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Digital Leadership, Innovation Capability and Sustainable Growth of SMEs in Nigeria: Evidence from Emerging Technology-Driven Businesses

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Abstract:- This research examined how digital leadership affects sustainable growth in technology-based small and medium enterprises (SMEs) in Nigeria. It considers innovation capability as a mediator and environmental dynamism as a potential moderator. Based on Dynamic Capabilities Theory and Contingency Theory, the study used a quantitative survey involving 252 owner-managers and senior managers from sectors like fintech, e-commerce, agritech, and other digital services. The data analysis employed partial least squares structural equation modeling with 5,000 bootstrap resamples. The results showed that digital leadership had a strong positive impact on innovation capability (β = 0.588), and innovation capability positively influenced sustainable growth (β = 0.391). Additionally, digital leadership directly affected sustainable growth significantly (β = 0.161). Innovation capability partially mediated the relationship between digital leadership and sustainable growth (β = 0.230), suggesting that digital leaders contribute to growth both directly and by enhancing their firms' ability to innovate. However, environmental dynamism did not significantly moderate the link between innovation capability and sustainable growth, so the moderated mediation effect was not supported. The model accounted for 34.6% of the variance in innovation capability and 27.1% in sustainable growth. These findings emphasize that digital leadership and innovation capability are key internal factors driving sustainable growth in Nigerian technology-focused SMEs. Managers should therefore focus on strengthening their digital strategies, encourage experimentation, and ensure that innovation aligns with sustainable business goals.

Keywords: *Digital leadership, Innovation capability, Sustainable growth, Environmental dynamism, Technology-driven MSMEs in Nigeria.*

1. Introduction

Small and medium enterprises (SMEs) are fundamental to the Nigerian economy, representing about 96 percent of registered businesses, employing nearly 84 percent of the workforce, and contributing close to 48 percent of the national gross domestic product [1]. These figures corroborates with findings from [2] which confirms that SMEs have a significant positive impact on economic growth in Nigeria from 1990 to 2024. In an increasingly digital global economy, the ability of these firms to embrace emerging technologies such as artificial intelligence, e-commerce platforms, fintech infrastructure, and other digital tools has become a critical factor for their competitiveness and long-term viability[3]. However, the adoption of these technologies by Nigerian SMEs still falls short, as compared to global standards [4], [5]. Much of the explanation for this disparity revolves around external resource-based limitations such as insufficient infrastructure, restricted access to finance, and skills shortages [3], [6].

Less attention has been given to an internal explanation: leadership. When firms have similar resources but differ significantly in their willingness and ability to pursue digitally enabled innovation, the key factor may lie in the strategic, relational, and adaptive competencies of their leaders. These leaders must first acknowledge the importance of digital tools, translate that awareness into organizational innovation, and maintain momentum

towards growth [3], [6]. Consequently, digital leadership is defined as the ability to lead effectively in digital environments while guiding organizational transformation has emerged as an increasingly important topic for scholarly research [7], [8].

In parallel with this leadership literature, considerable research has identified innovation capability as a vital precursor to growth and sustainability in SMEs, especially in resource-constrained developing economies like Nigeria [9]. Firms that can consistently turn ideas and technological opportunities into new products, processes, and market offerings are better positioned for sustained growth. Nonetheless, the ways in which digital leadership translates into this innovation capability and the conditions under which this translation is strengthened or weakened remain relatively underexplored within the literature on Nigerian SMEs.

This gap is exacerbated by a fragmented focus on context. Current empirical studies on digital leadership and innovation among African SMEs are scattered: some specifically address intentions behind artificial intelligence adoption [3], others examine how innovation capability affects sustainability and resilience without considering leadership as a precursor [9], while some investigate the direct impact of digital leadership on SME performance within a specific Nigerian state without examining how that impact operates [10]. Despite the growing importance of digital transformation, there remains a significant gap in the literature regarding how both digital leadership and innovation capability drive sustainable growth. While isolated components have been studied, their integration into a single moderated-mediation framework remains significantly limited [11]. However, no research has tailored this complex dynamic to the unique operational realities of technology-driven SMEs in emerging economies like Nigeria [3].

One further limitation relates to environmental dynamism. Technology-driven SMEs operate in settings where technologies, customer preferences, competitive structures, and market conditions can change swiftly and unpredictably. As a result, the impact of innovation capability on sustainable growth may vary between firms. Environmental dynamism can enhance the value of innovation capability when companies are able to respond effectively to changes; however, it can also complicate the process of transforming innovation into sustained growth if environmental shifts outpace organizational adaptation. Analyzing environmental dynamism as a boundary condition thus presents an opportunity to move beyond a straightforward linear explanation of SME growth.

These considerations highlight the necessity for an integrated framework that addresses how and under what circumstances digital leadership fosters sustainable SME growth. This study builds on Dynamic Capabilities Theory to conceptualize digital leadership as a crucial leadership capability through which firms can identify digital opportunities, mobilize resources, and promote the development of innovation capability. Innovation capability is then positioned as the means through which digital leadership may lead to sustainable growth. Contingency Theory offers an additional perspective for understanding why the effectiveness of innovation capability might be influenced by the level of environmental dynamism faced by the firm.

This research makes three key contributions. First, from a theoretical standpoint, it advances knowledge on digital leadership by framing innovation capability as a mechanism through which such leadership can drive sustainable SME growth while recognizing environmental dynamism as a boundary condition that may influence this relationship. By integrating perspectives from Dynamic Capabilities and Contingency Theory, this study aims to offer a more sophisticated understanding of how digital leadership can lead to sustainable outcomes. Second, empirically, it expands on emerging studies related to digital transformation and SME performance by concentrating on technology-driven SMEs in Nigeria's context where research into the leadership capabilities necessary for effective digital transformation is still relatively sparse [6]. Third, it provides practical insights for SME owner-managers, technology entrepreneurs, and policymakers by identifying critical leadership and innovation capabilities essential for maintaining growth in rapidly evolving technological landscapes.

2. Objectives

In this context, the aim of this study is to explore the relationships between digital leadership, innovation capability, environmental dynamism, and sustainable business growth among SMEs operating within Nigeria's

emerging technology-driven sectors. Specifically, the research seeks to assess whether digital leadership significantly enhances innovation capability; whether innovation capability leads to sustainable business growth; whether it acts as a mediator in the relationship between digital leadership and sustainable business growth; and whether environmental dynamism moderates the relationship between innovation capability and sustainable growth, thereby influencing the indirect effect of digital leadership on sustainable business growth.

To this end, the study poses several research questions: Does digital leadership have a significant impact on innovation capability among technology-driven SMEs in Nigeria? Does innovation capability significantly affect sustainable business growth? Does it mediate the relationship between digital leadership and sustainable growth? Finally, does environmental dynamism moderate both the connection between innovation capability and sustainable business growth and the consequent indirect relationship between digital leadership and sustainable business growth? These inquiries form the foundation for the proposed moderated-mediation model of this study.

3. Literature Review and Hypotheses Development

Digital Leadership

Digitalization has transformed the strategic landscape for SMEs, shifting leadership away from traditional administrative coordination towards the ability to steer organizations through technology-driven change [12], [13]. Digital leadership can be seen as a leadership skill that involves setting a strategic direction for digital transformation, mobilizing both technological and human resources, and aligning organizational members with evolving digital opportunities and threats [8].

A multi-method study by Tigre *et al.,* [8] positions digital leadership as an emerging concept that encompasses both strategic/business dimensions and interpersonal aspects, arguing that effective digital leadership necessitates capabilities suited to digitally transformed organizational environments.

The significance of digital leadership is especially evident in SMEs, where strategic decision-making often lies with owner-managers and senior executives. These individuals have considerable influence over technology adoption, resource allocation, and organizational change. Recent findings from Nigerian SMEs indicate that digital leadership capabilities are linked to an organization's innovative climate and intentions to adopt AI, underscoring the importance of leadership beyond traditional factors such as finance, infrastructure, and technological availability [3].

Recent international research on SMEs has similarly shown a connection between digital leadership and innovation outcomes. For example, Sawaean and Aburumman [7] discovered that digital leadership significantly impacts SME innovation performance, identifying digital capability as a mediating factor while noting that innovation culture moderates this relationship. Held *et al.,* [14] further connect dynamic capabilities with the development of digital leadership and culture in SMEs, suggesting that digital transformation involves not just technology but also the growth and application of organizational capabilities.

These studies imply that digital leadership should be viewed as more than mere technological competence; it reflects leaders' strategic ability to translate technological advancements into organizational action, foster innovation, and align resources with changing market conditions. This lays the conceptual groundwork for exploring its relationship with innovation capability in Nigerian technology-driven SMEs.

Innovation Capability

Innovation capability refers to a firm's ability to generate, develop, integrate, and commercialize new ideas, products, services, processes, or business models [9], [15]. For SMEs particularly, this capability is crucial since resource constraints make the effective deployment and recombination of available resources vital for competitiveness and survival. Innovation capability allows firms to convert knowledge and technological opportunities into commercially viable outcomes instead of merely adopting technologies without creating strategic value. This aligns with findings by Hoang and Hien [16], which indicate that innovation capability in SMEs is not static but is cultivated actively through digital capabilities and culture.

Recent literature strongly indicates a link between digital capabilities and innovation capabilities. Kim and Jin [6], in their examination of SMEs, found that digital capabilities enhance entrepreneurial performance while emphasizing the role of opportunity-related competencies in converting digital resources into business results. Their conclusions support the broader argument that merely having access to digital technologies does not guarantee performance advantages unless firms possess the necessary organizational capabilities to leverage them effectively.

Evidence from Nigeria reinforces this perspective. Olaleye *et al.,* [9] analyzed 401 employees in Nigerian SMEs and found that innovation capability positively influences business sustainability. Their research also considered factors like organizational resilience, sustainable competitive advantage, and environmental dynamism, demonstrating that SME sustainability arises from a comprehensive configuration of capabilities rather than isolated innovations.

Therefore, it follows that digital leadership may be an essential precursor to innovation capability since leaders shape strategic priorities, technology orientation, resource commitment, and employees' readiness to experiment. Sawaean and Aburumman [7] provide direct evidence supporting a positive relationship between digital leadership and SME innovation performance while Idowu and Babalola [3] highlight the relevance of these capabilities to organizational innovation climate and AI adoption in Nigeria.

Consequently, this study perceives innovation capability not just as a result of technology adoption but as an organizational competency enabling SMEs to convert digital opportunities into new or enhanced value propositions.

Sustainable Business Growth

Business growth is typically linked with increases in sales revenue, market share, customers and organizational scale. However, sustained growth necessitates firms maintaining the capabilities and resources essential for long-term competitiveness. Thus, sustainable business growth goes beyond short-term financial gains; it involves an organization's capacity to sustain economic performance while adapting to shifts in market dynamics and technological advancements [17].

This distinction holds particular weight for SMEs' rapid expansion without adequate organizational capabilities can lead to vulnerabilities such as resource overstretch operational inefficiencies or an inability to adapt to environmental changes. Therefore, sustainable growth hinges on firms' abilities to blend growth-oriented behaviors with ongoing adaptations within their organizations.

Recent research highlights the critical role of innovation capabilities in achieving sustainable outcomes for SMEs [18]. Olaleye *et al.,*[9] demonstrated a positive correlation between innovation capability and sustainable growth among Nigerian SMEs, while establishing environmental dynamism's relevance in sustaining businesses alongside enhancing their innovative capabilities. Similarly, studies on digital transformation suggest that robust digital capabilities can bolster sustainable innovation along with overall organizational performance, with environmental dynamism intensifying aspects of that relationship [19], [20], [21].

Environmental Dynamism

Environmental dynamism refers to the speed and unpredictability of changes in a firm's external environment such as shifts in technology, customer preferences, and competitive dynamics [9]. Firms operating in highly dynamic environments encounter greater uncertainty when converting internal capabilities into performance outcomes [22]. Therefore, environmental dynamism serves as an essential boundary condition that enhances the influence of digital leadership and innovation capabilities on the performance of SMEs in unstable markets [23].

Research concerning SME digitization also suggests contextual factors can modify how effectively they leverage their respective capacities [24], [25].

Thus, environmental dynamism emerges within this analysis not merely as another antecedent driving sustainable growth but rather functions here more appropriately framed boundaries guiding our study's overarching objectives.

Theoretical Development

This study primarily relies on Dynamic Capabilities Theory [26], which posits that competitive advantage during periods of rapid technological change depends on a firm's ability to identify opportunities, capitalize on them by reconfiguring resources, and adapt its internal processes accordingly. Within this framework, digital leadership can be viewed as both a sensing-and-seizing capability, with the human element allowing firms to recognize the relevance of digital technologies and innovation capability acts as the transformative mechanism that turns this recognition into new products or services that support sustained growth [14].

Additionally, the study incorporates Contingency Theory [27], as a supplementary framework suggesting that the effectiveness of organizational capabilities and strategies varies based on how well they align with external environmental characteristics [9]. Here Contingency Theory supports treating environmental dynamism as a boundary condition: the strength of the connection between innovation capability and sustainable growth, which is anticipated to fluctuate depending on how volatile the firm's operating environment is [28].

Digital Leadership and Innovation Capability

A growing body of empirical research connects digital leadership with innovation outcomes in SMEs. Sawaean and Aburumman [7], who surveyed 274 Kuwaiti SME owner-managers and CEOs found that digital leadership directly positively impacted innovation performance with digital capability partially mediating this relationship. Similarly, Hoang and Hien [16] utilized PLS-SEM analysis on Vietnamese SME data revealing that digital leadership significantly influenced firms' digital capabilities which subsequently shaped their innovation capability. In Nigeria specifically, Idowu and Babalola [3] observed that strong digital leadership capabilities positively influenced organizational innovation climates among SMEs which further affected their intentions to adopt AI technologies. Collectively these findings indicate that leaders who possess robust digital competencies are better equipped to foster technological, cultural and structural conditions that facilitate the development of innovation capability. Therefore, this study posits:

H1. *Digital leadership has a significant positive effect on innovation capability among Nigerian technology-driven SMEs.*

Innovation Capability and Sustainable Growth

Innovation capability has been consistently linked with sustainability outcomes at the firm level within SME research literature. Olaleye *et al.,*[9], studying Lagos-based SMEs found that innovation capability was a significant positive predictor of business sustainability while being further influenced by organizational resilience and environmental dynamism. Furthermore, recent empirical studies consistently highlight innovation capability as a key factor driving multidimensional sustainability in SMEs [29], [30], [31]. Therefore, innovation capability is seen as one of the main mechanisms through which firms convert operational resources into sustained economic growth. Firms proficient at translating ideas into new products or processes tended to maintain performance even amid typical resource constraints faced by Nigerian SMEs [32]. This aligns with broader expectations under Dynamic Capabilities Theory [26] where innovation capability serves as a transformative force turning internal competencies into growth results. Hence:

H2. *Innovation capability has a significant positive effect on the sustainable growth of Nigerian technology-driven SMEs.*

Digital Leadership and Sustainable Growth

In addition to its indirect influence via innovation capability, digital leadership has also been studied for its direct linkages with SME growth outcomes concerning sustainability metrics. Contemporary literature indicates that digital leadership indirectly fuels the growth of SMEs through pathways mediated by capabilities [33]. Leaders address resource constraints by developing digital capabilities and fostering a sustainable digital orientation [34], transforming technology investments into enduring environmental, operational, and financial resilience. Imran *et al.,*[35], analyzing data from Pakistani manufacturing sector and SMEs noted a positive correlation between digital leadership practices and SME sustainability with mediation occurring through digital transformation

efforts. Similarly, Kim and Jin [6] highlighted that substantial increases in entrepreneurial performance linked closely with leaders' technological orientations, hence:

H3. *Digital leadership has a significant positive effect on sustainable growth within Nigerian technology-driven SMEs.*

The Mediating Role of Innovation Capability

While both digital leadership & innovation capabilities independently associate with growth-related results, literature however increasingly frames the role of innovation instead as mechanisms communicating influences stemming from effective management rather than purely parallel contributions alone [33], [34], [36]. An explicit mediation pathway model by Sawaean & Aburumman [7], revealed effects where recognized digital capabilities mediated connections observed between overall digital leadership & improved performance across Kuwaiti-SME stakeholders, thus aligning ultimately within dynamic capabilities frameworks. It is therefore posited that;

H4. *Innovation capability significantly mediates between digital leadership and sustainable growth, impacting Nigerian tech-SMEs indirectly.*

Moderating Role of Environmental Dynamism

From the perspective of dynamic capabilities, the value of an organizational capability is partly shaped by its alignment with external environmental conditions. In dynamic environments, the significance of innovation capability grows as firms must continually adapt their products, services, processes, and business models to keep up with evolving market and technological conditions. Thus, Environmental dynamism acts as a critical boundary condition that conditions and amplifies how internal capabilities translate into firm performance during market turbulence [23]. However, excessive instability in the environment may prevent SMEs from fully realizing the benefits of innovation since technological and market landscapes might shift before investments in innovation can deliver satisfactory returns. Recent empirical research underscores this complexity. A study by Olaleye *et al.,*[9], which utilized PLS-SEM involving 401 employees from Nigerian SMEs, found that innovation capability is vital for business sustainability and highlighted the role of environmental dynamism in helping SMEs maintain operations and improve their innovation capabilities. Nonetheless, their results do not conclusively support the idea that environmental dynamism consistently strengthens the relationship between innovation capability and business sustainability.

Evidence from other SME contexts shows similar variability. Rehman *et al.,*[37], examined environmental dynamism, innovation capability, and SME environmental performance using data from 473 manufacturing SMEs. They identified a significant relationship between environmental dynamism and both innovation capability and environmental performance; however, perceived environmental volatility did not significantly moderate the link between innovation capability and environmental performance. This indicates caution against assuming that environmental dynamism will invariably enhance capability-performance relationships.

More recent studies have found support for a positive moderating role under specific circumstances [3].

A 2024 investigation into SMEs focusing on environmental turbulence, dynamic capabilities, and artificial intelligence revealed that environmental turbulence influences how SMEs leverage dynamic capabilities and AI; it can create opportunities for firms to navigate uncertainty while retaining a competitive edge [38]. Similarly, research on failure analysis related to dynamic capabilities and SME growth suggested that environmental dynamism positively moderated relationships associated with dynamic capabilities and growth, indicating that shifting environments can enhance the value of adaptive organizational capabilities [39].

However, emerging evidence suggests that this relationship may not always be straightforward. Wang and Zhang [40], studying 256 technology-focused SMEs, found an inverted U-shaped moderating effect of environmental dynamism: moderate levels amplified the impact of organizational capabilities on innovation while high levels diminished that effect.

Taken together, these findings suggest we should avoid presuming that environmental dynamism has exclusively positive or negative moderating effects. Instead, its influence may vary based on the type of organizational

capability being evaluated as well as the specific outcome at hand along with the degree of change within the environment. This consideration is especially relevant for emerging technology-driven SMEs in Nigeria where technological opportunities exist alongside significant uncertainties regarding markets, infrastructure, competition, and regulation.

Consequently, this study views environmental dynamism as a non-directional boundary condition influencing the relationship between innovation capability and sustainable business growth. The aim is not to assume whether dynamism enhances or diminishes this relationship but rather to empirically assess how varying levels of environmental dynamism affect the effectiveness of innovation capability in promoting sustainable growth for firms.

H5. *Environmental dynamism moderates the relationship between innovation capability and sustainable business growth among emerging technology-driven SMEs in Nigeria.*

Conditional Indirect Effect: Moderated Mediation

The previous discussions also shed light on the indirect relationship between digital leadership and sustainable business growth. Digital leadership is anticipated to enhance innovation capabilities by offering strategic direction, mobilizing digital resources, and fostering organizational adaptability. In turn, innovation capabilities are expected to drive sustainable business growth by enabling SMEs to convert technological and market opportunities into new products, services, processes, and business models [3], [41].

If environmental dynamism influences how effectively innovation capabilities lead to sustainable growth, it should also affect the indirect impact of digital leadership on sustainable growth through innovation capabilities. In other words, the extent to which digital leadership contributes to sustainable growth may depend not only on whether leaders cultivate innovation capabilities but also on the environmental conditions under which those capabilities are utilized.

This conditional mechanism aligns with the dynamic capabilities perspective, which highlights the interaction between organizational capabilities and evolving external environments. Recent studies on SMEs have increasingly utilized mediated-moderated or moderated-mediation models to illustrate how environmental factors affect the transformation of organizational capabilities into innovative performance outcomes [3], [41]. For instance, Rehman *et al.,* [37] employed a mediated-moderated PLS-SEM framework that involved digital technologies, innovation capability, environmental dynamism, and SME environmental performance. Similarly, recent research indicates that environmental dynamism can shape capability-based pathways to SME growth and innovation; however, the direction and nature of this effect can vary across different contexts [39].

As a result, this study does not assert that environmental dynamism will always enhance the indirect effect. Instead, it suggests that the strength of this indirect effect may fluctuate depending on varying levels of environmental dynamism. This opens up an opportunity to empirically examine whether digital leadership translates more effectively into sustainable growth through innovation capability under relatively stable, moderately dynamic, or highly dynamic environmental conditions.

H6. *The indirect effect of digital leadership on sustainable business growth through innovation capability is conditional on environmental dynamism.*

4. Methods

Research Design

This study employed a quantitative, positivist research philosophy along with a deductive approach, which aligns with its goal of testing a priori hypotheses (H1-H6) based on Dynamic Capabilities Theory and Contingency Theory. A cross-sectional survey design was utilized, which was consistent with recent PLS-SEM-based research exploring digital leadership, innovation capability, and outcomes at the firm level among SMEs [3], [41], [42].

Population, Sampling and Sample Size

The population consisted of owner-managers and senior managers from small and medium enterprises in Nigeria's emerging technology-driven sectors such as fintech, e-commerce, agritech, and other digitally enabled businesses. These firms are categorized as small, or medium enterprises according to the employment thresholds outlined in the National Policy on Small and Medium Enterprises [43], which defines micro enterprises as having fewer than 10 employees, small enterprises as employing 10 to 49 individuals, and medium enterprises as employing 50 to 199 individuals. Due to the lack of a comprehensive sampling frame for technology-driven SMEs in Nigeria, a purposive sampling technique was employed. This target registered SMEs operating in digitally intensive sectors within major commercial hubs while also incorporating snowball sampling through relevant industry associations and SME support networks to enhance outreach. The minimum sample size was calculated using the inverse square root method for PLS-SEM [44], which estimates the necessary sample size to detect a specified minimum path coefficient with an 80 percent statistical power at a 5 percent significance level. With a conservatively assumed minimum path coefficient of around 0.20, the required sample size is estimated to be between 160 to 200 respondents. To allow for added complexity from the moderated-mediation model and potential response attrition, the study aimed for at least 250 valid responses, which is consistent with sample sizes observed in similar PLS-SEM-based SME studies [7], [35].

Data Collection and Measurement

Data collection was carried out using a structured self-administered questionnaire consisting of closed-ended items rated on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). All constructs were measured using validated scales adapted from previous research. Digital leadership was assessed using a six-item scale developed by Zeike *et al.,*[45], which evaluates managers' abilities in directing digital transformation efforts including structuring digital processes and fostering enthusiasm for change. Innovation capability was gauged through items adapted from Wang and Ahmed [46] organizational innovativeness construct, covering product, process, and behavioral dimensions of innovation capability. Sustainable growth was evaluated using items tailored from Olaleye *et al.,*[9], focusing on firms' revenue growth, market expansion, and operational continuity over time. Environmental dynamism was assessed via items modified from Jaworski and Kohli's [47] market turbulence subscale that captures changes in customer preferences, technology advancements, and competitive conditions within the firm's environment. Before full deployment of the instrument, a pilot testing with a small group of SME owner-managers was conducted to evaluate item clarity and refine wording; content validity was confirmed through review by academic experts and industry practitioners.

Data Analysis Technique

Data analysis utilized Partial Least Squares Structural Equation Modelling (PLS-SEM) through SmartPLS software, a method well-suited for complex models involving mediation and moderation as well as aligning with this study's exploratory orientation aimed at theory extension [48]. The analysis unfolded in two phases: initially, the measurement model for internal consistency reliability was assessed (via Cronbach's alpha and composite reliability), convergent validity (average variance extracted), and discriminant validity (the heterotrait-monotrait ratio of correlations). Subsequently, the structural model was evaluated based on path coefficients along with measures such as the coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2), with significance determined through bootstrapping procedures involving 5,000 resamples. The mediating role of innovation capability (H4) was examined by assessing the significance of digital leadership's indirect effect on sustainable growth via innovation capability using bias-corrected bootstrap confidence intervals. The moderating influence of environmental dynamism (H5) was tested through a two-stage method involving creation of an interaction term between innovation capability and environmental dynamism while analyzing its impact on sustainable growth; simple slope analysis helped explore interaction forms further. Finally, the moderated-mediation hypothesis (H6) investigated how digital leadership affects sustainable growth at low, mean, and high levels of environmental dynamism following an index-of-moderated-mediation approach [49].

Ethical Considerations

Prior to data collection, ethical approval was sought from the appropriate institutional research ethics committee. Participation in the study was voluntary; respondents provided informed consent after being informed about the study's objectives along with assurances regarding confidentiality of their responses and their right to withdraw at any point without penalty. No personally identifiable information will be collected; data will be securely stored and used exclusively for research purposes.

5. Results

Sample Profile

A total of 252 valid responses were obtained from owner-managers and senior managers of Nigerian technology-driven SMEs. The study's sampling scope was defined around fintech, e-commerce and agritech firms with an additional open "Other digital services" option to accommodate technology-driven firms; 21 respondents (8.3%) used this open option, identifying sectors such as SaaS, EdTech, AI automation and digital product development. Consistent with the study, all 252 responses were retained in the analysis.

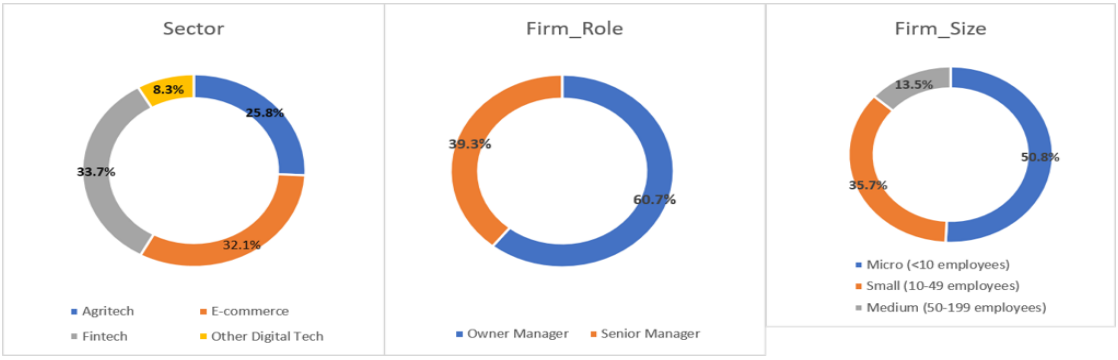


Figure 1. Sample profile by sector, firm size and respondent role (N = 252).
***Source:** Author's Computation (2026)*

Table 1. Sample Profile (N = 252)

Characteristic	Category	n	%
Sector	Fintech	85	33.7
-	E-commerce	81	32.1
-	Agritech	65	25.8
-	Other digital/technology services	21	8.3
Firm Size	Micro (<10 employees)	128	50.8
-	Small (10-49 employees)	90	35.7
-	Medium (50-199 employees)	34	13.5
Respondent Role	Owner-Manager	153	60.7
-	Senior Manager	99	39.3
Years Operating	2-5 years	104	41.3
-	Less than 2 years	62	24.6
-	6-9 years	55	21.8
-	10 years and above	31	12.3

The sample is weighted toward younger, smaller firms: 65.9% of respondents had been operating for five years or less and 50.8% were micro-enterprises with fewer than ten employees. Owner-managers (60.7%) outnumbered senior managers (39.3%) among respondents.

Measurement Model Assessment

Measurement Model Refinement

During initial measurement model assessment, five items were removed due to weak or cross-loading factor loadings that compromised construct reliability and convergent validity: IC4 and IC6 (Innovation Capability), SG3 and SG5 (Sustainable Growth) and ED4 (Environmental Dynamism). The final, refined measurement model retained six Digital Leadership items (DL1-DL6), four Innovation Capability items (IC1, IC2, IC3, IC5), three Sustainable Growth items (SG1, SG2, SG4) and four Environmental Dynamism items (ED1, ED2, ED3, ED5). This refinement is reported transparently as a standard step in PLS-SEM measurement model purification [48].

Table 2. Outer Indicator Loadings of Removed Items

Construct	Item	Loading
Sustainable Growth	SG3	0.631
-	SG5	0.592
Innovation Capability	IC4	0.673
-	IC6	0.605
Environmental Dynamism	ED4	0.613

Source. *Author's Computation (2026).*

Following item refinement, the measurement model was reassessed for internal consistency reliability, convergent validity and discriminant validity.

Table 3. Reliability and Convergent Validity of the Refined Model

Construct	Items	Cronbach's α	rho_a	rho_c	AVE
Digital Leadership	6	0.804	0.804	0.859	0.505
Environmental Dynamism	4	0.713	0.716	0.822	0.537
Innovation Capability	4	0.739	0.747	0.836	0.561
Sustainable Growth	3	0.588	0.594	0.784	0.548

Source. *Author's Computation (2026).*

Composite reliability (rho_c) exceeded the 0.70 threshold for all four constructs and average variance extracted (AVE) exceeded the 0.50 threshold for all four constructs, establishing both reliability and convergent validity across the refined measurement model. Sustainable Growth's Cronbach's alpha (rho_a = 0.594) fell below the conventional 0.70 benchmark. The construct was retained for further analysis based on two critical criteria. First, its composite reliability (rho_c = 0.784) comfortably exceeds the recommended 0.70 threshold, indicating adequate internal consistency. Secondly, its average variance extracted (AVE = 0.548) surpasses the 0.50 cutoff, establishing robust convergent validity (Hair et al., 2019). However, this is attributable to the construct's reduced item count (three items following refinement) combined with moderate, fairly even inter-item correlations - a known limitation of Cronbach's alpha as an estimator for few-item constructs. Deleting further items would severely compromise the content validity of the dimension.

Table 4. Outer Indicator Loadings and Variance Inflation Factors

Construct	Item	Loading	VIF
Digital Leadership	DL1	0.688	1.455
-	DL2	0.716	1.575
-	DL3	0.719	1.522
-	DL4	0.719	1.536
-	DL5	0.696	1.393
-	DL6	0.723	1.492
Environmental Dynamism	ED1	0.757	1.344
-	ED2	0.743	1.376
-	ED3	0.729	1.402
-	ED5	0.700	1.296
Innovation Capability	IC1	0.716	1.332
-	IC2	0.770	1.461
-	IC3	0.800	1.514
-	IC5	0.706	1.337
Sustainable Growth	SG1	0.769	1.192
-	SG2	0.763	1.219
-	SG4	0.685	1.160

Source. *Author's Computation (2026).*

Although all retained items exceeded the minimum acceptable outer loading threshold of 0.40, five items (IC4, IC6, SG3, SG5, ED4) were removed during measurement model refinement because their relatively low loadings, compared to other items within the same construct, were suppressing average variance extracted (AVE) below the recommended 0.50 threshold (Fornell & Larcker, 1981). Following Hair et al.'s (2019) guidance that indicators with loadings between 0.40 and 0.70 should be removed only when doing so improves composite reliability or AVE, each flagged item's removal was evaluated individually; all five removals resulted in AVE improvements that brought the affected constructs above the 0.50 threshold, while retained items with comparably moderate loadings (e.g., DL1 = 0.688, SG4 = 0.685) were kept because their removal did not yield a meaningful AVE or CR improvement.

All retained indicator loadings exceeded the minimum acceptable threshold of 0.40 and the majority exceeded 0.70. DL1 (0.688), DL5 (0.696), ED5 (0.700) and SG4 (0.685) fell marginally below the ideal 0.708 benchmark but were retained because their removal did not meaningfully improve construct-level AVE or CR, consistent with standard PLS-SEM item-retention guidance when convergent validity is already established at the construct level. All indicator-level VIF values ranged from 1.160 (SG4) to 1.575 (DL2) comfortably below the conservative threshold of 3.3, ruling out multicollinearity among indicators.

Discriminant validity was assessed using the heterotrait-monotrait ratio (HTMT). All six construct pairs returned HTMT values below the conservative 0.85 threshold, establishing discriminant validity with comfortable margin.

Table 5. Heterotrait Monotrait Ratio Matrix

Construct Pair	HTMT	Bias	2.5%	97.5%
Environmental Dynamism ↔ Digital Leadership	0.488	-0.001	0.294	0.641
Innovation Capability ↔ Digital Leadership	0.588	-0.001	0.446	0.704
Innovation Capability ↔ Environmental Dynamism	0.609	-0.001	0.451	0.734
Sustainable Growth ↔ Digital Leadership	0.391	-0.001	0.240	0.522
Sustainable Growth ↔ Environmental Dynamism	0.434	-0.000	0.251	0.584
Sustainable Growth ↔ Innovation Capability	0.485	-0.001	0.344	0.604

Source. *Author's Computation (2026).*

Structural Model and Hypothesis Testing

The structural model was estimated using the PLS algorithm with path-weighting scheme. Significance of path coefficients was assessed via bootstrapping with 5,000 resamples and bias-corrected and accelerated (BCa) 95% confidence intervals.

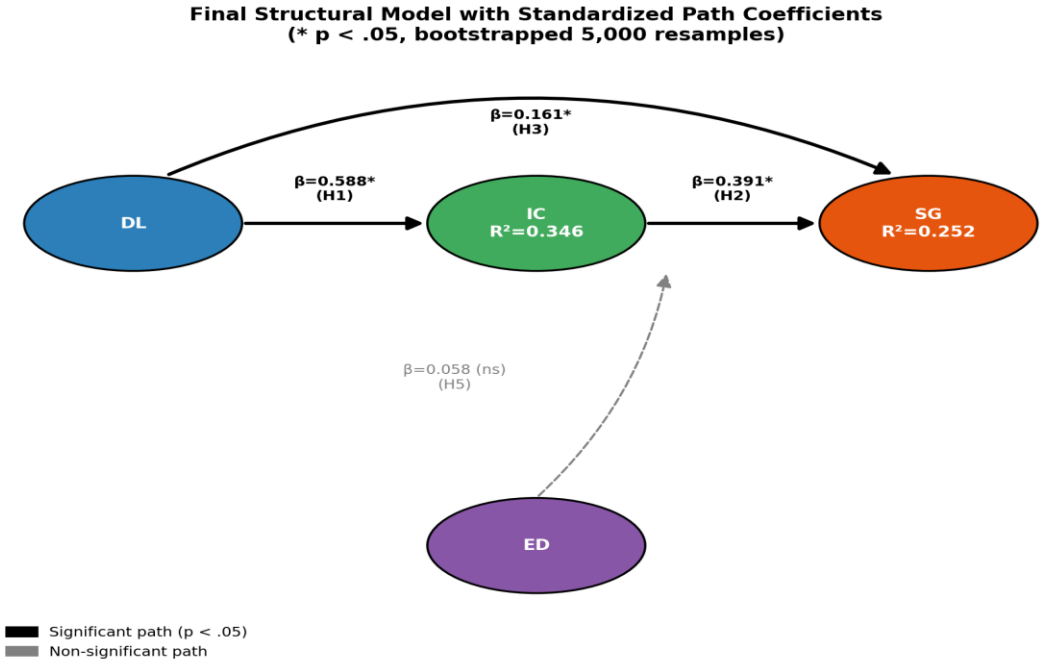


Figure 2. Final structural model with standardized path coefficients and R2.
Source. *Author's Computation (2026).*

Table 6. Direct Structural Path Estimates

Hypothesis	Path	Original sample (O)	Bias	T statistics (|O/STDEV|)	Standard deviation (STDEV)	2.5%	97.5%	P values
H1	DL → IC	0.588	-0.001	8.950	0.066	0.444	0.701	< 0.001
H2	IC → SG	0.391	-0.004	5.072	0.077	0.238	0.534	0.024
H3	DL → SG	0.161	0.002	2.261	0.071	0.021	0.296	< 0.001

Source. *Author's Computation (2026).*

Digital leadership had a strong, statistically significant positive effect on innovation capability (β = 0.588, t = 8.950, 95% BCa CI [0.444, 0.701]) providing strong support for H1.

Innovation capability significantly predicted sustainable growth (β = 0.391, 95% BCa CI [0.238, 0.534]) supporting H2.

Digital leadership also had a smaller but statistically significant direct effect on sustainable growth (β = 0.161, 95% BCa CI [0.021, 0.296]) supporting H3.

Table 7. Inner Model Variance Inflation Factors

Path	VIF (O)
DL → IC	1.000
DL → SG	1.731
ED × IC → SG	2.043
IC → SG	1.955

Source. *Author's Computation (2026).*

Inner model collinearity was assessed via variance inflation factors (VIF) for all structural predictors, including the interaction term. VIF values ranged from 1.000 to 2.043, well below the conservative threshold of 3.3, confirming that collinearity among predictors does not threaten the stability or interpretability of the structural path estimates.

Mediation Analysis

The mediating role of innovation capability in the relationship between digital leadership and sustainable growth was tested via the bias-corrected bootstrap confidence interval of the indirect effect.

Table 8. Specific Indirect Effect from Bootstrapping

Hypothesis	Indirect Path	Original sample (O)	Bias	T statistics (|O/STDEV|)	2.5%	97.5%	P value
H4	DL → IC → SG	0.230	-0.004	4.749	0.145	0.336	< 0.001

Source. *Author's Computation (2026).*

The indirect effect of digital leadership on sustainable growth through innovation capability was positive and statistically significant (β = 0.230, t = 4.749, p < .001, 95% CI [0.145, 0.336]), supporting H4. Because the direct effect (H3, β = 0.161) was also significant, this pattern constitutes complementary (partial) mediation (Zhao et al., 2010): digital leadership influences sustainable growth both directly and indirectly through innovation capability.

Moderation and Moderated Mediation

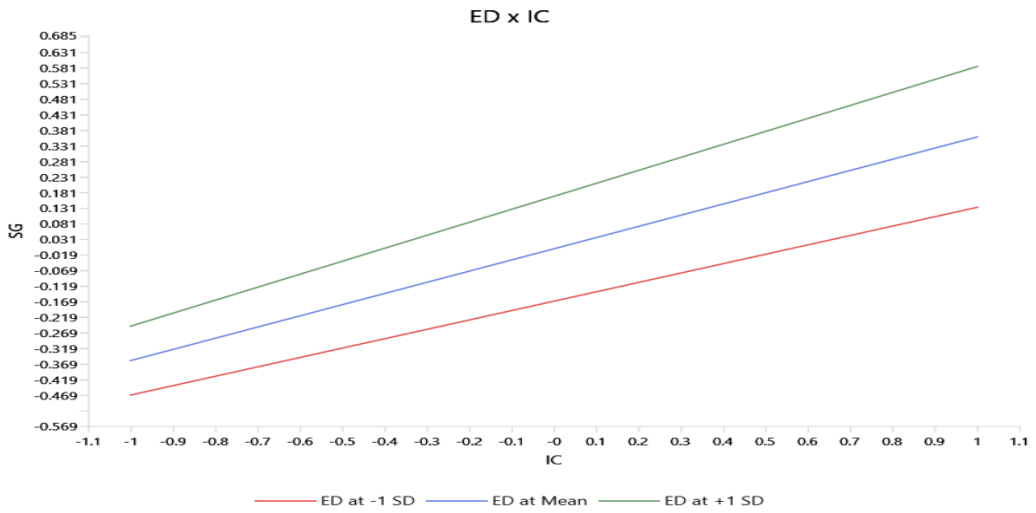


Figure 3. Simple slope interaction plot.

The simple slope analysis indicates a positive relationship between IC and SG at low, mean and high levels of ED. The approximately parallel slopes suggest that the relationship between IC and SG changes little across the three levels of ED.

Table 9. Conditional Effects of Innovation Capability on Sustainable Growth at Values of Environmental Dynamism

Level of ED	β (Original sample)	T-statistic	P-value
Low (-1 SD)	0.301	3.714	< 0.001
Mean	0.359	4.356	< 0.001
High (+1 SD)	0.417	3.641	< 0.001

Source*. Author's Computation (2026)*

Table 10. Interaction Moderation Effect

Hypothesis	Interaction	Original sample (O)	Bias	T statistics (|O/STDEV|)	2.5%	97.5%	P value
H5	IC × ED → SG	0.058	-0.002	1.046	-0.049	0.170	0.296

***Source**. Author's Computation (2026)*

The conditional direct effects analysis revealed that IC had a positive and statistically significant relationship with SG at low levels of ED (β = 0.301, t = 3.714, p < 0.001), average levels of ED (β = 0.359, t = 4.356, p < 0.001) and high levels of ED (β = 0.417, t = 3.641, p < 0.001). Although the estimated coefficient increased as ED increased, the interaction effect between ED and IC was not statistically significant (β = 0.058, 95% CI [-0.049, 0.170]). Thus, the results did not provide sufficient evidence that Environmental dynamism significantly moderated the relationship between innovation capability and sustainable growth in this sample.

Table 11. Index of Moderated Mediation

Hypothesis	Value	SE	T statistics (|O/STDEV|)	95% CI	p-value	Decision
H6	0.034	0.033	1.035	[-0.030, 0.100]	0.300	Not Supported

***Source**. Author's Computation (2026)*

The reported index of moderated mediation was not statistically significant (value = 0.034, SE = 0.033, t = 1.035, 95% CI [-0.030, 0.100], p = .300). Thus, H6 was not supported.

Explanatory and Predictive Power

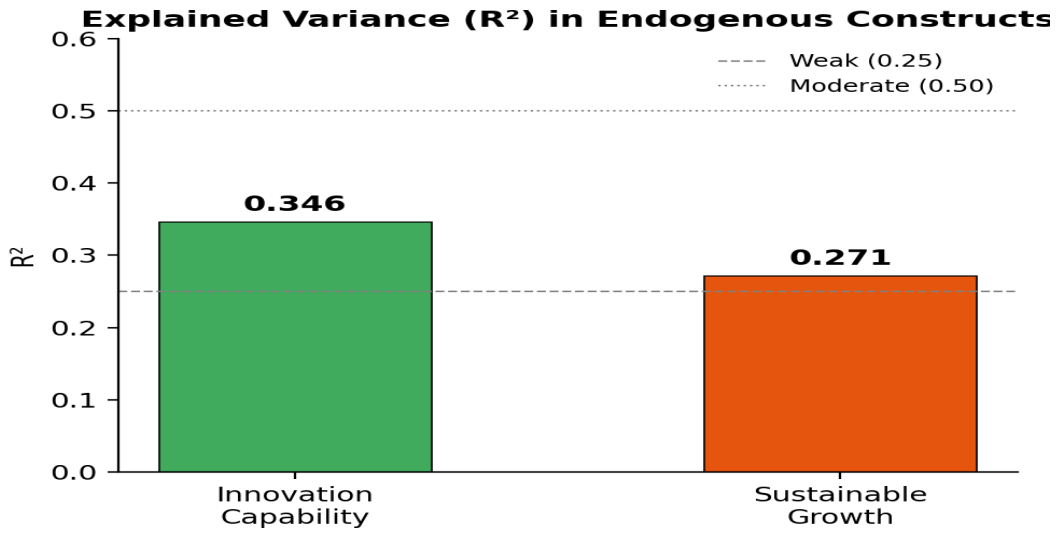


Figure 4. Explained variance in innovation capability and sustainable growth.
***Source**. Author's Computation (2026)*

Table 12. Coefficient of Determination

Endogenous Construct	R^2	R^2 Adjusted	Interpretation
Innovation Capability	0.346	0.343	Weak-to-moderate explanatory power
Sustainable Growth	0.271	0.259	Weak explanatory power

***Source**. Author's Computation (2026)*

The model explained 34.6% of the variance in innovation capability and 27.1% of the variance in sustainable growth. Both values fall in the weak-to-moderate range by conventional PLS-SEM benchmarks: 0.75 = substantial, 0.50 = moderate, 0.25 = weak, (Hair et al., 2019).

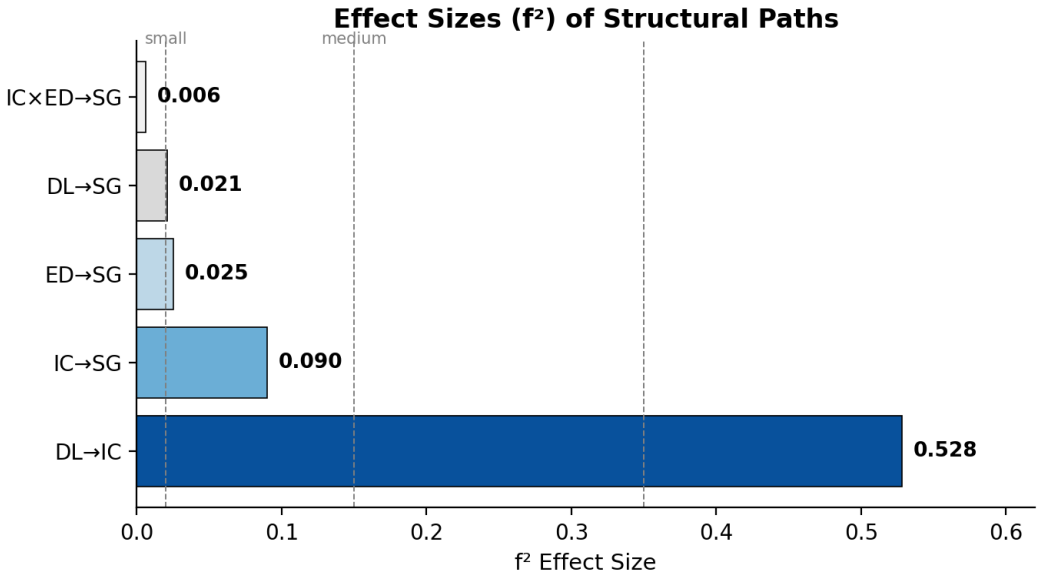


Figure 5. Effect sizes of structural paths.
***Source**. Author's Computation (2026)*

Table 13. Effect Sizes of Structural Paths

Path	f^2	Effect Size
DL → IC	0.528	Large
IC → SG	0.090	Small
DL → SG	0.021	Small
ED × IC → SG	0.006	Negligible

***Source**. Author's Computation (2026)*

Digital leadership's effect on innovation capability was large in magnitude (f^2 = 0.528), by far the strongest relationship in the model. Innovation capability's effect on sustainable growth was small (f^2 = 0.090) while Environmental dynamism's direct effect (f^2 = 0.025). Digital leadership's direct effect on sustainable growth, while statistically significant, is small in substantive size (f^2 = 0.021), as was the interaction effect (f^2 = 0.006).

Predictive relevance was assessed using PLSpredict. Q^2predict values were positive for both endogenous constructs (IC = 0.335; SG = 0.163), and PLS-SEM prediction errors (RMSE) were lower than those of the naive indicator-average benchmark (IC: 0.818 vs. 1.003; SG: 0.918 vs. 1.004), indicating predictive relevance. However, the linear model benchmark yielded marginally lower prediction errors (IC: 0.767; SG: 0.917), so the model's predictive power indicates low to medium predictive power.

Table 14. PLSpredict Results: Q2predict and RMSE Comparison

Construct	Q^2predict	PLS-SEM RMSE	LM RMSE	Naive (IA) RMSE
Innovation Capability	0.335	0.818	0.767	1.003
Sustainable Growth	0.163	0.918	0.917	1.004

***Source**. Author's Computation (2026)*

6. Discussion

Digital Leadership and Innovation Capability

Digital leadership emerged as a strong, statistically significant and substantively large predictor of innovation capability (β = 0.588, f^2 = 0.528), the single strongest relationship identified in the model. This finding provides robust support for the study's core theoretical premise, grounded in Dynamic Capabilities Theory: leaders who

articulate a digital vision, structure digital processes, mobilize technological resources and build organizational readiness for digital transformation substantially strengthen their firm's capacity to innovate.

Innovation Capability and Sustainable Growth

Innovation capability significantly predicted sustainable growth (β = 0.391, 95% CI [0.238, 0.534]), confirming its role as a mechanism converting internal organizational competencies into growth outcomes, consistent with the study's theoretical framing.

Direct and Indirect Effects of Digital Leadership

Digital leadership had a significant direct effect on sustainable growth (β = 0.161) in addition to its significant indirect effect through innovation capability (β = 0.230, H4). Because both pathways are significant, innovation capability partially, rather than fully, mediates the relationship between digital leadership and sustainable growth with the indirect pathway representing the larger share of digital leadership's total effect on growth.

Environmental Dynamism

Environmental dynamism did not significantly moderate the relationship between innovation capability and sustainable growth, and the index of moderated mediation was also not significant. The evidence therefore does not support a conditional effect of digital leadership on sustainable growth through innovation capability in this sample. These findings qualify the proposed contingency relationship rather than establish that environmental conditions are irrelevant.

Explanatory and Predictive Power

The model explained 34.6% of the variance in innovation capability ($R^2 = 0.346$) and 27.1% in sustainable growth ($R^2 = 0.271$), demonstrating acceptable weak-to-moderate explanatory power supported by positive out-of-sample predictive relevance (Q^2predict = 0.335 for IC, 0.163 for SG).

Theoretical Implications

The findings contribute to the application of Dynamic Capabilities Theory to technology-driven SMEs in Nigeria in three ways. First, the strong positive association between digital leadership and innovation capability (β = 0.588, $f^2 = 0.528$) is consistent with the view that leadership helps firms organize and mobilize digital resources in ways that support innovation. Second, the significant relationship between innovation capability and sustainable growth (β = 0.391) and the significant indirect effect of digital leadership through innovation capability (β = 0.230) support the proposed role of innovation capability as an organizational pathway linking digital leadership with growth. Third, the non-significant interaction and index of moderated mediation qualify the contingency argument: although environmental dynamism was theorized to alter the growth return from innovation capability, this study did not find sufficient statistical evidence for that conditional effect in its sample. The result therefore narrows the claim supported by the data; it does not disprove the broader theoretical relevance of environmental conditions. Future tests should establish when and how environmental dynamism conditions capability-performance relationships rather than assume that the contingency is universal.

Practical Implications

For owner-managers and senior managers of Nigerian technology-driven SMEs, the results suggest that digital leadership deserves attention as a means of strengthening innovation capability. Leadership practices that clarify digital priorities, support experimentation, coordinate technology-related work and make resources available for developing and implementing ideas may help build this capability. The positive association between innovation capability and sustainable growth also suggests that innovation efforts should be connected to business outcomes rather than treated as technology adoption for its own sake. Firms can monitor whether new products, services or processes contribute to customer value, operational performance and viable growth. However, managers should not infer from the non-significant moderation result that environmental dynamism can be ignored. The study simply did not establish that dynamism significantly changes the IC-SG relationship in this sample. SMEs should continue to monitor market, technological and competitive changes and assess their implications for individual strategic decisions.

Limitations and Future Research

Firstly, five items were removed during measurement model refinement (IC4, IC6, SG3, SG5, ED4); this is disclosed explicitly alongside the loading values that justified each removal. Secondly, the cross-sectional design limits causal inference despite the use of PLS-SEM bootstrapping. Furthermore, the model's weak-to-moderate R^2 values indicate that digital leadership, innovation capability and environmental dynamism, while significant predictors, do not capture the full range of factors contributing to sustainable business growth among Nigerian technology-driven SMEs.

The study's sectoral scope was expanded to accommodate 21 respondents (8.3% of the sample) whose firms did not fall neatly into the three primary sectors of fintech, e-commerce and agritech, instead spanning a wider range of digital and technology-driven services (e.g., SaaS, EdTech, AI automation). While this broadened scope improves sample size and captures a more representative cross-section of Nigeria's technology-driven SME landscape, the resulting sample is somewhat more heterogeneous than a narrowly-defined three-sector sample would be, which should be considered when generalizing findings to any single sector specifically.

Third, the cross-sectional survey design limits causal inference; the significant paths identified here are consistent with, but do not conclusively establish, the hypothesized causal ordering from digital leadership to innovation capability to sustainable growth. The current results do not determine whether the relationship is non-linear. If theory supports such a possibility, future work could test quadratic effects or thresholds rather than assume that the effect of ED is linear. Fourth, longitudinal or panel designs could clarify how digital leadership, innovation capability, environmental conditions and growth evolve over time.

Finally, the sample was weighted toward young and small firms, 65.9% had operated for five years or less and 50.8% were micro-enterprises. This profile may limit generalizability to larger, more established technology-driven SMEs in the Nigerian market and could mean that firms have not experienced a sufficiently broad range of environmental conditions for the hypothesized interaction to be clearly detected. However, the study did not directly test restricted variance in ED, so this remains a possible explanation rather than an established cause.

7. Conclusion

This study examined the structural relationships between digital leadership, innovation capability, environmental dynamism and sustainable business growth. Digital leadership was confirmed as a powerful driver of innovation capability ($\beta = 0.588$, $f^2 = 0.528$) and innovation capability significantly predicted sustainable growth ($\beta = 0.391$). Digital leadership exerted both direct ($\beta = 0.161$) and indirect ($\beta = 0.230$) effects on sustainable growth, establishing complementary partial mediation through innovation capability. Neither environmental dynamism's moderation of the innovation capability-growth relationship (H5) nor its moderation of the indirect digital-leadership-to-growth pathway (H6) was statistically supported.

The findings support the core theoretical claim that digital leadership drives SME growth substantially through its organizational enabler: innovation capability, while maintaining reliable explanatory power ($R^2 = 0.346$ for IC, $R^2 = 0.271$ for SG) and predictive relevance (Q^2predict).

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