilitating access to external knowledge (Al Nuaimi *et al.*, 2024). Their organizational and interactive capabilities shape SMEs' openness to external knowledge. Thus, clustering serves as the relational foundation for OI and DC (Hoffmann *et al.*, 2023). Consequently, Figure 2 below shows how social capital can support SMEs' SP within a cluster. The SCT explains how CS can support SMEs' SP through OI and DC.

### *Insert Figure 2*

#### ***Diffusion of Innovation Theory***

Rogers' Diffusion of Innovation theory (1962) explains how new ideas or technologies spread within societies. Initially viewed as a communication theory, it shows how innovations gain traction through word-of-mouth over time (Bianchi *et al.*, 2017). The theory clarifies how and why new behaviors and concepts are adopted (Rogers, 2003). The rate of diffusion depends on how quickly innovations are communicated and on potential adopters' perceptions (Vargo *et al.*, 2020). Diffusion involves the acceptance of innovations within a social system (Schiavone and Simoni, 2019). It often starts with the use of a new idea to improve organizational performance, making it vital for market development (Biemans, 2018). Overall, diffusion research focuses on how and why innovations are adopted within groups or societies (Reddy and Sasidharan, 2023). In the context of this study, DOI helps explain how SMEs' adoption of digital technologies is influenced by the OI processes facilitated by social networks within the cluster. As SMEs interact within the cluster, they gain access to innovations (in the form of digital tools, processes, or models), and DOI explains how these innovations are adopted over time, starting with innovators, spreading to early adopters, and eventually reaching the majority. Using DOI, the study can investigate the rate of adoption of digital technologies among SMEs and how the spread of innovations is influenced by both internal factors (e.g., the SME's organizational readiness) and external factors (e.g., social networks and collaboration within the cluster). The mediating role of DOI can be observed in its enhancement of digital capacity (DC) within SMEs through knowledge exchange and idea diffusion within the cluster. As SMEs are exposed to new technologies and business models through their participation in OI practices, the rate and extent of their adoption are influenced by social networks (via SCT) and the observability of successful outcomes within the cluster.

For innovation to succeed, understanding this diffusion process is essential. Initial adoption is typically limited to a small segment of the population, known as Innovators, who represent approximately 2.5%. Following the Innovators are the Early Adopters, who make up about 13% of the

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population and act as opinion leaders. The critical threshold of 15-18% adoption that reaches the tipping point is essential for widespread acceptance (Rogers, 2003). This requires engaging both Innovators and Early Adopters to create momentum (Upadhyay *et al.*, 2022). Thus, involving employees in the rationale behind new initiatives is critical for organizational adoption (Burcharth *et al.*, 2017; Roumeliotis, 2020). Figure 3 below illustrates the distribution of Innovators, who explore new ideas; Early Adopters, who provide influential feedback; the Early Majority, who follow the lead of the Early Adopters; the Late Majority, who adopt under social pressure; and the Laggards, who resist change until it becomes unavoidable.

*Insert Figure 3*

DOI is the rate at which users in a network adopt an invention. It is the rate at which a new idea or technology spreads within a social setting (Rogers, 2003). The illustrations in Figure 4 below demonstrate how DOI can facilitate digitalization adoption for SME sustainability. As shown below, DOI can help SMEs achieve SP in a cluster through OI and DC.

*Insert Figure 4*

***Integrating Social Capital and Diffusion of Innovation Theories***

The connection between SCT and DOI lies in how social capital enables and accelerates the diffusion of OI, particularly within business clusters. The strong network ties and trust within clusters (as described by SCT) create a fertile environment for OI practices to thrive. SCT explains why SMEs within clusters are more likely to engage in collaborative innovation, while DOI clarifies how these innovations spread, are adopted, and are integrated into SMEs’ business models. This integration is particularly important for understanding the mediating and moderating effects in the model: The study proposes that CS (mediated by social capital) fosters an environment that supports the diffusion of OI practices. The adoption of innovations (influenced by DOI) enhances DC, which, in turn, affects SP. Therefore, SCT and DOI work together to explain how CS catalyzes the adoption of digital technologies and facilitates SME sustainability. DOI also moderates the relationship between CS and OI. DC (as a key factor in DOI) moderates the effect of CS on OI adoption. The more developed an SME’s DC, the more likely it is to embrace and integrate OI practices, thereby enhancing its SP. Figure 5 below presents this relationship. These theories integrate through social networks, relationships, and social systems. While SCT clarifies the catalytic role of CS in supporting sustainability, DOI explains how DC and OI, facilitated through CS, can help SMEs achieve sustainability.

*Insert Figure 5*

## Conceptual Framework and Hypotheses Development

The study suggests that CS and OI can support DC in producing SMEs' SP outcomes within a cluster by redesigning business models to better use available resources, reduce transaction costs, leverage economies of scale, and complement one another for collective growth (Gentile-Lüdecke *et al.*, 2020). CS was used to represent and measure the business cluster. The study also found a relationship between the size and age of businesses within a cluster, highlighting their interconnections with other firms. As a result, an SP model that incorporates CS, OI, and DC was developed for this study. CS was measured using coexistence, business support, and knowledge sharing. OI was measured for inbound and outbound. Environmental, social, and economic performance was used to measure SP. Control variables in the model were firm size (FS) and firm age (FA). Figure 6 below presents the study's conceptual framework, illustrating how CS, OI, and DC can support SMEs' SP within a cluster. The following paragraph discusses the measurements that underpin the hypotheses.

*Insert Figure 6*

### Hypothesis 1: Cluster Support and Open Innovation

*H1: Cluster support, through enhanced networking, knowledge sharing, and collaborative opportunities, positively influences the adoption of open innovation practices among SMEs.*

BC creates relational environments where SMEs gain access to knowledge, resources, expertise, and collaborative opportunities that are difficult to obtain independently. Through repeated interactions among firms, suppliers, customers, and supporting institutions, clusters strengthen trust, reciprocity, and knowledge-sharing practices. From the perspective of SCT, these network-based relationships reduce information barriers and transaction costs, while improving firms' ability to access and exchange valuable external knowledge. Such conditions provide an important foundation for OI, which depends on firms' ability to acquire, integrate, and apply knowledge beyond their organizational boundaries. Empirical studies support the relationship between CS and OI. Fulgence *et al.* (2023) demonstrated that cluster environments enhance SME innovative performance by strengthening knowledge absorptive capacity, suggesting that firms embedded in supportive networks are better positioned to identify and utilize external knowledge. Similarly, Ketels and Protsiv (2021) found that cluster presence improves firm-level outcomes through concentrated networks, collaboration, and resource-sharing mechanisms. Franco *et al.* (2024) further showed that clusters operate as mechanisms for knowledge sharing and innovation by enabling firms to exchange ideas, develop partnerships, and

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3 access complementary capabilities. In addition, Urzelai and Puig (2019) highlighted that clustering  
4 contributes to the development of international social capital by strengthening communities of practice  
5 and facilitating knowledge exchange among interconnected firms. These findings indicate that CS does  
6 not merely provide physical proximity among SMEs. Rather, it creates a collaborative ecosystem  
7 (Egere *et al.*, 2022) where firms are encouraged to engage in inbound and outbound knowledge flows,  
8 joint problem-solving, and innovation partnerships. The combination of trust-based relationships,  
9 shared resources, and continuous interaction increases SMEs' ability to search for external ideas, adopt  
10 new technologies, and develop innovative solutions. Therefore, CS represents an important antecedent  
11 of OI because it enhances both access to external knowledge and the internal capability required to  
12 transform such knowledge into innovation outcomes.  
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21 **Hypothesis 2: Cluster Support and Digital Capacity**

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23 *H2: CS positively enhances DC by providing SMEs with access to digital tools, collaborative*  
24 *networks, and technological resources.*  
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27 CS provides SMEs with access to shared infrastructure, business services, knowledge,  
28 expertise, and relationships needed for digital adoption. This support is relevant to SMEs because  
29 many small firms lack the financial resources, specialized personnel, and technical knowledge required  
30 to build DC independently. Within a cluster, repeated interactions with suppliers, competitors, support  
31 organizations, and technologically advanced firms expose SMEs to digital tools and practices already  
32 tested by other organizations. Empirical research supports this relationship across stages. Dyba and De  
33 Marchi (2022) examined the movement toward Industry 4.0 within manufacturing clusters and  
34 identified an important role for business support organizations in helping firms respond to digital  
35 transformation requirements. Awolaye, (2022) study of Nigerian ICT clusters showed how human  
36 capital and knowledge spillovers operate within technology-based clusters. Fulgence et al. (2023)  
37 found that the cluster environment strengthens the relationship between knowledge absorptive capacity  
38 and SME innovative performance. Franco et al. (2024) also showed that clusters function as  
39 mechanisms for knowledge sharing and innovation through network relationships. These studies do  
40 not all test CS and DC as a single direct relationship. They provide evidence for the underlying process.  
41 Cluster environments facilitate knowledge spillovers, business assistance, learning, and innovation,  
42 while such resources reduce the informational and capability barriers associated with digital adoption.  
43 SCT explains how trust, proximity, and repeated interaction improve access to knowledge and  
44 technological resources. DOI explains how digital technologies spread through communication,  
45 observation, peer influence, and interaction with early adopters. SMEs embedded in supportive clusters  
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therefore receive more opportunities to observe digital solutions, evaluate their usefulness, acquire technical knowledge, and incorporate digital tools into their operations.

### **Hypothesis 3: Open Innovation and Digital Capacity**

*H3: Engaging in OI practices positively enhances SMEs' DC by facilitating access to external digital knowledge and technologies, which are then integrated into the firms' operations.*

OI involves the deliberate movement of knowledge, technologies, and ideas across organizational boundaries. For resource-constrained SMEs, external partnerships provide access to technological expertise and digital solutions beyond the firms' internal resource base. Inbound OI brings external technologies and specialist knowledge into the firm, while outbound OI fosters interaction, experimentation, and knowledge exchange with external partners. These activities support the development of digital skills, routines, infrastructure, and organizational readiness. Albats et al. (2023) examined OI in SMEs as a process through which external knowledge supports business-model innovation. Coco et al. (2024) presented digital transformation among small and micro-enterprises as an open and guided innovation process, highlighting the importance of external guidance and digital literacy. Scuotto et al. (2020) identified knowledge sharing and technology transfer as important micro-foundations of OI partnerships. (Al Nuaimi *et al.*, 2024) also examined OI in SMEs from a dynamic-capabilities perspective, linking external knowledge engagement with organizational capability development. This evidence suggests that OI supports DC through access, assimilation, and application. External relationships first expose SMEs to relevant technologies. Knowledge-sharing and technology-transfer processes then help firms understand and evaluate those technologies. Through experimentation and organizational learning, SMEs develop the routines and skills needed to apply digital solutions. DOI reinforces this reasoning. Exposure to an innovation alone does not produce organizational capacity. Firms must receive information about the innovation, assess its compatibility with existing operations, test its usefulness, and integrate it into organizational routines. OI provides the communication channels and external relationships through which these stages occur.

### **Hypothesis 4: Open Innovation and Sustainable Performance**

*H4: OI contributes to SP by enabling SMEs to develop innovative solutions that address economic, environmental, and social challenges.*

OI supports SP by broadening the range of knowledge, technologies, and solutions available to SMEs. External collaboration helps firms improve products, redesign processes, reduce resource consumption, address stakeholder expectations, and identify new market opportunities. These outcomes contribute to the economic, environmental, and social dimensions of SP. Camilleri et al.

(2023) linked OI approaches to shared-value creation and corporate sustainability, showing how collaboration with external stakeholders supports broader sustainability objectives. Lee and Roh (2025) examined SP in emerging markets and identified key roles for inbound and outbound OI in the relationship between digitalization capability and performance. Faeroevik and Maehle (2024) showed how cross-industry innovation and cluster collaboration support sustainable strategic repositioning. Wang et al. (2021) also demonstrated how OI links innovation activities to commercialization and value creation. Together, these studies show that OI contributes to several components of SP. External knowledge supports environmental improvements by exposing firms to cleaner technologies and resource-efficient practices. Collaboration contributes to social performance through stakeholder engagement, shared-value initiatives, and solutions that respond to community needs. Commercialization, product development, and access to new markets strengthen economic performance. SCT explains why trusted relationships improve the exchange of sustainability-related knowledge. DOI explains how externally sourced practices and technologies become accepted and incorporated into firm operations. OI therefore provides a mechanism through which relational resources become sustainability-oriented products, processes, and business models.

### **Hypothesis 5: Digital Capacity and Sustainable Performance**

*H5: The enhancement of DC enables SMEs to adopt and implement digital technologies that drive sustainability.*

DC refers to a firm's ability to acquire, integrate, and apply digital technologies through suitable infrastructure, employee skills, managerial knowledge, and organizational routines. DC differs from merely possessing digital equipment. A firm achieves DC when digital resources are integrated into decision-making, customer engagement, production, knowledge management, and operational processes. Denicolai et al. (2021) demonstrated relationships among digitalization, internationalization, and SME sustainability, identifying connections among these growth paths. Lee and Roh (2025) directly examined digitalization capability and SP in emerging markets. Arroyabe et al. (2024) linked the integration of digital transformation and circular economy practices with SME innovation. Radicic and Petković (2023) found a relationship between digitalization and technological innovation among SMEs. DC contributes to economic performance by improving productivity, decision quality, market reach, and customer service. Environmental performance improves when digital technologies help firms monitor resource use, reduce waste, manage supply chains, and support circular production practices. Social performance also benefits through improved communication, service accessibility, employee learning, and stakeholder engagement. DOI explains why digital adoption produces different outcomes across firms. The effect of an adopted technology depends on

the firm's ability to integrate it into existing processes and sustain its use. SMEs with stronger DC possess the technical skills and organizational routines needed to convert digital adoption into measurable performance outcomes.

### **Hypothesis 6: Sustainable Performance**

*H6: Cluster Support is positively related to Sustainable Performance*

CS provides SMEs with knowledge-sharing opportunities, business assistance, specialized suppliers, market information, collaborative relationships, and access to complementary resources. These advantages reduce the costs of acquiring information and solving operational problems. They also strengthen firms' ability to respond to market changes, institutional disruptions, and sustainability pressures. Ketels and Protsiv (2021) found a relationship between cluster presence and economic performance. Jordão and Novas (2024) linked information management, knowledge management, and intellectual capital to sustainable growth among networked SMEs. Sunny and Shu (2019) identified investment, incentives, innovation, and geographical clustering dynamics as drivers of sustainable entrepreneurship. Faeroevik and Maehle (2024) showed how cluster collaboration supports cross-industry innovation and sustainable repositioning. These findings support a positive association between CS and SP. Knowledge sharing and joint problem-solving improve operational efficiency and innovation. Access to complementary resources reduces duplication and transaction costs. Collaborative responses to environmental and social pressures also help firms develop sustainability practices beyond what individual SMEs can achieve. SCT explains this relationship through the value embedded in trust, reciprocity, and network ties. Strong cluster relationships reduce information asymmetry and support coordinated action. CS therefore creates a resource environment associated with better economic, social, and environmental outcomes. The relationship should still be presented with theoretical caution. Cluster resources represent potential rather than guaranteed value. Their performance effect depends on whether SMEs mobilize shared knowledge through OI and integrate the resulting knowledge through DC.

### **Control Variables for the Research**

Control variables are pivotal in regulating the dependent and independent variables, serving as stabilizing factors that maintain consistency and limit external influences on the study (Henseler *et al.*, 2015). Despite their seemingly indirect relevance to the primary research objective, their management is critical because of their latent potential to affect the study's outcomes (Alem, 2020). Within this study, the control variables include firm size and age. Based on the developed hypotheses, the study conceptualizes the SP model shown in Figure 6 above.

#### 4.0 Methodology

This confirmatory, quantitative study examines data gathered through a structured survey questionnaire from Nigerian SMEs within the Lagos business cluster (Computer Village). This approach provided a basis for examining SMEs within a cluster. The questionnaires were administered via Qualtrics Survey to the Computer and Allied Products Dealers Association of Nigeria (CAPDAN), which holds records of SMEs in the Computer Village. To enhance transparency in data collection, the following were applied. A non-random sampling method was used to obtain a representative sample of SMEs. CAPDAN distributed the survey link to the SME owners and managers via WhatsApp and email. The recruitment process ensured that each SME had the opportunity to participate by targeting decision-makers, specifically owners and managers who were knowledgeable about the firm's digital activities and sustainability performance. Data were collected using a structured survey questionnaire administered via the Qualtrics Survey Platform. The online survey was preferred due to its efficiency and accessibility, particularly given the widespread use of WhatsApp and email in Nigeria. CAPDAN distributed the survey link to participants. A total of 604 surveys were distributed, and 583 usable responses were collected, yielding a 97% response rate. The high response rate indicates that the data collection process was effective and that the sample is likely to be representative of the population (Geddes, 2017). All data were collected anonymously, and participants were assured that their responses would not be linked to their identities. The data were stored securely, with access limited to the research team only. No personally identifiable information was collected, and all participants were anonymous to ensure confidentiality. Participation in the survey was voluntary, and participants could withdraw at any time without penalty. Participants were allowed to ask questions about the research before agreeing to participate. After data collection, the responses were carefully reviewed for completeness and accuracy. Duplicates and incomplete responses were removed, leaving only valid, complete surveys for analysis. A total of 583 usable responses were retained for further analysis, ensuring the reliability and integrity of the data. Before conducting the main analysis, the data were tested for assumptions such as normality, reliability, and validity. This helped ensure that the dataset met the necessary criteria for statistical testing, particularly for the Partial Least Squares Structural Equation Modelling (PLS-SEM) approach used in this study.

#### *Sample and Participants*

As indicated, the study surveyed SMEs in the Lagos Computer Village that operate under CAPDAN. The study applied Yamane's (1967) formula to determine the sample size. It has a 95% confidence level and a 5% error tolerance. CAPDAN confirmed that the population of SMEs in the

Computer Village at the time of the survey is three thousand, five hundred and fourteen (3514).

Therefore, to determine a representative sample size:

$$n = \frac{N}{1 + N(e)^2}$$

where n is the sample size

N is the population, in this case, 3,514

e is the level of precision of 0.05

Singh and Masuku (2014, p9) suggested a sample size of 400 for a population of less than 100,000.

Therefore, this project used a five-percent precision.

$$n = \frac{3,514}{1 + 3,514(0.05)^2}$$

$$n = \frac{3,514}{1 + 3,514(0.0025)}$$

$$n = \frac{3,514}{1 + 8.785}$$

$$n = \frac{3,514}{9.785}$$

$$n = 359.12 \approx 359$$

From the above, a representative sample size of approximately 359 is adequate for this study (Geddes, 2017). However, CAPDAN successfully distributed 604 surveys to the SMEs in the cluster within the research time constraints, and 583 usable responses were received, representing 97 percent. The usable sample indicates that the number of responses received exceeded the recommended threshold for this study. Moreover, the valid survey indicates that SMEs' SP through OI and digitalization in the Lagos Computer Village cluster is extensive and reliable.

### ***Method of Analysis and Questionnaire***

The research aim informed the development of the questionnaire, consistent with Egere et al. (2022). Consequently, descriptive statistical analysis (DSA) using Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to estimate the relationships among the variables (Cluster and SP). The rationale is the need to evaluate the research model with multiple dependent variables simultaneously. This approach enables the generation of regression results consistent with

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those of Ritchie and Spencer (2002). SEM has the statistical ability to empirically test the causal relationships among variables with multiple measurement items using the study’s conceptual and theoretical models (Church and Goscinski, 2015). Also, SmartPLS, which has a graphical user interface for variance-based SEM using partial least squares, was used to import the data for analysis. (Collier, 2020). The questionnaire survey collected crude information from SMEs in the Lagos Computer Village cluster, and participation was voluntary. The questions allowed respondents to rate their agreement on a 7-point Likert scale from “strongly disagree” to “strongly agree.” (Hair *et al.*, 2010). The questionnaire was divided into two sections. Section A comprises the respondents’ demographic and organizational levels. Section B consists of questions aligned with the study’s objectives. The questions cover aspects of a cluster as a catalyst for developing SMEs’ SP framework on the relationship between OI and digitalization. Variance-based Structural Equation Modelling (PLS-SEM) is an appropriate methodology for this study, as it aligns with both the research objectives and the data characteristics. While convenience and the software interface are considerations, the primary justification for choosing PLS-SEM lies in its methodological advantages for this type of research. Below, I provide a more robust justification for using PLS-SEM, tying the choice of this technique directly to the research goals, model complexity, and data structure.

This study’s conceptual framework includes multiple latent constructs, each measured by several indicators. PLS-SEM is a variance-based method particularly effective for estimating complex models involving multiple constructs and indicators. It does not require normality assumptions about the data distribution, making it ideal for non-normally distributed data, which is often encountered in real-world business research, particularly in developing economies like Nigeria. The use of multiple mediators and moderators also aligns well with PLS-SEM’s capabilities to handle hierarchical and multi-stage relationships, which would be difficult to model using covariance-based SEM (CB-SEM). Furthermore, PLS-SEM can estimate models with many constructs and paths. This is particularly advantageous in this study, where the model combines OI, DC, and sustainability performance, each influenced by various mediators and moderators. PLS-SEM allows the researcher to model complex interrelationships efficiently, making it the most suitable approach for this study’s hypotheses and data structure.

**5.0 Results and Findings**

***Demographic Survey***

This section evaluates the respondents’ firm classifications, job titles, management teams, staff numbers, and gender distribution. Table 1 below classifies participants by firm. The respondents’

primary occupations were phone and computer accessory sales (22%). Computer and communication equipment maintenance accounted for 14.8% of the workforce, followed by computer installation and networking (13.4%), computer programming, consulting, and related services (10.8%), and telecommunications (10.3%). Other SMEs' categories included software publication (4.6%), apprenticeship training (4.3%), and ICT wholesale/retail distribution (6.2%). Only 8.1% of participants worked for non-information or communication SMEs. Table 2 below displays respondents' corporate occupations. The respondents included 37.6% managers and 62.4% proprietors. Depending on the distribution, the sample contains both daily managers and decision-makers.

*Insert Table 1*

*Insert Table 2*

Table 3 below shows the gender breakdown among management personnel. 67.2 percent had a mixed-gender management team, 27.3 percent a male team, and 5.5 percent a female staff. This implies that there are more men in the computer village cluster. However, all-male management teams are more common.

*Insert Table 3*

### ***Confirmatory Factor Analysis***

The study performed Cronbach's Alpha and Composite Reliability (CR) ( $\rho_c$ ) to test construct reliability and internal consistency. Table 4 below shows that Cronbach's Alpha test was 0.9 for the constructs. Cronbach's Alpha values above 0.7 indicate that the items within each construct consistently measure the same underlying concept. (Nunnally and Bernstein, 1994). This measure helps ensure that the items are reliable and consistent in measuring the intended construct in the research study. Moreover, Cronbach's Alpha values that exceed the recommended threshold of 0.7 indicate strong internal consistency. Furthermore, composite reliability measures the internal consistency of the indicators used to represent a construct. It assesses how the indicators consistently measure the same underlying concept. CR values range from 0 to 1, with higher values indicating greater reliability. The accepted threshold for CR is 0.7; values above 0.6 are considered acceptable in exploratory research. (Hair *et al.*, 2010). Table 4 below presents CR values of 0.925 to 0.944 for the constructs, all above 0.7, indicating that the constructs are internally consistent and reliable. This strengthens the study's credibility and provides confidence in the reliability of the data collected for these variables.

*Insert Table 4*

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Discriminant validity was conducted to test the measurement’s independence and uniqueness. The constructs in Table 5 below meet the Fornell-Larcker criterion. Thus, the data demonstrate high reliability and validity, supporting the structural model’s analysis and the accurate interpretation of the relationships among the constructs.

**Insert Table 5**

SMEs SP Model Bootstrapping involves using a resampling technique to estimate the precision of the model’s path coefficients and to generate confidence intervals, thereby assessing the statistical significance of the relationships within the model (Henseler *et al.*, 2015). This method enhances the robustness of the findings by providing more accurate estimates of standard errors and testing the stability of the results (Hair *et al.*, 2017). **Figure 7 below shows SMEs' SP Model with Bootstrapping.**

**Insert Figure 7**

The path coefficients in the model provide insight into the relationships among the constructs and their statistical significance, as shown in Table 6 below. For instance, CS ( $\beta = 0.898$ ;  $|t| = 99.318$ ;  $p = 0.000$ ) positively impacts OI. This suggests that robust cluster-support mechanisms, such as networking opportunities, shared resources, and collaborative environments, are pivotal for enhancing business support, driving coexistence strategies, and promoting knowledge sharing among SMEs. These findings align with previous research by Ketels and Protsiv (2021), which emphasizes that clusters provide a fertile platform for innovation and competitiveness through concentrated collaboration and resource sharing.

**Insert Table 6**

Additionally, the positive and significant path coefficient from DC to SP ( $\beta = 0.403$ ;  $|t| = 6.538$ ;  $p = 0.000$ ) underscores the importance of digital transformation in achieving sustainability. With a T-value of 6.538 and a p-value of 0.000, this relationship indicates that investments in digital technologies are associated with better SP outcomes. The positive impact of OI on DC ( $\beta = 0.906$ ;  $|t| = 81.573$ ;  $p < 0.001$ ) and SP ( $\beta = 0.536$ ;  $|t| = 9.030$ ;  $p < 0.001$ ) further underscores OI’s role in enhancing both technological capabilities and sustainability. This aligns with Podmetina *et al.* (2018). Digital transformation and OI are key drivers of competitive advantage in businesses. Conversely, the negative coefficient for Firm Size to SP ( $-0.065$ ) suggests that larger firms might face more challenges in implementing effective sustainability practices, potentially due to bureaucratic inertia and complexity (Geissdoerfer *et al.*, 2018). This understanding of the path coefficients provides a comprehensive view of how various factors influence business and sustainability outcomes in SMEs.

### Hypotheses Testing Findings

The findings from the SmartPLS analysis confirm a positive relationship between CS and OI ( $\beta = 0.898$ ,  $T = 99.318$ ,  $p = 0.000$ ); thus, hypothesis 1 (*Cluster support, through enhanced networking, knowledge sharing, and collaborative opportunities, positively influences the adoption of open innovation practices among SMEs*) is accepted. It highlights that firms operating within cluster ecosystems are significantly better positioned to engage in OI activities (Franco *et al.*, 2024). Clusters allow collaboration, resource sharing, and knowledge exchange, enabling firms to access external ideas and technologies essential for innovation (Hoffmann *et al.*, 2023). Similarly, the findings confirm that OI positively impacts DC ( $\beta = 0.906$ ,  $T = 81.573$ ,  $p = 0.000$ ); thus, hypothesis 3 (*Engaging in OI practices enhances SMEs' DC by facilitating access to external digital knowledge and technologies, which are then integrated into the firms' operations*) is accepted. Li *et al.* (2023) argue that engaging in OI allows firms to advance their digital transformation efforts. OI enables firms to integrate external technologies, expertise, and ideas, accelerating the development and implementation of digital solutions (Albats *et al.*, 2023).

Furthermore, the analysis confirms that OI helps SP ( $\beta = 0.536$ ,  $T = 9.030$ ,  $p = 0.000$ ); thus, hypothesis 4 (*Open innovation contributes to sustainable performance by enabling SMEs to develop innovative solutions that address economic, environmental, and social challenges*) is accepted. This finding highlights the essential role of OI in addressing sustainability challenges and achieving long-term performance goals. (Aliakbari *et al.*, 2025). OI facilitates the exchange of ideas, technologies, and expertise, enabling firms to develop innovative solutions that align with environmental, social, and economic goals. (Camilleri *et al.*, 2023). Additionally, the findings confirm that DC helps SP ( $\beta = 0.403$ ,  $T = 6.538$ ,  $p = 0.000$ ); thus, hypothesis 5 (*The enhancement of DC enables SMEs to adopt and implement digital technologies that drive sustainability*) is accepted. It highlights the integral role of digital technologies in advancing sustainability. (Denicolai *et al.*, 2021). DC enables firms to optimise resource utilisation, reduce waste, and enhance operational efficiency, thereby contributing to SP. (George *et al.*, 2021). Hypothesis 2 (*Cluster support enhances DC by providing SMEs with access to digital tools, collaborative networks, and technological resources within the cluster*) and Hypothesis 6 (*Cluster Support is positively related to Sustainable Performance*) are rejected. The implication is that CS needs OI to be effective. Table 7 below presents the results of hypothesis testing.

### Insert Table 7

### Endogeneity Bias Results

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To avoid endogeneity bias in the findings, this study employed regression analyses consistent with Zaefarian et al. (2017) and Nwoba et al. (2021). Endogeneity arises when explanatory variables correlate with the error term, leading to biased and inconsistent estimates (Semykina and Wooldridge, 2010). This can falsely suggest a causal link between independent and dependent variables (Abdallah et al., 2015). Common sources of endogeneity include measurement error, omitted variables, and reverse causality (Ullah et al., 2018). In this context, CS and OI may be endogenous, potentially impacting their observed relationship with SP within clusters. To address any bias, a three-stage least squares (SLS) regression analysis was conducted. In stage one, CS and OI were regressed on SP. In stage two, the effects of CS and OI on DC were tested by regressing SP on CS, OI, DC, and control variables. In stage three, DC’s moderating role was assessed by regressing SP on CS, OI, and the controls. Results showed that the residual effects of CS, OI, and SP, as well as the interaction between OI, DC, and SP, were significant at the 5% and 1% levels. However, the interaction terms involving CS and DC, and CS and SP, were not significant at the 5% level. These findings align with the study’s PLS-SEM results, confirming that the conclusions are robust and free of endogeneity bias.

**6.0 Discussion**

The findings offer important insights into how CS, OI, DC, and SP interact within the Nigerian SME environment. While existing theories explain the importance of networks, knowledge exchange, and technological capabilities, the Nigerian context offers additional reasons for these relationships. Nigerian SMEs operate in an environment marked by limited access to formal financial resources, infrastructural challenges, institutional constraints, and uneven technological development (e.g., Costa et al., 2023; Malekinezhad et al., 2024). Under these conditions, SMEs often rely on informal networks, collaborative relationships, and collective resource-sharing arrangements to overcome barriers that constrain individual firm growth. The strong relationship between CS and OI underscores the importance of relational networks within Nigerian SME ecosystems. Unlike highly structured cluster environments in developed economies, where formal institutions often support innovation, many Nigerian clusters emerge organically through entrepreneurial relationships, shared markets, apprenticeship systems, and informal knowledge exchange. The Lagos Computer Village cluster exemplifies such an ecosystem, where proximity among technology-oriented SMEs facilitates interaction, learning, and access to market information. These characteristics help explain why CS strongly influences OI practices among SMEs. Existing studies show that clusters enhance collaboration, knowledge exchange, and innovation through network-based relationships (e.g., Fulgence et al., 2023; Franco et al., 2024). Similarly, Awolaye, (2022) demonstrated the importance of knowledge spillovers, human capital, and agglomeration dynamics within Nigerian ICT clusters.

These findings suggest that, in the Nigerian context, clustering serves as an important substitute for formal innovation systems that remain limited for many SMEs.

The weak direct relationship between CS and DC offers additional context. Although Nigerian SME clusters create opportunities for knowledge sharing and collaboration, physical proximity and social ties alone may not be sufficient to build digital capabilities. Many SMEs still face challenges with digital infrastructure, financial constraints, technical skills, and access to specialized digital training. Therefore, cluster membership provides exposure to digital opportunities, but firms still need active innovation processes and internal capability development to translate these opportunities into digital transformation. This finding aligns with the broader argument that digital transformation requires more than technology availability. It requires organizational readiness, knowledge assimilation, and the ability to integrate digital tools into business processes (e.g., Coco et al., 2024; Mele et al., 2024). The strong relationship between OI and DC further reflects the realities of Nigerian SMEs. Because many SMEs operate with limited internal research and development resources, external knowledge partnerships become an important pathway for acquiring digital knowledge, technologies, and expertise. OI allows SMEs to overcome internal resource limitations by accessing ideas, technologies, and capabilities from customers, suppliers, universities, technology providers, and other firms. This finding is consistent with Albats et al. (2023), who emphasized the role of OI processes in supporting SME transformation, and Li et al. (2023), who demonstrated how digital transformation influences firm innovation performance. In Nigeria, where many SMEs face financial and technical barriers to independent digital development, external knowledge networks become particularly important for building DC.

The positive relationship between DC and SP also warrants interpretation in the Nigerian context. SMEs contribute significantly to employment and economic activity in Nigeria. However, many struggle with operational inefficiencies, market limitations, and sustainability challenges. DC offers SMEs opportunities to improve customer engagement, increase operational efficiency, expand market reach, and manage resources more effectively. This is particularly relevant in Nigeria, where digital platforms have become increasingly important for small businesses seeking wider market access despite physical infrastructure limitations. Previous research has shown that digital technologies improve SME innovation, productivity, market access, and sustainable growth (e.g., Fossen and Sorgner, 2021; Radicic and Petković, 2023). Similarly, Denicolai et al. (2021) demonstrated the relationship between digitalization, sustainability, and SME growth pathways. The rejection of a direct relationship between CS and SP also provides an important contextual contribution. Previous research often assumes that clustering automatically produces competitive and sustainability benefits. However,

the Nigerian findings indicate that cluster participation alone does not guarantee sustainable outcomes. SMEs may belong to active business networks; however, they still lack the internal capabilities required to transform shared resources into improved performance. This result highlights the importance of capability development within clusters. In the Nigerian setting, CS appears to create opportunities for innovation and learning, but sustainability outcomes emerge when SMEs actively engage in OI and develop DC.

Overall, the findings demonstrate that Nigerian SME clusters operate through a relational capability-building process. CS provides access to networks and knowledge, OI enables SMEs to acquire and exchange external resources, and DC allows firms to convert these resources into sustainable business outcomes. This process reflects the realities of emerging economies, where informal networks often compensate for institutional gaps, and SMEs must combine social relationships with technological adaptation to remain competitive. The Nigerian context therefore strengthens the theoretical argument by showing that cluster benefits are not automatic outcomes of proximity but depend on firms' ability to mobilize knowledge and develop appropriate capabilities. This contextual interpretation extends existing research on SME sustainability by showing how business clusters function within a developing economy where institutional support structures remain uneven. Previous studies have highlighted the importance of clusters, OI, and digitalization individually (e.g., Sunny and Shu, 2019; Speldekamp et al., 2020), but the Nigerian evidence demonstrates how these mechanisms interact within a resource-constrained entrepreneurial environment. The findings therefore provide practical implications for policymakers and cluster managers seeking to strengthen SME development through targeted digital training, innovation support programs, improved infrastructure, and stronger connections between SMEs and knowledge institutions.

## 7.0 Conclusions

### *Contribution of the Study*

Understanding the dynamics of SME clustering and its impact on SP would offer stakeholders valuable insights to support and promote SME development in Nigeria and other Global South countries with similar SME landscapes. Moreover, this paper positions the mediation-moderation structure as a core contribution, extending current understanding of how CS affects SMEs' SP. The inclusion of both mediating and moderating mechanisms offers a perspective that existing models, which focus on direct effects, do not. The findings presented in this study not only enhance the theoretical landscape but also provide practical recommendations for SME development within clusters, particularly in emerging

economies. Thus, this study offers the following contributions. First, it refines SCT by distinguishing the availability of relational resources from their productive use. Cluster relationships, trust, coexistence, and knowledge sharing represent potential resources. Their presence alone does not guarantee SP. OI serves as the mobilization mechanism through which SMEs convert social capital into useful knowledge, technologies, and collaborative opportunities. As a result, SMEs in developing countries can apply this framework to benefit their businesses and extend the literature on SMEs' SP within BC (e.g., Denicolai et al., 2021; Nudurupati et al., 2022). Second, the study extends DOI by positioning DC as an organizational assimilation mechanism. DC does not represent technology adoption alone. It reflects the firm's ability to absorb, integrate, and apply knowledge gained through OI. This perspective connects DOI to economic, environmental, and social performance rather than treating adoption as the outcome, and contributes to and extends the literature (e.g., Ketels and Protsiv, 2021; Fulgence et al., 2023). It offers a novel contribution to the literature by emphasizing the mediation-moderation structure. Third, integrating both theories produces a staged relational-to-capability explanation. SCT explains how firms gain access to external knowledge through cluster relationships. DOI explains how such knowledge spreads and becomes embedded through digital adoption and organizational readiness. OI connects these theoretical stages by converting network access into knowledge flows, while DC converts those flows into sustainability outcomes, contributing to and extending the literature (e.g., Lawal et al., 2016; Okuwhere and Adekunle, 2020) by investigating how DC and OI can help SMEs' SP within BC. Nigeria is therefore presented as a theoretically informative setting rather than the principal source of originality. The organically developed Computer Village BC operates under infrastructure constraints, fragmented institutional support, and uneven access to formal business resources. Such conditions provide a demanding setting for examining whether relational proximity alone produces performance benefits. The results suggest that BC offers potential value, but firms require OI and DC to realize that value, contributing to and extending (Kryeziu et al. (2024). Finally, the study emphasizes the crucial role of stakeholders in the sustainable development of SMEs by highlighting the need to establish structures and provide support in developing countries to ensure SMEs' SP within BC and to support national development.

### ***Policy Implications and Recommendations***

The study emphasized that SMEs in clusters can harness their ecosystem's collaborative potential to strengthen OI practices across the Global South. This has important implications for owners, managers, and policymakers in developing countries seeking to improve SP. Practitioners and policymakers should develop innovation strategies that integrate economic, environmental, and social sustainability, emphasizing value creation through eco-friendly products, sustainable operations, and

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responsible resource management. Cluster managers should collaborate with stakeholders to secure grants and subsidies for digital training programs. At the same time, policymakers should promote digital strategies aligned with SMEs’ objectives to ensure effective integration and meaningful contributions to SP. Establishing innovation incubators and accelerators within clusters can provide SMEs with access to novel ideas and technologies. Accordingly, the study recommends two key actions. First, policymakers should strengthen CS frameworks by providing infrastructure, financial incentives, and opportunities for networking, knowledge sharing, and collaboration, leveraging the interplay among OI, digitalization, and social networks. Second, SME owners and managers should actively engage in OI practices, partnering with universities, research institutions, and other firms within and beyond the cluster to maximize access to external knowledge and enhance innovation capabilities.

Additionally, SMEs should be encouraged to participate in joint research and development projects, share patents, and engage in collaborative problem-solving initiatives. To fully realize the benefits of CS and OI, SMEs must invest in building their digital capacities. They could collaborate with businesses in developed countries to adopt advanced digital technologies such as big data analytics, the Internet of Things (IoT), artificial intelligence (AI), and blockchain. Lastly, SMEs in developing countries should prioritize training and development programs that enhance digital literacy and technical skills to support SMEs’ SP and regional and national socioeconomic development and growth. Future research should explore additional geographic areas, diverse cultural contexts, and various industry sectors within SME clusters in different regions and developing countries. Future studies need to expand the range of measures used in this study to encompass additional dimensions of the second-order constructs. Furthermore, the study recognizes that it may not have fully considered all the factors that impact SMEs’ SP. This highlights the need for future research initiatives to expand the scope of the research variables. Furthermore, a qualitative study should be considered to provide additional layers of evidence in future research. It is also vital that future research examines how SCT or DOI alone could promote SMEs’ SP.

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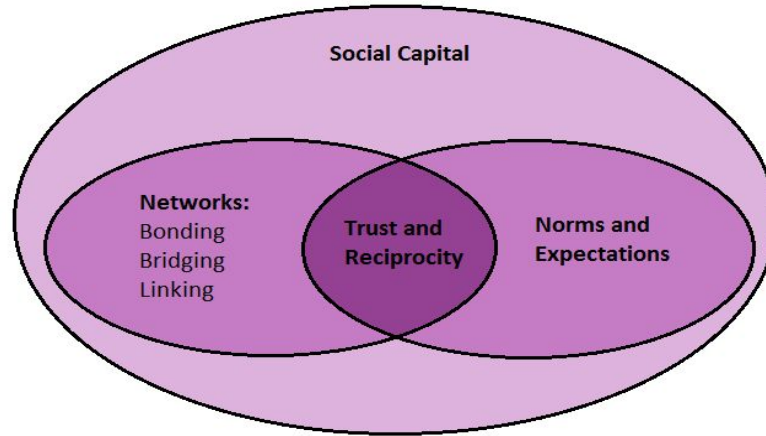
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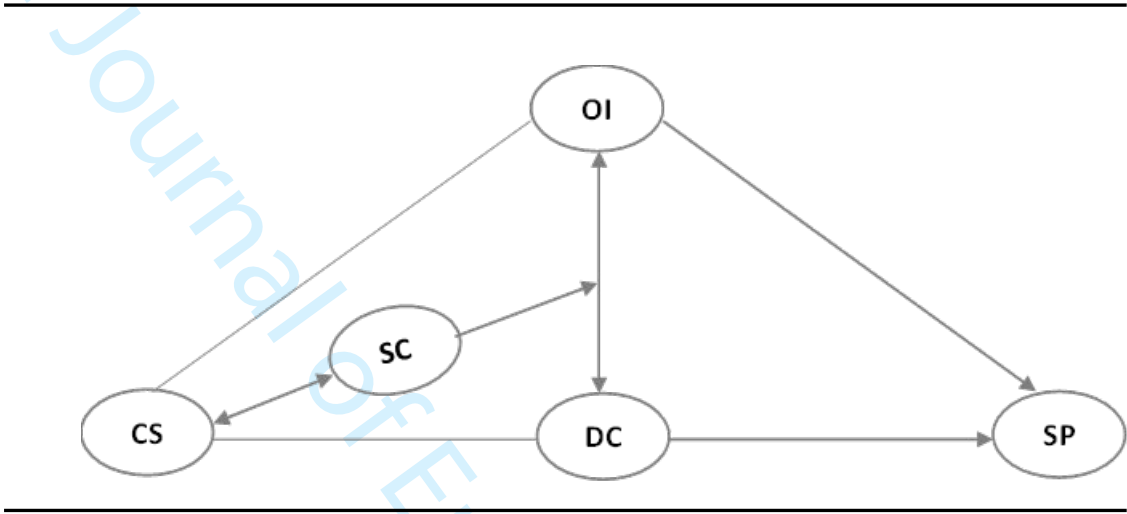
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**Figure 1**  
**Social Capital Theory**

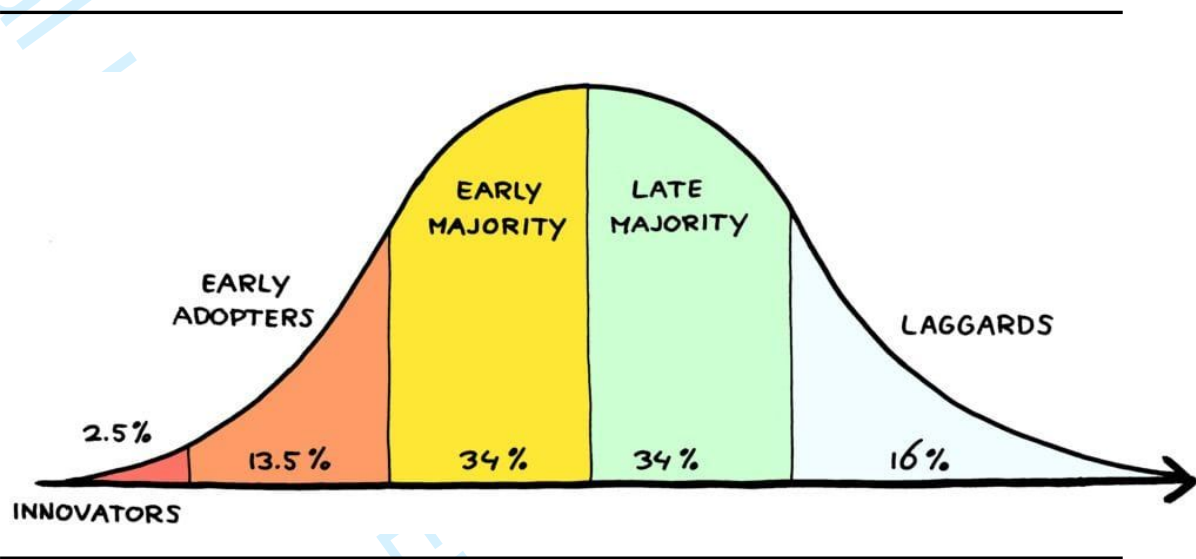


Note: (Weebly, 2014)

**Figure 2:**  
**Social Capital in a Cluster**

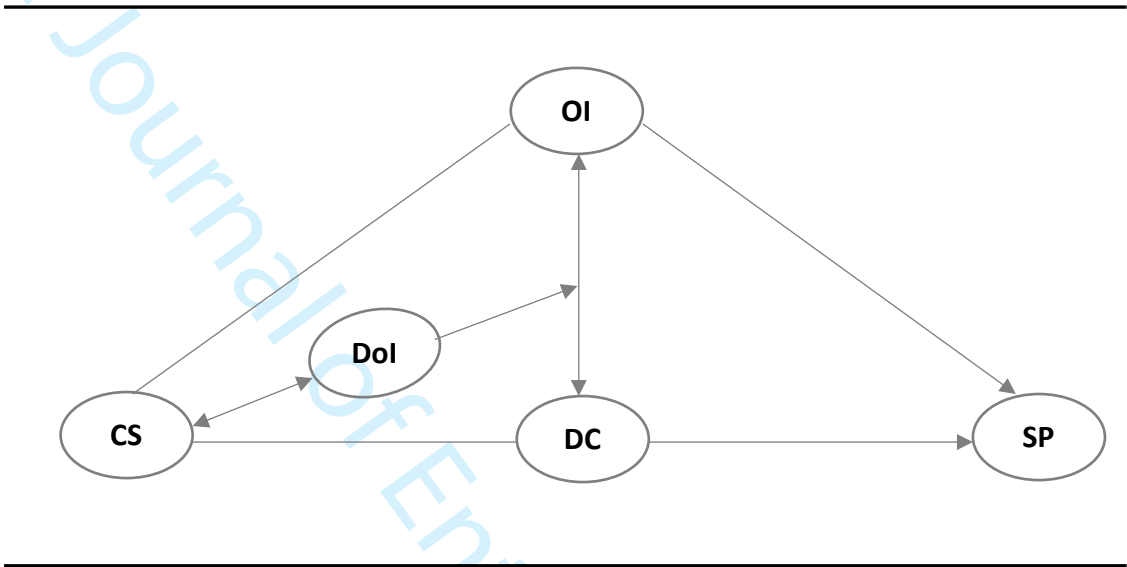


**Figure 3:**  
**Diffusion of Innovations Theory**



Note: Roumeliotis (2020)

**Figure 4:**  
**Diffusion of Innovation in a Cluster**



**Figure 5:**  
**The integration of SC and DoI**

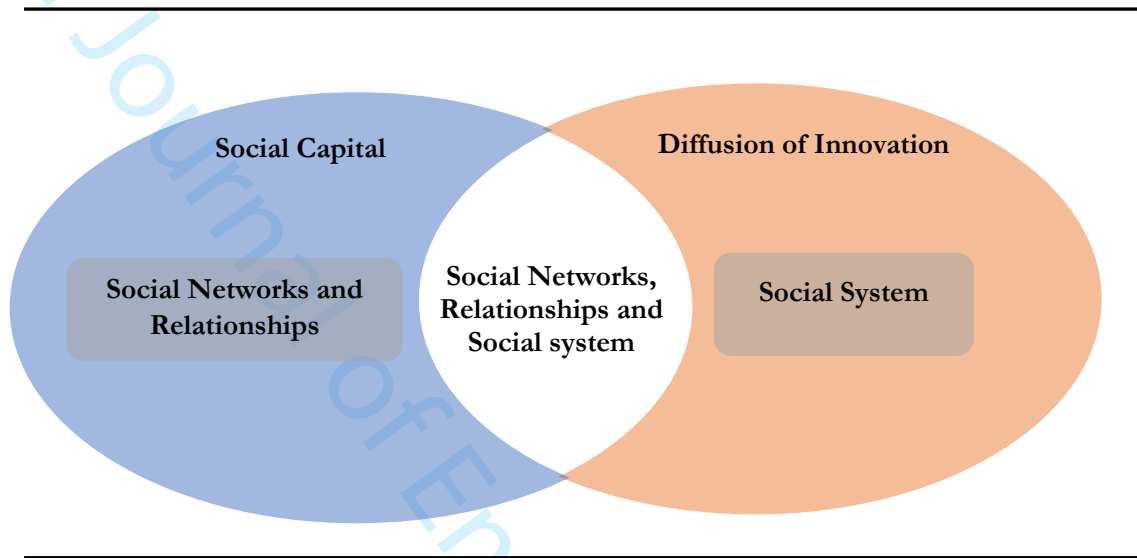
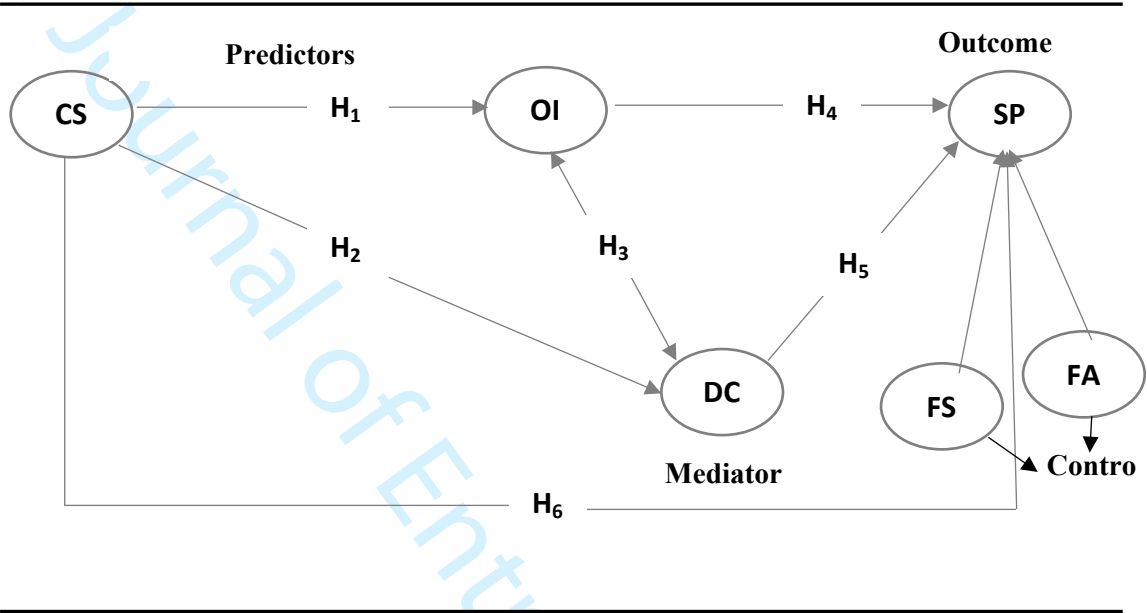
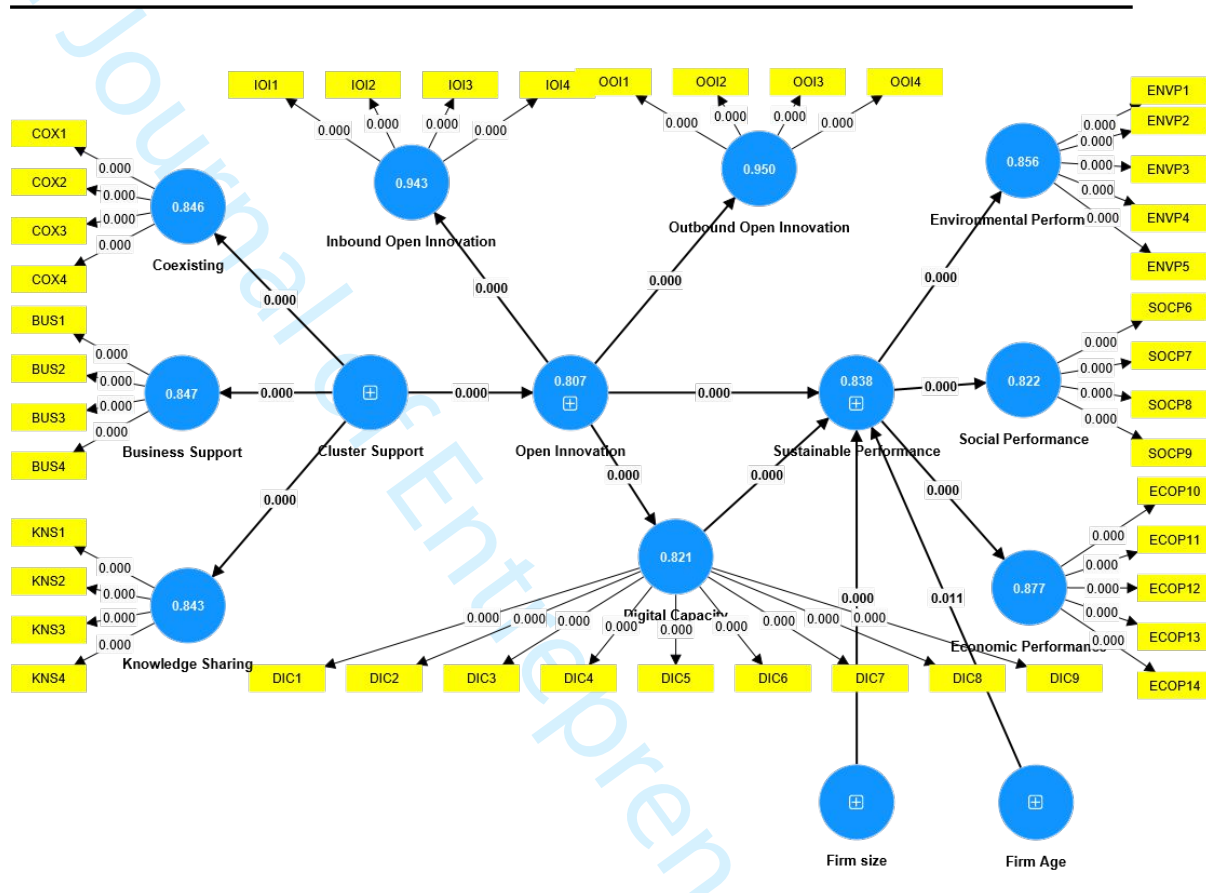


Figure 6:  
The Research Conceptual Model



**Figure 7:**  
**SMEs' Sustainable Performance Model with Bootstrapping**



Note: (Ringle *et al.*, 2024)

Table 1:

Distribution of Respondents by Business Type

| Category                                                      | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------------------------------------------------------------|-----------|---------|---------------|--------------------|
| Wholesale/retailer of information and communication equipment | 36        | 6.2     | 6.2           | 6.2                |
| Software publishing                                           | 27        | 4.6     | 4.6           | 10.8               |
| Computer and phones accessories sales                         | 128       | 22.0    | 22.0          | 32.8               |
| Computer installation and networking                          | 78        | 13.4    | 13.4          | 46.1               |
| Telecommunication                                             | 60        | 10.3    | 10.3          | 56.4               |
| Computer programming, consultancy and related activities      | 63        | 10.8    | 10.8          | 67.2               |
| Repairs of computers and communication equipment              | 86        | 14.8    | 14.8          | 82.0               |
| Apprenticeship training                                       | 25        | 4.3     | 4.3           | 86.3               |
| Other related to information and communication businesses     | 33        | 5.7     | 5.7           | 91.9               |
| Non-information/communication-related businesses              | 47        | 8.1     | 8.1           | 100.0              |
| Total                                                         | 583       | 100.0   | 100.0         |                    |

**Table 2:**  
**Respondents' Roles or Positions in their Businesses**

| S/N   | Category      | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|---------------|-----------|---------|---------------|--------------------|
| 1     | Founder/Owner | 364       | 62.4    | 62.4          | 62.4               |
| 2     | Manager       | 219       | 37.6    | 37.6          | 100.0              |
| Total |               | 583       | 100.0   | 100.0         |                    |

Table 3:

Composition of the Management Team in Terms of Gender

| S/N   | Category             | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|----------------------|-----------|---------|---------------|--------------------|
| 1     | Female only          | 32        | 5.5     | 5.5           | 5.5                |
| 2     | Male only            | 159       | 27.3    | 27.3          | 32.8               |
| 3     | Both Female and Male | 392       | 67.2    | 67.2          | 100.0              |
| Total |                      | 583       | 100.0   | 100.0         |                    |

**Table 4:**  
**Construct Reliability and Validity**

| <b>Construct</b>               | <b>Cronbach's Alpha</b> | <b>Composite Reliability (rho_c)</b> | <b>Average Variance Extracted (AVE)</b> |
|--------------------------------|-------------------------|--------------------------------------|-----------------------------------------|
| <b>Cluster Support</b>         | <b>0.925</b>            | <b>0.925</b>                         | <b>0.507</b>                            |
| <b>Open Innovation</b>         | <b>0.943</b>            | <b>0.944</b>                         | <b>0.679</b>                            |
| <b>Digital Capacity</b>        | <b>0.930</b>            | <b>0.931</b>                         | <b>0.601</b>                            |
| <b>Sustainable Performance</b> | <b>0.933</b>            | <b>0.934</b>                         | <b>0.502</b>                            |

Table 5:  
Discriminant Validity - Fornell-Larcker Criterion Overview

| Construct                 | Business Support | Coexisting | Digital Capacity | Economic Performance | Environmental Performance | Firm Age | Firm Size | Inbound Open Innovation | Knowledge Sharing | Outbound Open Innovation | Social Performance |
|---------------------------|------------------|------------|------------------|----------------------|---------------------------|----------|-----------|-------------------------|-------------------|--------------------------|--------------------|
| Business Support          | 0.729            |            |                  |                      |                           |          |           |                         |                   |                          |                    |
| Coexisting                | 0.947            | 0.723      |                  |                      |                           |          |           |                         |                   |                          |                    |
| Digital Capacity          | 0.886            | 0.914      | 0.775            |                      |                           |          |           |                         |                   |                          |                    |
| Economic Performance      | 0.908            | 0.917      | 0.931            | 0.740                |                           |          |           |                         |                   |                          |                    |
| Environmental Performance | 0.908            | 0.932      | 0.924            | 0.932                | 0.716                     |          |           |                         |                   |                          |                    |
| Firm Age                  | 0.297            | 0.303      | 0.346            | 0.368                | 0.342                     | 1.000    |           |                         |                   |                          |                    |
| Firm Size                 | 0.209            | 0.225      | 0.253            | 0.272                | 0.160                     | 0.208    | 1.000     |                         |                   |                          |                    |
| Inbound Open Innovation   | 0.936            | 0.934      | 0.957            | 0.942                | 0.927                     | 0.341    | 0.291     | 0.809                   |                   |                          |                    |
| Knowledge Sharing         | 0.930            | 0.934      | 0.932            | 0.906                | 0.920                     | 0.352    | 0.179     | 0.937                   | 0.736             |                          |                    |
| Outbound Open Innovation  | 0.950            | 0.945      | 0.966            | 0.940                | 0.918                     | 0.335    | 0.328     | 0.994                   | 0.912             | 0.842                    |                    |
| Social Performance        | 0.915            | 0.923      | 0.918            | 0.935                | 0.918                     | 0.310    | 0.175     | 0.904                   | 0.896             | 0.914                    | 0.724              |

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**Table 6:**  
**Path Coefficient**

| Path                                        | Original sample (O) | Sample mean (M) | Standard deviation (STDEV) | T statistics ( O/STDEV ) | P values |
|---------------------------------------------|---------------------|-----------------|----------------------------|--------------------------|----------|
| Cluster Support -> Open Innovation          | 0.898               | 0.899           | 0.009                      | 99.318                   | 0.000    |
| Digital Capacity -> Sustainable Performance | 0.403               | 0.403           | 0.062                      | 6.538                    | 0.000    |
| Firm Age -> Sustainable Performance         | 0.043               | 0.043           | 0.017                      | 2.532                    | 0.011    |
| Firm size -> Sustainable Performance        | -0.065              | -0.065          | 0.015                      | 4.218                    | 0.000    |
| Open Innovation -> Digital Capacity         | 0.906               | 0.906           | 0.011                      | 81.573                   | 0.000    |
| Open Innovation -> Sustainable Performance  | 0.536               | 0.536           | 0.059                      | 9.030                    | 0.000    |

**Table 7:**  
**Hypotheses Results**

| <b>Path</b>                                                   | <b>Coefficients<br/>(<math>\beta</math>)</b> | <b>T statistics<br/>( O/STDEV )</b> | <b>P<br/>values</b> | <b>Result of<br/>Hypothesis<br/>testing</b> |
|---------------------------------------------------------------|----------------------------------------------|-------------------------------------|---------------------|---------------------------------------------|
| <b>H1. Cluster Support -&gt; Open<br/>Innovation</b>          | <b>0.898</b>                                 | <b>99.318</b>                       | <b>0.000</b>        | <b>Supported</b>                            |
| <b>H2. Cluster Support -&gt; Digital<br/>Capacity</b>         | 0.101                                        | 0.647                               | 0.518               | Rejected                                    |
| <b>H3. Open Innovation -&gt; Digital<br/>Capacity</b>         | <b>0.906</b>                                 | <b>81.573</b>                       | <b>0.000</b>        | <b>Supported</b>                            |
| <b>H4. Open Innovation -&gt;<br/>Sustainable Performance</b>  | <b>0.536</b>                                 | <b>9.030</b>                        | <b>0.000</b>        | <b>Supported</b>                            |
| <b>H5. Digital Capacity -&gt;<br/>Sustainable Performance</b> | <b>0.403</b>                                 | <b>6.538</b>                        | <b>0.000</b>        | <b>Supported</b>                            |
| <b>H6. Cluster Support -&gt;<br/>Sustainable Performance</b>  | 0.083                                        | 0.325                               | 0.745               | Rejected                                    |
| <b>* p&lt;0.05; ** p&lt;0.001</b>                             |                                              |                                     |                     |                                             |