

Digital Transformation of SMEs as a Catalyst for Supply Chain Resilience, Sustainability, and Competitive Advantage: Evidence from Nigeria

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ABSTRACT: This study investigates how digital transformation enhances supply chain resilience, sustainability performance, and competitiveness among small and medium enterprises (SMEs) in Nigeria. Anchored on the Resource-Based View (RBV), Dynamic Capability Theory, and the Technology–Organization–Environment (TOE) framework, the study develops and empirically tests a sequential mediation model linking digitalization to competitiveness through resilience and sustainability. A mixed-method research design with quantitative dominance was adopted. Survey data were collected from 312 SMEs operating in the agribusiness and retail sectors and analyzed using Structural Equation Modeling (SEM). The findings reveal that digitalization significantly enhances supply chain resilience ($\beta = 0.62$) and positively influences sustainability performance ($\beta = 0.48$). Supply chain resilience strongly predicts competitiveness ($\beta = 0.53$), while sustainability also exerts a significant positive effect ($\beta = 0.36$). Although digitalization has a direct impact on competitiveness ($\beta = 0.21$), the results confirm partial mediation through resilience and sustainability. The study demonstrates that digital transformation is a strategic capability that strengthens adaptive capacity, improves resource efficiency, and enhances market positioning. It concludes that digitalization is not merely a technological upgrade but a development imperative for the survival of SMEs in emerging economies. Policy recommendations emphasize strengthened public–private partnerships, flexible financing, regional innovation hubs, and harmonized digital industrial policies to build an inclusive and competitive SME ecosystem in Nigeria.

KEYWORDS: Digital transformation; Supply chain resilience; Sustainability performance; Competitiveness; Small and medium enterprises (SMEs)

1.0 INTRODUCTION

Across sectors worldwide, organizations are increasingly shaping their strategies around three core priorities: resilience, sustainability, and competitiveness. Resilience describes the capacity of firms and their supply chains to foresee potential disruptions, withstand shocks, and recover quickly from setbacks. Sustainability emphasizes reducing environmental harm while safeguarding long-term economic growth and social well-being. Competitiveness relates to a company's ability to innovate, streamline operations, and sustain a strong market position in rapidly changing environments. Collectively, these three dimensions are redefining the trajectory of modern production systems. A series of global disruptions; including the COVID-19 pandemic, geopolitical conflicts, trade barriers, and climate-induced events has highlighted structural weaknesses in global value chains. These shocks exposed excessive reliance on a narrow base of suppliers, inadequate supply chain transparency, and limited digital connectivity across networks. In reaction, many multinational corporations have

intensified investments in advanced digital technologies such as artificial intelligence (AI), cloud computing, the Internet of Things (IoT), blockchain, and sophisticated data analytics. These tools enable real-time monitoring, improve demand forecasting, enhance traceability, boost operational performance, and support better environmental management.

Despite these advancements, a major constraint persists within the broader production landscape. Small and Medium Enterprises (SMEs), which account for more than 90% of businesses globally, are integrating digital technologies at a much slower rate than large corporations. In Nigeria, SMEs contribute roughly 48% to GDP and generate over 80% of employment, underscoring their vital role in economic growth and job creation. Yet, Nigerian SMEs continue to confront enduring challenges, including poor infrastructure, unstable electricity supply, limited access to affordable financing, inadequate digital competencies, and weak broadband infrastructure. The slower pace of digital adoption among SMEs is not mainly the result of resistance to

innovation or lack of awareness. Instead, it stems largely from structural and financial limitations typical of small enterprises. Many SMEs operate with constrained cash flows, where immediate operational concerns such as paying salaries, managing stock, and meeting day-to-day expenses take priority over long-term technology investments. High upfront costs, insufficient collateral for access to credit, and uncertainty about returns on digital investments further discourage transformation efforts.

This widening digital divide carries broader systemic implications. Even amid geopolitical fragmentation, global value chains remain highly interconnected. When SME suppliers are not digitally integrated, the entire production network experiences diminished transparency, weaker coordination, limited information sharing, and reduced capacity to monitor sustainability performance. Consequently, even technologically sophisticated multinational firms cannot fully realize their goals of resilience, sustainability, and competitiveness without digitally empowered SME partners. For SMEs, digital transformation represents a strategic pathway to mitigate these vulnerabilities. By adopting digital solutions, they can enhance demand planning, streamline inventory control, minimize waste, improve energy efficiency, diversify suppliers, and leverage e-commerce and digital financial platforms. Digitalization also advances environmental sustainability through emissions monitoring, resource optimization, and the integration of reverse logistics systems. Ultimately, stronger digital capabilities enable SMEs to participate more effectively in both domestic and international markets, thereby reinforcing their overall competitiveness.

1.1 Statement of the Problem

Despite the recognized importance of SMEs and the proven benefits of digital technologies, a persistent digital adoption gap exists between large corporations and SME suppliers. This gap undermines supply chain resilience, limits sustainability performance, and weakens ecosystem-wide competitiveness. In developing economies such as Nigeria, structural barriers, including financial constraints, infrastructure limitations, skill gaps, and policy fragmentation, intensify this challenge. Unless deliberate strategies are implemented to support SME digital transformation, industrial ecosystems will struggle to achieve long-term resilience, environmental sustainability, and competitive efficiency. Given that SMEs represent the majority of firms globally, inclusive digitalization is not optional but essential for the future of production systems.

1.2 Objectives of the Study:

This study aims to examine the role of digital transformation in enhancing SME resilience, sustainability, and competitiveness. Specifically, it seeks to:

- (i) analyze the relationship between digital transformation and operational resilience among SMEs.
- (ii) examine how digital technologies contribute to environmental sustainability in SME supply chains.
- (iii) evaluate the impact of digital adoption on SME competitiveness in domestic and global markets.
- (iv) identify structural barriers limiting SME digital transformation.
- (v) propose strategic policy and ecosystem-based interventions to accelerate inclusive digitalization.

1.3 Research Questions:

The study addresses the following research questions:

- (i) How does digital transformation influence supply chain resilience among SMEs?
- (ii) In what ways can digital technologies enhance sustainability performance in SME operations?
- (iii) What is the relationship between digital adoption and SME competitiveness?
- (iv) What barriers constrain SME digital transformation, particularly in emerging economies?
- (v) What strategies can support SME participation in digitally enabled production ecosystems?

1.4 Research Hypothesis

H1: Digitalization positively influences resilience.

H2: Digitalization positively influences sustainability.

H3: Resilience positively influences competitiveness.

H4: Sustainability positively influences competitiveness.

H5: Resilience mediates the digitalization–competitiveness relationship.

2.0 REVIEW OF RELATED LITERATURE

The increasing volatility of global markets, technological disruptions, climate change pressures, and geopolitical uncertainties have reshaped the discourse on industrial competitiveness. Contemporary scholarship emphasizes three interconnected strategic imperatives for firms: resilience, sustainability, and competitiveness. Resilience refers to the capacity of firms and supply chains to anticipate disruptions, absorb shocks, adapt to changing conditions, and recover swiftly from crises (Ivanov & Dolgui, 2020). Sustainability encompasses the integration of environmental stewardship, social responsibility, and long-term economic viability into business operations (Elkington, 2019; United Nations, 2023). Competitiveness reflects an organization’s ability to innovate continuously, operate efficiently, and sustain market advantage in volatile and dynamic environments (Porter & Kramer, 2019). Collectively, these three pillars increasingly define the future trajectory of modern production and supply systems.

Recent global disruptions have reinforced the urgency of these strategic imperatives. The COVID-19 pandemic

exposed structural weaknesses in global supply networks, revealing excessive reliance on geographically concentrated suppliers and limited end-to-end visibility (Guan et al., 2020). In addition, geopolitical tensions, trade restrictions, and climate-induced disruptions have intensified uncertainty in global value chains (UNCTAD, 2023). These shocks highlighted deficiencies in digital integration, data sharing, and coordinated risk management across supply networks. In response, multinational corporations have accelerated investments in advanced digital technologies. Artificial intelligence, cloud computing, blockchain, Internet of Things (IoT), and advanced analytics are increasingly deployed to enhance transparency, forecasting accuracy, traceability, and operational efficiency (Ivanov, 2022). Digital technologies enable real-time monitoring of inventory flows, predictive risk assessment, emissions tracking, and automated decision-making processes, thereby strengthening resilience and sustainability performance simultaneously (Büyüközkan & Göçer, 2020). However, a critical bottleneck persists within the broader production ecosystem: the comparatively slow digital transformation of Small and Medium Enterprises (SMEs). SMEs constitute over 90% of global firms and remain central to employment generation and economic development (Aikor, 2018).

In Nigeria, SMEs account for approximately 48% of GDP and over 80% of employment, underscoring their strategic role in national development (SMEDAN, 2022). Despite their importance, many Nigerian SMEs face structural constraints including unreliable electricity supply, limited broadband penetration, restricted access to affordable finance, and inadequate digital capabilities (Afolabi et al., 2023). Importantly, the slower rate of digital adoption among SMEs is not primarily attributable to resistance to innovation. Rather, it reflects systemic financial and infrastructural constraints. Many SMEs operate under tight liquidity conditions, where short-term operational obligations such as payroll, procurement, and inventory replenishment take precedence over long-term digital investments (World Bank, 2023). High upfront capital costs, limited collateral for credit access, and uncertainty regarding return on investment further discourage digital transformation initiatives (Akeredolu-Ale et al., 2022).

This digital divide generates systemic consequences for global value chains. Despite growing geopolitical fragmentation, production networks remain deeply interconnected. When SME suppliers lack digital integration,

supply chains suffer from reduced transparency, fragmented data exchange, and weak coordination mechanisms (Ivanov, 2022). Inadequate digital capability among SMEs constrains environmental monitoring, limits traceability, and weakens compliance with sustainability standards. Consequently, even technologically advanced multinational corporations cannot fully realize resilience, sustainability, and competitiveness objectives without digitally capable SME partners (WEF, 2023).

Digital transformation offers SMEs a strategic pathway to overcome these vulnerabilities. Adoption of digital tools can enhance demand forecasting accuracy, optimize inventory management, reduce operational waste, and improve energy efficiency (Büyüközkan & Göçer, 2020). Digital platforms also facilitate supplier diversification, strengthen risk monitoring, and expand access to e-commerce and digital financial services (World Bank, 2023). Moreover, digitalization supports environmental sustainability by enabling emissions tracking, resource optimization, and integration of reverse logistics systems (Aikor&Ejem,2022). Enhanced digital capability improves SME participation in both domestic and international markets, thereby strengthening overall competitiveness and long-term growth potential (McKinsey & Company, 2021).

In summary, achieving resilient, sustainable, and competitive production systems requires inclusive digital transformation across the entire supply chain ecosystem. Strengthening SME digital capacity is not merely a technological agenda but a systemic imperative for national and global economic stability. Small and Medium Enterprises (SMEs), which account for over 90% of global businesses and contribute significantly to employment and GDP, particularly in developing economies such as Nigeria, are central to this discussion. However, despite their economic importance, SMEs face structural and technological constraints that limit their ability to fully participate in digitally integrated supply chains. The literature increasingly positions digital transformation as a critical enabler of resilience, sustainability, and competitive performance among SMEs.

2.1 Conceptual Framework

The conceptual foundation of this study is anchored on the interrelationship between digital transformation (independent variable) and three key organizational outcomes: resilience, sustainability, and competitiveness (dependent variables).

Proposed Structural Model:

SEM Path Diagram: Digitalization → Resilience → Sustainability → Competitiveness



Structural Interpretation: Digitalization (independent variable) directly influences Resilience enhances sustainability, and sustainability drives competitiveness. The model represents a sequential mediation framework, where resilience mediates the relationship between digitalization and sustainability, and sustainability further mediates the relationship between resilience and competitiveness, and the overall effect of digitalization on competitiveness is transmitted through the two mediators.

Digital transformation: Digital transformation refers to the integration of digital technologies such as cloud computing, big data analytics, artificial intelligence, blockchain, the Internet of Things (IoT), and enterprise resource planning systems into business processes and supply chain operations.

Supply Chain Resilience: Supply chain resilience refers to the ability of a firm to anticipate, absorb, adapt to, and recover from disruptions. Literature suggests that digital tools enhance visibility, improve demand forecasting, enable real-time monitoring, and facilitate collaborative decision-making, thereby strengthening adaptive capacity.

Sustainability: Sustainability encompasses environmental, social, and economic dimensions. Digital technologies support sustainable practices by optimizing resource utilization, reducing waste, tracking carbon emissions, enabling reverse logistics, and improving transparency in supply chains.

Competitiveness: Competitiveness reflects a firm’s capacity to innovate, reduce costs, improve quality, respond quickly to market changes, and access new markets. Digitalization enhances productivity, customer engagement, operational efficiency, and integration into global value chains. The conceptual model therefore assumes that higher levels of digital adoption among SMEs positively influence resilience, sustainability, and competitiveness. However, the relationship may be moderated by factors such as financial capacity, infrastructure availability, human capital, institutional support, and policy environment.

2.2 Theoretical Framework

Resource-Based View (RBV): The Resource-Based View posits that firms achieve sustained competitive advantage through valuable, rare, inimitable, and non-substitutable (VRIN) resources. Digital capabilities, including data analytics skills, IT infrastructure, and digital organizational culture, constitute strategic resources. For SMEs, investment in digital competencies can enhance operational efficiency and differentiate them in competitive markets. However, resource constraints often limit SMEs’ ability to develop these capabilities.

Dynamic Capabilities Theory: Dynamic Capabilities Theory emphasizes a firm’s ability to integrate, build, and reconfigure internal and external competencies in rapidly changing environments. Digital transformation strengthens sensing (market intelligence), seizing (technology adoption), and transforming (process reconfiguration) capabilities. SMEs with stronger dynamic capabilities are better positioned to respond to supply chain disruptions and environmental uncertainties.

Technology-Organization-Environment (TOE) Framework: The TOE framework explains technology adoption based on three contextual factors: technological readiness, organizational characteristics, and environmental influences. For SMEs, technological factors include the perceived usefulness and complexity of digital tools; organizational factors include firm size, leadership support, and financial resources; and environmental factors include competitive pressure, government policy, and customer requirements. This framework is particularly relevant in understanding the slower pace of digital adoption among SMEs in developing economies.

Institutional Theory: Institutional Theory suggests that firms adopt practices due to coercive, normative, and mimetic pressures. Large multinational corporations increasingly require digital integration, sustainability reporting, and traceability from SME suppliers. Such institutional pressures may accelerate digital adoption, though SMEs may struggle

to comply due to structural limitations. Digital capabilities are treated as strategic resources that enhance sensing, seizing, and transformation capacities.

2.3 A Framework for Supporting SME Digitalization in Nigeria

Small and Medium-sized Enterprises (SMEs) play a central role in Nigeria’s economic structure, contributing significantly to employment generation and national output. According to the Small and Medium Enterprises Development Agency of Nigeria. SMEs account for over 96% of businesses in Nigeria. However, despite their importance, many Nigerian SMEs remain digitally underdeveloped, limiting their ability to achieve resilience, sustainability, and competitiveness in an increasingly technology-driven global economy. argues that resilient, sustainable, and competitive production ecosystems must be intentionally designed through structured digital transformation support systems. In Nigeria, this requires coordinated action between large corporations, government institutions, financial organizations, and educational institutions.

Private sector-led Programmes to support SME Digitalization

- (i) **Supplier Training and Capacity Building:** Large corporations operating in Nigeria can support SME suppliers through structured workshops, on-site training, and joint problem-solving initiatives. Such initiatives help SMEs build operational capacity in advanced manufacturing, digital inventory systems, and supply chain analytics. As noted by the World Economic Forum (2023), sustained knowledge-sharing is critical to building long-term supplier capabilities.
- (ii) **Access to Technology and Innovation Resources:** Technology transfer arrangements, shared access to digital platforms, and participation in innovation hubs can significantly lower adoption barriers. emphasizes that SMEs benefit from collaborative innovation ecosystems that reduce experimentation costs and accelerate learning.
- (iii) **Financial Support and Risk Sharing:** Financial constraints remain one of the most significant barriers to digital adoption in Nigeria. Co-investment models, loan guarantees, and supplier grants can reduce financial risk exposure. highlights that blended finance mechanisms are essential in emerging economies to stimulate SME digital upgrading.
- (iv) **Standardization and Technology Alignment:** Standardized digital systems across supply chains improve interoperability and efficiency. Clear

technology standards and integration support ensure seamless operations across value chains.

- (v) **Long-Term Collaborative Partnerships:** Long-term contractual arrangements encourage SMEs to invest confidently in digital technologies. Sustainable supplier relationships foster innovation, continuous improvement, and supply chain resilience.

Government-Led Programmes to Support SME Digitalization

- i) **Financial Incentives and Support:** Government-backed institutions such as the Bank of Industry and SMEDAN play crucial roles in providing grants, soft loans, and tax incentives. Access to affordable finance remains a primary determinant of SME survival and growth.
- ii) **Technical Assistance and Advisory Support:** Technical consultancy services help SMEs select appropriate technologies and avoid costly implementation errors. Benchmarking and digital readiness assessments further improve transformation outcomes....
- iii) **Collaborative Ecosystems:** Government-facilitated collaboration among universities, research institutes, and private firms enhances knowledge transfer and innovation diffusion.
- iv) **Education and Industry 4.0 Skills Development:** Investment in technical education and Industry 4.0 skills is essential to close Nigeria’s digital skills gap. Workforce capability is a critical determinant of digital transformation success.
- v) **SME-Friendly Programme Design:** Streamlined application processes, flexible eligibility criteria, and tailored support ensure higher participation rates among SMEs. Administrative simplicity is key to programme effectiveness.

Key Gaps and Recommendations in the Nigerian Context

Gaps: Below are the five gaps listed clearly and separately:

- (i) Persistent knowledge and skills deficit among SMEs in managing digital transformation and operating advanced technologies.
- (ii) Weak capacity to develop a clear business case for technology investment and limited access to flexible financial support programmes.
- (iii) Lack of sustained post-adoption support following initial technology implementation.
- (iv) Limited access to innovation hubs, cutting-edge technologies, and collaboration networks for SMEs in underserved regions.
- (v) Poor alignment and coordination between government-led programmes and corporation-led digitalization initiatives.

Below are the recommendations to address the gaps:

- (i) Establish sustained knowledge-sharing and capacity-building ecosystems involving larger firms, government programmes, and technical/trade institutions to continuously strengthen SME competencies.
- (ii) Improve financial accessibility and transparency of business case metrics by designing flexible, SME-tailored financing solutions, simplifying application processes, scaling co-financing opportunities, and offering innovative repayment models.
- (iii) Institutionalize long-term post-adoption support structures, including troubleshooting services, maintenance networks, and peer-learning platforms through industry associations and clusters.
- (iv) Strengthen regional innovation clusters and global linkages by leveraging digital collaboration platforms and increasing SME awareness of international development and innovation programmes.
- (v) Enhance public-private partnerships and program alignment to leverage complementarities, reduce duplication, and create synergistic digitalization initiatives.

3. METHODOLOGY

3.1 Research Design

This study adopted a mixed-method research design, integrating quantitative and limited qualitative approaches to provide a comprehensive understanding of the relationship between digital transformation and organizational outcomes among SMEs in Nigeria. The mixed-method approach was considered appropriate because it allows triangulation of findings, enhances validity, and provides both statistical rigor and contextual depth. The quantitative component constituted the core of the study and involved a structured survey of Small and Medium Enterprises (SMEs) operating within the agribusiness and retail sectors in Nigeria. These sectors were selected due to their strategic importance to Nigeria's economy, employment generation, and supply chain networks particularly in light of recent disruptions affecting food systems and distribution networks. The qualitative dimension complemented the survey by enabling contextual interpretation of the quantitative findings through informal follow-up discussions with selected SME managers during data collection.

3.2 Population and Sampling

The target population comprised registered SMEs in the agribusiness and retail sectors across Nigeria. SMEs were defined in line with the classification of the Small and

Medium Enterprises Development Agency of Nigeria (SMEDAN), which categorizes firms based on employment size and asset base. A total of 312 SMEs participated in the study. A purposive random sampling technique was adopted. First, purposive sampling was used to identify SMEs actively engaged in digital business processes (e.g., use of digital payment systems, ERP platforms, social media marketing, and supply chain tracking systems). Thereafter, random selection was applied within the identified pool to minimize sampling bias and improve representativeness. The sample size of 312 was considered statistically adequate for Structural Equation Modeling (SEM), as it exceeds the minimum recommended threshold of 200 observations for robust parameter estimation.

3.3 Instrumentation and Measurement of Variables

Data were collected using a structured questionnaire divided into five sections:

1. Section A: Demographic characteristics (firm size, years of operation, sector classification, ownership structure).
2. Section B: Digitalization (DIG)
3. Section C: Supply Chain Resilience (SCR)
4. Section D: Sustainability (SUS)
5. Section E: Competitiveness (COMP)

All latent constructs were measured using a 5-point Likert scale, ranging from 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Operationalization of Constructs

- (i) Digitalization (DIG): Measured through indicators such as adoption of digital payment systems, enterprise resource planning (ERP), e-commerce platforms, data analytics usage, and digital supply chain coordination tools.
- (ii) Supply Chain Resilience (SCR): Measured through adaptability, redundancy capacity, flexibility, recovery time, and risk monitoring capabilities.
- (iii) Sustainability (SUS): Measured across environmental practices (waste reduction, energy efficiency), social responsibility, and long-term economic viability.
- (iv) Competitiveness (COMP): Measured through innovation capability, market share growth, cost efficiency, customer responsiveness, and product/service differentiation.

3.4 Reliability and Validity Analysis

To ensure the robustness of the measurement model, internal consistency reliability and convergent validity were assessed using Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE).

Table 1: Measurement Reliability and Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
Digitalization	0.91	0.93	0.71
Resilience	0.88	0.90	0.69
Sustainability	0.85	0.87	0.63
Competitiveness	0.89	0.91	0.72

Table 1 evaluates the psychometric properties of the measurement model using Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). These statistics collectively determine whether the constructs, namely, digitalization, resilience, sustainability, and competitiveness, were measured with sufficient internal consistency and convergent validity to justify structural modelling. All constructs report Cronbach's Alpha values above 0.85, with digitalization exhibiting the highest coefficient (0.91). Values above the conventional 0.70 benchmark indicate that the measurement items for each construct demonstrate strong inter-item correlation and consistency. This suggests that respondents interpreted and answered the scale items in a coherent manner, reinforcing confidence in the instrument's stability. Composite Reliability (CR) values range from 0.87 to 0.93, exceeding the recommended minimum threshold of 0.70. CR is often considered superior to Cronbach's Alpha in SEM contexts because it accounts for varying factor loadings. The consistently high CR values therefore confirm that the latent constructs are reliably represented by their respective indicators. All constructs report Cronbach's Alpha values above 0.85, with digitalization exhibiting the highest coefficient (0.91). Values above the conventional 0.70 benchmark indicate that the measurement items for each construct demonstrate strong inter-item correlation and consistency. This suggests that respondents interpreted and answered the scale items in a coherent manner, reinforcing confidence in the instrument's stability. Composite Reliability (CR) values range from 0.87 to 0.93, exceeding the recommended minimum threshold of 0.70. CR is often considered superior to Cronbach's Alpha in SEM contexts because it accounts for varying factor loadings. The consistently high CR values therefore confirm that the latent constructs are reliably represented by their respective indicators. The results in Table 1 confirm that the measurement model satisfies reliability and convergent validity criteria. This establishes a sound empirical foundation for proceeding to structural path estimation. From a methodological standpoint, the robustness of these statistics enhances the credibility of the causal inferences drawn in subsequent analysis.

3.5 Data Analysis Technique

Data were analyzed using Structural Equation Modeling (SEM). SEM was selected because it allows simultaneous

estimation of multiple dependent relationships, assesses both measurement and structural models, and accounts for latent constructs. The analysis followed a two-step approach: Measurement Model Assessment (Confirmatory Factor Analysis—CFA) and Structural Model Assessment (Path Analysis and Hypothesis Testing)

3.6 Model Fit Assessment

The overall goodness-of-fit indices indicate a well-fitting model: Comparative Fit Index (CFI) = 0.95, Root Mean Square Error of Approximation (RMSEA) = 0.049 and Chi-square/df = 2.08. These values meet established thresholds (CFI $\geq$ 0.90; RMSEA $\leq$ 0.08; Chi-square/df $\leq$ 3), confirming that the structural model adequately fits the observed data.

3.7 Ethical Considerations

Participation was voluntary, and informed consent was obtained from all respondents. Respondents were assured of anonymity and confidentiality. Data were used strictly for academic purposes.

4.0 RESULTS AND FINDINGS

Table 2: Structural Path Coefficients

Path	Beta	t-value	Significance
DIG $\rightarrow$ SCR	0.62	9.84	$p < 0.001$
DIG $\rightarrow$ SUS	0.48	7.21	$p < 0.01$
SCR $\rightarrow$ COMP	0.53	8.17	$p < 0.001$
SUS $\rightarrow$ COMP	0.36	5.44	$p < 0.01$
DIG $\rightarrow$ COMP	0.21	2.89	$p < 0.05$

Source: Author's compilation

This is the strongest direct relationship in the model. A coefficient of 0.62 indicates a substantial positive effect, implying that increased digital adoption significantly enhances SMEs' ability to anticipate, absorb, and recover from disruptions. The high t-value (9.84) demonstrates statistical robustness. Empirically, this finding supports the argument that digital tools such as ERP systems, analytics, and digital coordination platforms improve visibility, forecasting accuracy, and adaptive decision-making capacity. Theoretically, this validates Dynamic Capability Theory, as digitalization strengthens sensing and reconfiguration capabilities under volatile conditions.

Digitalization $\rightarrow$ Sustainability ($\beta = 0.48$, $p < 0.01$): The relationship between digitalization and sustainability is

positive and moderately strong. A coefficient of 0.48 suggests that SMEs integrating digital technologies are more likely to implement environmentally and economically sustainable practices. Digital systems facilitate waste monitoring, resource optimization, and traceability, which directly influence environmental performance. Although this effect is slightly weaker than the digitalization–resilience linkage, it remains substantial and statistically significant. This result positions digital transformation as not merely operational but also environmentally strategic.

Supply Chain Resilience → Competitiveness ($\beta = 0.53, p < 0.001$): Resilience exerts a strong positive influence on competitiveness. A coefficient of 0.53 indicates that SMEs with stronger adaptive capacity achieve superior market positioning, responsiveness, and cost efficiency. This finding is particularly important because it demonstrates that resilience is not simply defensive (shock absorption) but also strategic (value creation). Firms capable of maintaining operations during disruptions can protect customer relationships and sustain market share, thereby reinforcing competitive advantage.

Sustainability → Competitiveness ($\beta = 0.36, p < 0.01$): Sustainability also significantly enhances competitiveness, though the magnitude is smaller than resilience. A coefficient of 0.36 suggests that environmentally responsible and socially conscious practices contribute positively to firm performance. This supports the growing body of literature suggesting that sustainability enhances brand reputation, stakeholder trust, and operational efficiency. In emerging markets, sustainability may also improve access to international supply chains that require compliance with environmental standards.

Digitalization → Competitiveness ($\beta = 0.21, p < 0.05$): The direct effect of digitalization on competitiveness is positive but comparatively modest. The smaller coefficient (0.21) indicates that digital transformation does not translate into competitiveness automatically; rather, its primary influence operates indirectly through resilience and sustainability.

This pattern confirms partial mediation. Digital tools strengthen internal capabilities (resilience and sustainability), which then drive competitive outcomes. The finding reinforces the study’s sequential mediation logic and aligns with Resource-Based View (RBV) assumptions that capabilities, not technologies alone, generate sustained advantage.

Table 3. Measurement Reliability and Validity

Construct	Cronbach Alpha	Composite Reliability	AVE
Digitalization	0.91	0.93	0.71
Resilience	0.88	0.90	0.69
Sustainability	0.85	0.87	0.63
Competitiveness	0.89	0.91	0.72

Table 3 replicates the reliability and validity statistics to reinforce the measurement model’s stability. The consistency of Cronbach’s Alpha, CR, and AVE values across reporting strengthens confidence in construct operationalization. The repetition is methodologically relevant because it demonstrates robustness across estimation procedures and confirms that structural path results are not artifacts of weak measurement properties.

Structural Model Results: Model Fit: CFI = 0.95; RMSEA = 0.049; Chi-square/df = 2.08

Findings confirm that SME digitalization significantly strengthens resilience and sustainability. Resilience partially mediates competitiveness outcomes, validating Dynamic Capability Theory. An RMSEA below 0.05 indicates excellent approximation of the data, suggesting minimal model misspecification. The CFI of 0.95 reflects strong comparative improvement over a null model. Together, these values confirm that the hypothesized mediation structure adequately represents empirical reality among Nigerian SMEs.

4.1 Discussion of findings

Drawing from the empirical findings, which show that digitalization significantly improves resilience ($\beta = 0.62$), sustainability ($\beta = 0.48$), and competitiveness ($\beta = 0.21$ direct effect; stronger indirect effects), the study highlights critical policy implications for strengthening Nigeria’s SME ecosystem, particularly in agribusiness and retail supply chains, thus:

Broadband infrastructure expansion: The strong positive relationship between digitalization and resilience underscores the need for reliable and affordable broadband connectivity across Nigeria. Many SMEs, particularly in semi-urban and rural agribusiness clusters, face unstable internet access, which limits their adoption of cloud-based systems, digital payment platforms, and real-time supply chain tracking tools. Government-led broadband expansion, aligned with initiatives such as the Nigerian Communications Commission and the Federal Ministry of Communications, Innovation, and Digital Economy, should prioritize the extension of fiber-optic networks to agro-production belts, reduction in broadband costs for SMEs, and public-private partnerships

for rural connectivity. Improved broadband infrastructure would directly enhance digital integration in supply chains, reduce transaction costs, and improve coordination between suppliers, distributors, and retailers, thereby strengthening resilience and sustainability outcomes.

SME Digital Grants and Tax Incentives: The findings demonstrate that digitalization has both direct and mediated effects on competitiveness. However, cost remains a major barrier to digital adoption among SMEs. Policy interventions may include digital transformation grants for SMEs adopting ERP, inventory automation, and e-commerce platforms; tax credits for investment in digital tools and cybersecurity systems; and accelerated capital allowance for digital infrastructure investments. Agencies such as the Small and Medium Enterprises Development Agency of Nigeria and the Bank of Industry could administer targeted funding programs linked to measurable digital adoption milestones. Such incentives would lower entry barriers, accelerate digital uptake, and amplify the resilience–competitiveness pathway identified in the structural model.

Capacity Building and Digital Literacy Programs: While infrastructure and funding are critical, human capital development remains central to sustainable digital transformation. The positive impact of digitalization on sustainability ($\beta = 0.48$) suggests that SMEs that understand digital tools are better positioned to optimize resource efficiency and environmental practices.

Policy measures should focus on digital literacy training for SME owners and managers, sector-specific training in agritech, retail analytics, and e-commerce logistics, public-private partnerships with universities and technology hubs, and inclusion of digital supply chain management modules in vocational programs. Collaborative programs involving the National Information Technology Development Agency and industry associations can bridge the knowledge gap and improve digital readiness across SME clusters. Capacity development ensures that digital tools are not merely adopted but strategically deployed to enhance operational resilience and long-term competitiveness.

One of the critical constraints facing SMEs, especially in agribusiness, is limited access to affordable working capital. Digitalization can unlock innovative financing mechanisms through Fintech-enabled supply chain finance solutions. Platforms integrating digital payments, invoice discounting, and blockchain-based transaction verification can: Improve transparency across supply chains, reduce information asymmetry between SMEs and lenders, enable faster credit assessment using transaction data, and strengthen financial resilience during supply disruptions.

Institutions such as the Central Bank of Nigeria can support regulatory frameworks that promote digital lending ecosystems while ensuring consumer protection and cybersecurity safeguards. Fintech-enabled supply chain

finance aligns directly with the study’s findings, as improved financial liquidity enhances SMEs’ ability to absorb shocks (resilience), invest in sustainable practices, and maintain competitive positioning.

5. CONCLUSION AND RECOMMENDATION

This study examines how digital transformation enhances supply chain resilience, sustainability performance, and competitiveness among Small and Medium Enterprises (SMEs) in Nigeria. Drawing on the Resource-Based View (RBV), Dynamic Capability Theory, and the Technology–Organization–Environment (TOE) framework, a conceptual model was developed and tested using Structural Equation Modelling (SEM) with survey data from 312 SMEs in agribusiness and retail outlets. It employed a mixed-method research design with quantitative dominance. Data from 312 Nigerian SMEs in agribusiness and retail sectors were analyzed using structural equation modelling. This methodological framework provides empirical rigor and supports the theoretical proposition that digital transformation serves as a catalyst for supply chain resilience, sustainability, and competitive advantage among SMEs in Nigeria. Digital transformation is a strategic imperative for SME survival and competitiveness in developing economies.

Overall, the study demonstrates that digital transformation is not merely a technological issue but a strategic development imperative. Policy interventions that combine infrastructure development, financial incentives, human capital strengthening, and digital finance innovation will create a reinforcing ecosystem in which Nigerian SMEs can become more resilient, sustainable, and globally competitive. In the context of Nigeria’s evolving digital economy, these policy actions are critical for transforming SMEs from vulnerable supply chain participants into adaptive and innovation-driven growth engines.

Despite existing interventions, significant gaps remain in Nigeria’s SME digital transformation ecosystem. These include limited transformation management skills, difficulty in building robust business cases for technology investments, weak post-adoption support, regional digital divides, and insufficient public-private alignment. Addressing these challenges requires strengthened public-private partnerships, expanded regional innovation hubs, continuous mentorship networks, flexible financing mechanisms, and harmonized digital industrial policies. Digital transformation of SMEs in Nigeria is not optional; it is a strategic necessity for achieving industrial resilience, environmental sustainability, and competitive advantage. By aligning corporate initiatives with government policy frameworks, Nigeria can design inclusive digital ecosystems that empower SMEs and enhance national productivity.

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