

Innovation and Sustainability of Small and Medium-Sized Enterprises in Imo State: The Moderating Effect of Information Technology Adoption

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ABSTRACT

This study examined the relationship between innovation and sustainability of Small and Medium-sized Enterprises (SMEs) in Imo State, Nigeria, with Information Technology (IT) adoption as a moderating variable. Grounded in the Resource-Based View, Dynamic Capability Theory, the study argues that innovation capabilities and IT adoption jointly strengthen firms' sustainable performance. A correlational research design was employed, and the population comprised 1,886 registered SMEs in Imo State, from which a sample of 329 SMEs was determined using the Taro Yamane formula. A stratified proportional random sampling technique was adopted to ensure adequate representation of SMEs sectors. Data were collected through a structured questionnaire, 291 valid responses depicting a response rate of 88.45% were analyzed using descriptive statistics, Pearson correlation, and multiple regression analysis with interaction terms to test the moderating effect via SPSS version 26. Validity was ascertained through expert review while reliability were measured using Cronbach's alpha and all the variables were above 0.70. Results revealed significant positive relationships between product, process, and marketing innovations and economic, social, and environmental sustainability measures of SMEs at a 5% significance level, and IT adoption strengthened this relationship across all innovation dimensions. The findings suggest that SMEs that adopt innovative practices while leveraging IT are more likely to achieve sustainable business performance. The study concludes that innovation practices enhance SME sustainability when supported by IT adoption. The study recommends that SMEs institutionalize innovation culture, invest in IT adoption, seek government support for digital transformation, and engage in capacity-building programs for sustainable practices.

Keywords: Innovation, Sustainability, Information Technology Adoption, SMEs, Sustainable Business Performance

INTRODUCTION

In an era marked by rapid technological advancement and environmental consciousness, innovation has emerged as a vital driver of sustainable competitiveness among Small and Medium-sized Enterprises (SMEs). SMEs in Nigeria, particularly in Imo State, play a crucial role in economic growth and employment generation. However, their sustainability has been increasingly threatened by rising competition, technological disruption, and environmental challenges (Olaleye et al., 2024). Innovation, encompassing product, process, and marketing dimensions, enables SMEs to adapt, differentiate, and survive in volatile markets (Ndubuisi et al., 2024). Despite growing recognition of innovation's role, the link between innovation and sustainability in Nigerian SMEs remains inadequately understood. Akinwale et al. (2021) examined innovation's effect on firm performance without sufficiently addressing its long-term sustainability implications. Moreover, the effect of IT adoption as a moderator in this relationship has received limited empirical attention in the Nigerian SME

context, despite its proven influence in enhancing business agility and innovation performance in developed economies (Hossain et al., 2023). Furthermore, many SMEs lack the technological capabilities to fully leverage their innovative practices, which limits their ability to achieve holistic sustainability outcomes (Campbell Institute, 2020). Therefore, this study was motivated by the above gaps in prior literature. In response to these gaps, this study seeks to examine the moderating effect of IT adoption on the relationship between innovation and sustainable business performance of SMEs in Imo State, Nigeria.

By addressing these issues, the study contributes to the growing body of literature on innovation-led sustainability in developing economies and provides practical insights for policy and management interventions. Moreover, the study provides empirical evidence to guide SME managers in integrating innovation and technology to achieve long-term sustainability outcomes.

Conceptual Framework

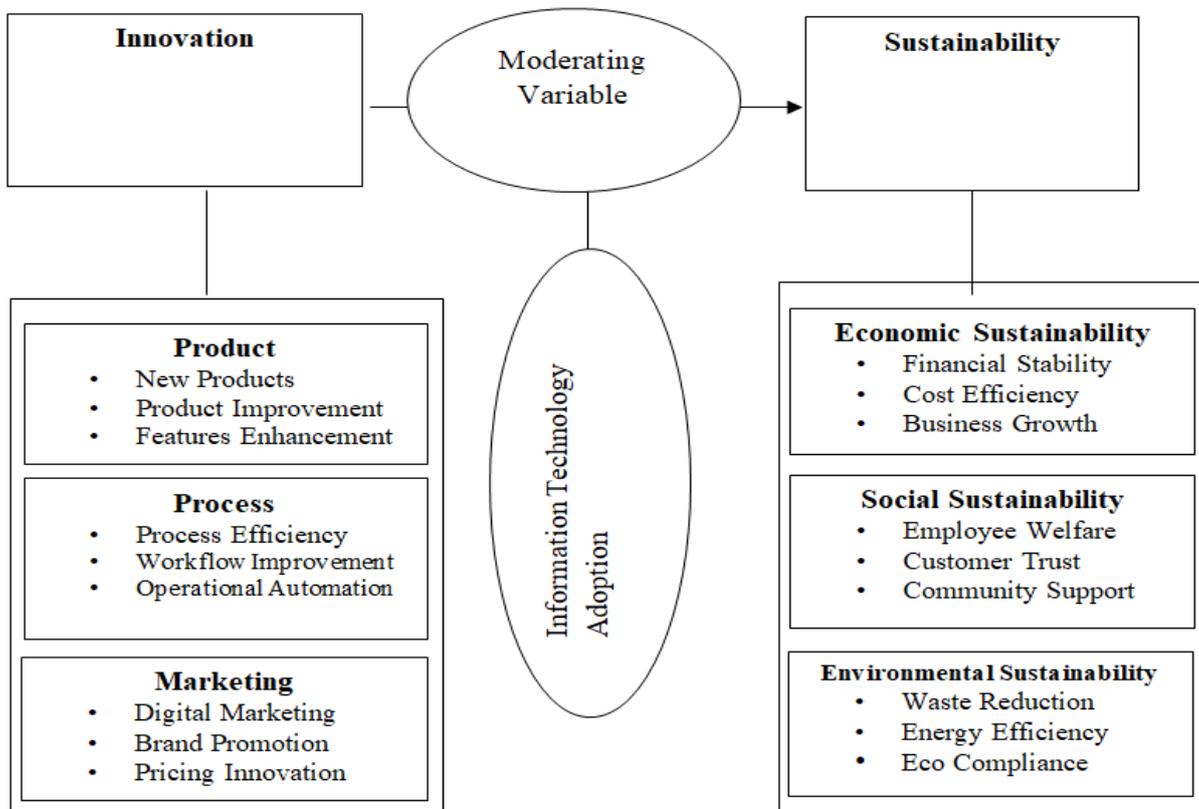


Fig 1: Conceptual Framework of Innovation and Sustainability of Small and Medium-Sized Enterprises in Imo State: The Moderating Effect of Information Technology Adoption.

Source: Innovation (OECD, 2018; Kotler & Keller, 2021); Sustainability (Elkington, 1997); and Information Technology Adoption (Hossain et al., 2023).

Research Hypothesis

H0₁: There is no significant relationship between product innovation and economic sustainability of SMEs in Imo State.

H0₂: There is no significant association between product innovation and social sustainability of SMEs in Imo State.

H0₃: There is no significant correlation between product innovation and environmental sustainability of SMEs in Imo State.

H0₄: There is no significant association between process innovation and economic sustainability of SMEs in Imo State.

H0₅: There is no significant link between process innovation and social sustainability of SMEs in Imo State.

H0₆: There is no significant relationship between process innovation and environmental sustainability of SMEs in Imo State.

H0₇: There is no significant correlation between marketing innovation and economic sustainability of SMEs in Imo State.

H0₈: There is no significant association between marketing innovation and social sustainability of SMEs in Imo State.

H0₉: There is no significant link between marketing innovation and environmental sustainability of SMEs in Imo State.

H0₁₀: Information Technology (IT) adoption significantly moderates the relationship between innovation and sustainability of SMEs in Imo State.

LITERATURE REVIEW

Theoretical Framework

This study is anchored on the Resource-Based View (RBV) and Dynamic Capability Theory.

Resource-Based View (RBV)

The RBV theory suggests that firms gain competitive advantage through valuable, rare, and inimitable resources, including innovation and IT (Barney, 1991). Innovation whether in products, processes, or marketing constitutes a strategic internal capability that enables SMEs to differentiate their offerings, optimize operations, reduce costs, and enhance customer satisfaction. According to RBV, innovation capability is an intangible asset that directly strengthens a firm's long-term sustainability outcomes. In SMEs, innovation (product, process, and marketing) and IT adoption serve as strategic resources that enhance competitiveness and sustainability. Moreover, innovation capabilities, knowledge assets, technical skills, creative routines serve as strategic resources that enhance sustainability performance. SMEs with strong product and process innovation capacities are better positioned to respond to market changes and environmental pressures. Therefore, RBV explains how innovation is a unique internal resource that drives sustainability.

Dynamic Capability Theory (DCT)

Dynamic capabilities are higher-order strategic processes that enable firms to renew competencies and remain competitive in volatile settings. This theory extends RBV by emphasizing firms' ability to integrate, build, and reconfigure resources in rapidly changing environments enhances performance, highlighting the role of IT adoption in leveraging innovation (Teece, 2007). Teece (2007) classifies dynamic capabilities into three clusters: (i) Sensing which is the ability to identify, interpret and anticipate opportunities or threats in the external environment. For SMEs in Imo State, this includes recognizing changes in customer preferences, new sustainability regulations, or emerging digital trends; (ii) Seizing which entails the capacity to mobilize resources to capture recognized opportunities, such as developing new products, adopting digital systems or implementing greener processes; (iii) Reconfiguring/Transforming, which is the ability to continuously realign and renew resources, capabilities, processes and technologies in response to market changes. Innovation is considered a dynamic capability, enabling SMEs to sense opportunities, seize them, and transform operations. IT adoption strengthens these capabilities by supporting digital workflows, knowledge sharing, and operational flexibility, ultimately enhancing sustainable performance. Thus, dynamic capabilities theory explains how innovation and IT adoption help SMEs adapt and achieve sustained performance in dynamic environments.

Innovation

Innovation is widely recognized as a central driver of competitiveness, differentiation, and long-term sustainability for small and medium-sized enterprises (SMEs). Compared to larger firms, SMEs typically operate under resource constraints, limited technological capacity, and narrower market access, making innovation an essential survival strategy rather than an optional activity. Research consistently conceptualizes innovation as a multidimensional construct encompassing product, process, and marketing innovation, with each dimension contributing distinctly to firm performance (Schumpeter, 1934; OECD, 2018; Kotler & Keller, 2021). The Oslo Manual (OECD, 2018) defines innovation as the introduction of novel or substantially improved products, production processes, marketing techniques, or organizational methods to enhance firm competitiveness. Within SMEs, innovation tends to be more incremental, flexible, and customer-driven due to entrepreneurs' close market interactions and agile decision-making structures (Saunila, 2020). He further posits that a combination of all three dimensions has a stronger impact on performance than any individual dimension alone. Also, Gonzales-Gemio et al. (2020) advanced that Innovation enhances responsible business practices and strategic sustainability in SMEs. The three predominant innovation dimensions product, process, and marketing innovation serve as frameworks for understanding how SMEs respond to market turbulence, technological change, and competitive pressures.

Product Innovation

It is the introduction of new or significantly improved goods or services in terms of features, performance, quality, or technological characteristics (OECD, 2018). It enhances competitive advantage and supports sustainability by offering environmentally friendly or socially beneficial products. This dimension is crucial for SMEs as it enables differentiation, customer attraction, and expansion into new markets. Empirical evidence demonstrates that product innovation positively influences SME performance, including profitability and sales growth (Le et al., 2023). SMEs often achieve such innovation through customer feedback, entrepreneurial vision, flexible structures, and collaborative learning with suppliers and customers. This aligns with findings that product innovation in SMEs is often incremental and market-driven due to limited Research and Development (R&D) budgets but still significantly enhances competitiveness (Saunila, 2020).

Process Innovation

This refers to improvements in production and operational processes, including automation, waste reduction, and quality enhancement. It includes technological upgrades, workflow redesign, automation, lean practices, and digital enhancements (OECD, 2018). Although less visible than product innovation, process innovation is critical for SMEs because it enhances efficiency, reduces cost, and improves output quality. Recent empirical findings show that process innovation is strongly associated with productivity improvements in developing economy (Islami & Mulolli, 2024). Their study emphasizes that even incremental process changes such as digital billing, simplified workflow procedures, and equipment upgrades can yield substantial gains in operational performance. Therefore, process innovation strengthens SMEs' internal capacity to deliver improved products more efficiently, reinforcing overall competitiveness.

Marketing Innovation

Marketing innovation involves adopting new marketing methods related to product design, positioning, promotion, pricing, or distribution (OECD, 2018). With the rapid expansion of digital technologies, marketing innovation has become a major driver of SME competitiveness. It supports sustainability by strengthening customer engagement and ensuring long-term market relevance through ethical and value-driven strategies. Dwivedi and Pawsey (2023) found that digital marketing innovation, including social media marketing, online branding, mobile advertising, and new pricing strategies, significantly enhances SMEs' market reach and customer engagement. These innovative marketing approaches allow SMEs to overcome geographical limitations, communicate value more effectively, and tap into new customer segments. Marketing innovation thus, represents a low-cost, high-impact approach for SMEs particularly beneficial in environments with limited access to capital or research and development resources.

Sustainability

Sustainability has emerged as a central theme in contemporary organizational research, driven by increasing global concern for economic resilience, social well-being, and environmental protection. In the business context, sustainability refers to the balanced pursuit of economic viability, social responsibility, and environmental stewardship (Elkington, 1997; OECD, 2020). For firms especially small and medium-sized enterprises (SMEs) sustainability practices enhance long-term competitiveness, stakeholder legitimacy, and resilience in turbulent environments (Agyekum et al., 2021). The modern view of sustainability derives from the Brundtland Report, which defines sustainable development as the ability to meet the needs of the present without compromising that of the future generations to meet their own needs (World Commission on Environment and Development, 1987). Elkington (1997) further operationalized this through the Triple Bottom Line (TBL) framework economic, social, and environmental sustainability widely adopted in management and organizational research. The TBL framework argues that organizational sustainability requires simultaneous attention to financial performance, community well-being, and ecological responsibility. These three pillars serve as a foundation for analyzing sustainability practices in firms of all sizes, including SMEs. Sustainability is paramount in any business endeavours because, it aids resource conservation, long term success and creates balance between human activities and the environment as well as resilience to economic and environmental shocks.

Economic Sustainability

This refers to a firm's ability to maintain long-term financial viability, create value, and ensure continued productivity, and profitability while efficiently using resources (OECD, 2020). For SMEs, economic sustainability involves strategies such as prudent cost management, innovation investment, financial resilience, and long-term growth planning. Scholars argue that economically sustainable firms integrate resource efficiency, ensures stable cash flow, and incorporate risk management into their operational strategies (Agyekum et al., 2021). Economic sustainability is therefore not only about short-term profitability but also about creating enduring economic value for stakeholders (Elkington, 1997). Empirical research shows that SMEs with strong economic sustainability practices often exhibit higher productivity, stronger competitiveness, and improved survival rates (Mohammed & Masa'deh, 2022). Thus, this implies that SMEs can continue operations, create employment, and generate value for stakeholders. Therefore, economic sustainability thus strengthens the firm's ability to withstand market fluctuations and enhances resilience in competitive environments.

Social Sustainability

Social sustainability encompasses practices such as fairness, human rights, employee welfare, community engagement, and ethical practices that improve the well-being of employees, communities, and society at large, (WCED, 1987; Elkington, 1997 & Udoka & Oduro, 2022). In SMEs, social sustainability is particularly relevant due to the close ties these firms have with local communities and their employees. Socially responsible practices such as employee training, workplace safety, fair compensation, and equitable treatment lead to enhanced employee commitment, lower turnover, and improved organizational reputation (Amoako & Lyon, 2020). Empirical studies emphasize that SMEs adopting social sustainability practices experience stronger stakeholder trust and improved customer loyalty, ultimately enhancing their competitive advantage (Agyekum et al., 2021).

Environmental Sustainability

Environmental sustainability focuses on reducing negative environmental impacts and promoting responsible use of natural resources. It includes waste reduction, pollution control, eco-efficiency, renewable energy usage, and compliance with environmental regulations (OECD, 2020; Onwuka & Olamide, 2020). For SMEs, environmental sustainability practices such as energy efficiency, green product design, recycling, and cleaner production contribute to reduced operational costs and improved environmental performance. Research shows that environmentally sustainable SMEs often benefit from improved market reputation, access to green markets, and regulatory compliance advantages (Amoako & Lyon, 2020). Hence, SMEs that innovate in ways

that reduce environmental impact contribute to sustainability while potentially gaining market advantages through green products or operations. Additionally, empirical findings reveal that environmental sustainability not only reduces operational risks, but also enhances long-term strategic positioning, especially in industries under strict regulatory scrutiny (Mohammed & Masa'deh, 2022). Consequently, evidence demonstrates that the integration of economic, social, and environmental sustainability yields superior competitive advantage compared to adopting a single sustainability dimension (OECD, 2020).

Moderating Effect of Information Technology (IT) Adoption on the Relationship between Innovation and Sustainability

Information Technology (IT) adoption is widely recognized as a strategic enabler that enhances the effectiveness of innovation in achieving sustainable outcomes in SMEs (Hossain et al., 2023; Yuwono et al., 2024). In practice, IT adoption can include cloud computing, enterprise resource planning (ERP) systems, customer relationship management (CRM) software, digital marketing platforms, and mobile applications. While innovation through product, process, and marketing improvements directly influences economic, social, and environmental sustainability, the degree to which these innovations translate into measurable sustainable performance often depends on the extent of IT integration. IT adoption provides SMEs with digital tools and platforms for process automation, product design optimization, data-driven decision-making, and marketing analytics, allowing innovative initiatives to be implemented more efficiently and at a larger scale. It is particularly critical in developing countries where SMEs face resource constraints and require technology to bridge capability gaps (Yuwono et al., 2024). For instance, a firm introducing an eco-friendly product (product innovation) may rely on IT enabled production monitoring systems (process innovation) and digital marketing campaigns (marketing innovation) to maximize its economic, social, and environmental impact. Conceptually, IT adoption strengthens the innovation sustainability nexus, acting as a moderator that amplifies the positive effects of innovation on sustainable business performance. Therefore, SMEs that combine high levels of innovation with effective IT adoption are more likely to achieve holistic sustainability outcomes, balancing profitability, social responsibility, and environmental stewardship (Udoka & Oduro, 2022; Mishrif & Khan, 2023).

Relationship between Innovation and Sustainability

Innovation and sustainability are closely interconnected in the operations of SMEs, as innovation provides the mechanisms through which sustainable practices are implemented and enhanced. Innovation comprising product, process, and marketing enables firms to improve efficiency, reduce costs, create new market opportunities, and respond proactively to environmental and social challenges (OECD, 2018; Kotler & Keller, 2021). Product innovation allows SMEs to design eco-friendly products or services that reduce resource consumption and waste, thereby enhancing environmental sustainability (Udoka & Oduro, 2022). Process innovation improves operational workflows, reduces energy usage, minimizes production waste, and ensures better compliance with environmental standards, contributing simultaneously to economic and environmental sustainability (Olaleye et al., 2024). Marketing innovation, on the other hand, enables SMEs to communicate sustainability-oriented products or services effectively, increasing consumer awareness and adoption while promoting social responsibility (Eze et al., 2022). The integration of innovation into business processes also drives economic sustainability by increasing efficiency, lowering costs, and improving profitability. It strengthens social sustainability by fostering ethical practices, promoting stakeholder welfare, and enhancing community engagement. Similarly, innovation enhances environmental sustainability by encouraging resource-efficient operations and sustainable supply chain practices (Onwuka & Olamide, 2020).

Empirical Review

Recent empirical studies have investigated the relationship between innovation, sustainability, and IT adoption in SMEs, highlighting both direct and moderating effects. Olaleye et al. (2024) examined Nigerian SMEs and found that innovation capability significantly enhances business sustainability, with organizational resilience acting as a partial mediator. This underscores the practical role of innovation in achieving economic, social, and environmental objectives. In the same light, Alake et al. (2024) investigated business model innovation and technological capabilities in Nigerian SMEs, concluding that innovations in products and processes,

supported by technology, significantly improve SMEs' resilience and sustainable performance. Omoyele et al. (2023) found that business model innovation is a key driver of sustainable entrepreneurship, demonstrating that SMEs introducing novel products, processes, or marketing approaches achieve higher sustainability outcomes. Mishrif and Khan (2023) explored IT adoption as a survival strategy during COVID-19, reporting that SMEs leveraging digital technologies were better able to sustain operations and implement innovative practices, highlighting the moderating effect of IT adoption in innovation and sustainability linkages. Yuwono et al. (2024) conducted a systematic review of information communication technology adoption in SMEs and reported that technology adoption facilitates innovation diffusion, process efficiency, and market responsiveness, directly enhancing sustainability performance. Moreover, Ardiansah et al. (2024) found that SMEs in Indonesia adopting ICT tools experienced enhanced operational efficiency and sustainable performance, with perceived usefulness and compatibility of technology significantly affecting adoption levels. Furthermore, Onyemaobi and Ifere (2024) examined manufacturing SMEs in Nigeria, showing that innovation practices positively influence economic, social, and environmental sustainability, accounting for approximately 45% of variance in sustainable outcomes. Similarly, Udoka and Oduro (2022) investigated SMEs across Nigeria and Ghana and confirmed that innovation positively impacts sustainability, while emphasizing the potential of IT adoption to strengthen this relationship. These studies collectively indicate that innovation (product, process, and marketing) is a critical predictor of sustainability in SMEs.

Research Gaps

Despite the growing recognition of the role of innovation and IT adoption in enhancing SME performance, several gaps remain in the Nigerian context. First, most Nigerian SME studies emphasize profitability and growth rather than holistic sustainability outcomes. Second, while IT adoption is recognized as an enabler of innovation, few studies have examined how IT adoption strengthens the link between innovation and sustainability in emerging economies. Third, few studies have simultaneously examined all three dimensions of innovation (product, process, marketing) alongside all three pillars of sustainability (economic, social, and environmental), particularly within SMEs in Imo State. Lastly, as observed from literature, there is a paucity of empirical data on context-specific evidence from South-Eastern Nigeria, particularly Imo State, despite its high SME concentration. This creates a significant knowledge gap regarding how innovation and IT adoption together influence sustainable business performance in this regional context. Addressing these gaps, this study investigates the moderating effect of IT adoption on the relationship between innovation and sustainable business performance of SMEs in Imo State, providing comprehensive insights for managers and policymakers seeking to enhance SME sustainability.

METHODOLOGY

This study adopted a correlational research design to examine the relationship between innovation and the sustainability of small and medium enterprises (SMEs) in Imo State, and to test the moderating effect of IT adoption. The population comprised 1,886 registered SMEs in Imo State, obtained from the Imo State Ministry of Commerce and Industry (2024). A sample size of 329 SMEs was determined using Taro Yamane's (1973) formula at a 5% margin of error. A stratified proportional random sampling technique was employed to ensure fair representation across the sectors (manufacturing, services, Agriculture, and trading) and the three senatorial zones (Owerri, Orlu and Okigwe) in Imo State. Out of the 329 distributed questionnaires, 291 were correctly completed and returned, yielding an effective response rate of 88.4 %. The instrument used was a structured questionnaire based on existing validated scales. Content validity was ensured through expert review by three academics specializing in innovation and SME studies. A pilot test with 30 SMEs outside the sample yielded Cronbach's alpha coefficients above 0.70 for all constructs, indicating acceptable internal consistency. The variables were measured on 3 items each while the responses were rated on a five-point Likert scale (1=Strongly Disagree to 5=Strongly Agree). The study adopted descriptive and inferential statistics in analyzing the data using SPSS (Version 26). Descriptive statistics such as mean and standard deviation) were used to summarize the responses for all variables. Pearson Product Moment Correlation Coefficient tested the relationships between innovation dimensions (product, process, marketing and the measures of sustainability (economic, social, environment). Multiple regression analysis with interaction terms

was used to test the moderating effect of IT adoption on these relationships. The tests were set at 0.05 significance level.

INTERPRETATION OF RESULTS

Table 1: Reliability Coefficients of Variables

S/No	Dimension/Measurement of Variables	Number of Items	Number of Cases	Cronbach Alpha
1	Innovation	9	291	0.867
2	Sustainability	9	291	0.852
3	IT Adoption	3	291	0.874

Source: Field Survey, 2025 and SPSS Version 26.0

From table 1, the reliability coefficients obtained were 0.867 for innovation, 0.852 for sustainability, and 0.874 for IT adoption. These values exceed the minimum acceptable threshold of 0.70, indicating good internal consistency. Therefore, the measurement scales are considered reliable and appropriate for testing the study hypotheses.

Table 2: Descriptive Statistics of Variables

Variables/Dimensions	N	Mean(M)	Standard Deviation(SD)	Interpretation (Mean)
Product Innovation	291	3.93	0.64	High
Process Innovation	291	3.79	0.67	High
Marketing Innovation	291	3.88	0.59	High
IT Adoption	291	3.92	0.65	High
Economic Sustainability	291	3.86	0.72	High
Social Sustainability	291	3.74	0.66	High
Environmental Sustainability	291	3.83	0.68	High

Source: Field Survey, 2025 and SPSS Version 26.0

Table 2 depicts the descriptive statistics of the study variables: innovation and its dimensions (product, process and marketing), the moderating variable information technology adoption and sustainability and its measures (economic, social and environmental) with their various mean values and standard deviations. The mean scores (3.74 to 3.93) indicate that innovation practices, sustainability measures, and IT adoption levels among SMEs in Imo State are generally high, implying active engagement with innovative and sustainable practices facilitated by technology. Also, standard deviation values (0.59 to 0.72) depicts low variability meaning opinions are largely consistent.

Testing of Hypotheses (Relationship Hypotheses)

Pearson product–moment correlation coefficient was employed to examine the relationships between product, process, and marketing innovation and the economic, social, and environmental dimensions of sustainability. These analyses tested hypotheses H_{01} to H_{09} at the 0.05 level of significance.

Table 3: Correlation Matrix of Product Innovation and Measures of Sustainability

Variable		Economic Sustainability	Social Sustainability	Environmental Sustainability
Product Innovation	Correlation Coefficient(r)	0.697**	0.685**	0.677**,
	P-value	0.000	0.002	0.001
	N	291	291	291

** Correlation is significant at the 0.05 level (2-tailed).

Source: Field Survey, 2025 and SPSS Version 26.0

Table 3 shows that product innovation has strong positive significant association with economic ($r = 0.697$; $p=0.000$), social ($r = 0.685$; $p=0.002$) and environmental ($r = 0.677$; $p=0.001$) sustainability respectively. Consequently, **H0₁**, **H0₂** and **H0₃** were rejected and their alternate hypotheses were accepted. This infers that significant correlation exist between innovation and sustainability of SMEs in Imo State.

Table 4: Correlation Matrix of Process Innovation and Measures of Sustainability

Variable		Economic Sustainability	Social Sustainability	Environmental Sustainability
Process Innovation	Correlation Coefficient(r)	0.742**	0.683**	0.664**,
	P-value	0.000	0.001	0.003
	N	291	291	291

** Correlation is significant at the 0.05 level (2-tailed).

Source: Field Survey, 2025 and SPSS Version 26.0

Table 4 reveals that process innovation has strong positive significant relationship with economic ($r = 0.742$; $p=0.000$); social ($r = 0.683$; $p=0.001$) and environmental ($r = 0.664$; $p=0.003$) sustainability respectively at 0.05 significant level. Thus, **H0₄**, **H0₅** and **H0₆** were rejected and their alternate hypotheses were accepted. This implies that significant association exist between innovation and sustainability of SMEs in Imo State.

Table 5: Correlation Matrix of Marketing Innovation and Measures of Sustainability

Variable		Economic Sustainability	Social Sustainability	Environmental Sustainability
Marketing Innovation	Correlation Coefficient(r)	0.803**	0.721**	0.698**,
	P-value	0.000	0.001	0.001
	N	291	291	291

** Correlation is significant at the 0.05 level (2-tailed).

Source: Field Survey, 2025 and SPSS Version 26.0

Table 5 indicates that marketing innovation has very strong positive significant association with economic ($r = 0.803$; $p=0.000$) and strong positive significant association with social ($r = 0.721$; $p=0.001$) and environmental ($r = 0.698$; $p=0.001$) sustainability respectively. Against this backdrop, **H0₇, H0₈ and H0₉** were rejected and their alternate hypotheses were accepted. This means that that there are significant link between innovation and sustainability of SMEs in Imo State.

Testing of H₀₁₀ (Moderation Hypothesis)

Multiple regression analysis with interaction terms was used to test the moderating effect of information technology adoption on the relationship between innovation and sustainability. Product, process, and marketing innovation were entered simultaneously, followed by information technology adoption and the interaction terms. This analysis tested hypothesis **H₀₁₀**.

Table 6: Moderating Effect of IT Adoption on the Relationship between Innovation and Sustainability. Hierarchical Multiple Regression Coefficients (Interaction Terms Included)

Predictor	B	SE B	β	t	P
Step 1: Direct Effects					
Product Innovation(PI)	0.312	0.062	0.305	5.03	0.000
Process Innovation(Prl)	0.291	0.058	0.287	5.02	0.000
Marketing Innovation(MI)	0.354	0.065	0.339	5.45	0.000
IT Adoption(ITA)	0.276	0.061	0.268	4.52	0.000
Step 2: Interaction Terms(Moderation)					
PI x ITA	0.118	0.045	0.107	2.62	0.010
Prl x ITA	0.103	0.041	0.095	2.51	0.013
MI x ITA	0.127	0.048	0.111	2.65	0.009
R² (Step 1)	0.62				
R² (Step 2)	0.68				
ΔR^2	0.06				
F-change	11.42				0.000

** Correlation is significant at the 0.05 level (2-tailed).

Source: Field Survey, 2025 and SPSS Version 26.0

H₀₁₀ posited that information technology (IT) adoption moderates the relationship between innovation and sustainability. A hierarchical multiple regression analysis with interaction terms was conducted, as summarized in table 6 above. The results reveal that:

Direct effects of innovation dimensions: Product ($\beta = 0.305$, $p < 0.001$), process ($\beta = 0.287$, $p < 0.001$), and marketing ($\beta = 0.339$, $p < 0.001$) innovations all positively and significantly predict sustainability, confirming their unique contributions when included simultaneously in the model. IT adoption also has a significant direct effect ($\beta = 0.268$, $p < 0.001$).

Interaction effects (moderation): The interaction terms for product innovation \times IT adoption ($\beta = 0.107$, $p = 0.010$), process innovation \times IT adoption ($\beta = 0.095$, $p = 0.013$), and marketing innovation \times IT adoption ($\beta = 0.111$, $p = 0.009$) are all significant. This indicates that IT adoption strengthens the positive effect of each innovation dimension on sustainability.

Model fit: Step 1 of the regression model (direct effects only) explained 62% of the variance in sustainability ($R^2 = 0.62$). Including the interaction terms increased the explained variance to 68% ($\Delta R^2 = 0.06$), with a significant F-change ($p < 0.000$), confirming the improvement in model fit due to moderation. These results provide strong empirical support for hypothesis H_{010} and indicate that IT adoption is a crucial enabling factor that enhances the effectiveness of innovation in achieving sustainability outcomes in SMEs. Based on the result, we reject H_{010} and accept the alternate hypothesis, which states that IT adoption significantly strengthens the relationship between innovation and sustainability.

The Moderated Multiple Regression Model (Single Integrated Model):

$$Y = \beta_0 + \beta_1 PI + \beta_2 PrI + \beta_3 MI + \beta_4 ITA + \beta_5 (PI \times ITA) + \beta_6 (PrI \times ITA) + \beta_7 (MI \times ITA) + \varepsilon$$

Y = Sustainability Dimension (Economic / Social / Environmental)

PI = Product Innovation

PrI = Process Innovation

MI = Marketing Innovation

ITA = Information Technology Adoption

PI \times ITA, PrI \times ITA, MI \times ITA = Interaction (Moderation) Terms

ε = Error Term

β_0 = Intercept

$\beta_1 - \beta_3$ \rightarrow Unique Direct Effects of Innovation Dimensions

β_4 \rightarrow Direct Effect of IT Adoption

$\beta_5 - \beta_7$ \rightarrow Moderating Effects of IT Adoption

DISCUSSION OF FINDINGS

The findings of the study reveal consistently strong and statistically significant correlations across economic, social, and environmental sustainability dimensions. Product innovation demonstrated strong positive correlations with economic ($r = 0.697$, $p = 0.000 < .05$), social ($r = 0.685$, $p = 0.002 < .05$), and environmental sustainability ($r = 0.677$, $p = 0.001 < .05$). This indicates that SMEs that introduce new products or significantly improve existing ones tend to perform better across multiple sustainability indicators. This finding aligns with Al-Ansari et al. (2021), which revealed that product innovation significantly enhances sustainability outcomes. Similarly, Danso et al. (2020) confirmed that product innovation fosters environmental and social sustainability by promoting resource-efficient offerings. Similarly, process innovation also showed strong positive relationships with economic ($r = 0.742$, $p = 0.000 < .05$), social ($r = 0.683$, $p = 0.001 < .05$), and environmental sustainability ($r = 0.664$, $p = 0.003 < .05$). This suggests that SMEs' adoption of improved production methods, digital workflows, and efficient operation techniques significantly boosts their overall sustainability. This outcome corresponds with Salisu and Bakar (2020), who observed that process innovation improves operational efficiency and directly strengthens both financial and non-financial sustainability of SMEs. Likewise, Oduro (2021) found that innovations in production processes reduce waste and improve environmental performance among SMEs.

Furthermore, marketing innovation recorded the strongest correlations with all sustainability measures: economic ($r = 0.803$, $p = 0.000 < .05$), social ($r = 0.721$, $p = 0.001 < .05$), and environmental sustainability ($r = 0.698$, $p = 0.001 < .05$). This demonstrates that adopting new marketing strategies such as digital promotion, branding, and revised pricing models has the most substantial influence on SME sustainability. This finding is consistent with Al Barwari et al. (2025), whose study confirmed that marketing innovation improves economic and social resilience in SMEs. Similarly, Nguyen and Luu (2021) found that digital marketing innovation fosters environmental responsibility through efficient communication and reduced material usage. Hierarchical multiple regression with interaction terms revealed that IT adoption significantly moderates the effect of innovation on sustainability: Product \times IT adoption: $\beta = 0.107$, $p = 0.010$; Process \times IT adoption: $\beta = 0.095$, $p = 0.013$; and Marketing \times IT adoption: $\beta = 0.111$, $p = 0.009$. The model explained 62% of the variance in sustainability with direct effects (Step 1) and increased to 68% after including interaction terms ($\Delta R^2 = 0.06$, $p < 0.001$), confirming that IT adoption strengthens the impact of innovation. High IT adoption strengthens the impact of product, process, and marketing innovation on economic, social, and environmental sustainability, highlighting its role as a strategic enabler in the digital era. This finding addresses a key gap in the literature: while prior studies have examined innovation and sustainability, few have investigated the enabling role of IT adoption, especially in the context of SMEs in South-Eastern Nigeria (Anusi & Dlamini, 2025). The study shows that IT adoption not only facilitates operational efficiency but also maximizes the sustainability benefits of innovation.

Lastly, findings provide empirical support for both the Resource-Based View (RBV) and the Dynamic Capabilities Theory (DCT) in explaining how innovation drives the sustainability of SMEs in Imo State, with IT adoption strengthening these relationships. In line with RBV, the study confirms that innovation equips firms with strategic resources that enhance profitability, strengthen stakeholder relationships, and improve environmental compliance, as well serve as internal strengths that determine long-term firm sustainability. The findings also closely align with the assumptions of the Dynamic Capabilities Theory (DCT), which argues that in rapidly changing environments, firms must continually reconfigure their resources and processes to remain competitive. Therefore, the significant effect of IT adoption as a moderating variable supports the idea that digital tools enhance SMEs' ability to sense market opportunities, seize innovation potential, and reconfigure operations for sustainable outcomes (Hossain et.al. 2023). Collectively, RBV explains why innovation drives sustainability, while DCT explains how IT adoption enhances SMEs' ability to deploy and reconfigure innovative resources effectively. Together, the theories provide a comprehensive understanding of the mechanisms through which innovation and digital capability support sustainable SME development in Imo State. Practically, the results underscore the importance of adopting a holistic innovation strategy that integrates product, process, and marketing innovation, supported by effective IT infrastructure. Thus, policymakers and development agencies should promote digital capacity building and innovation-friendly policies to enhance SME sustainability.

CONCLUSION

This study examined the relationship between innovation and sustainability of SMEs in Imo State, Nigeria, with emphasis on the moderating effect of information technology adoption. Based on responses from 291 SMEs, the findings provide strong empirical evidence that product, process, and marketing innovations are significantly associated with economic, social, and environmental sustainability outcomes of SMEs. These results affirm that innovation remains a critical driver of sustainable business performance in developing economies. More importantly, the study establishes that information technology adoption significantly moderates the innovation–sustainability relationship. SMEs that effectively adopt and utilise digital technologies are better positioned to translate innovative efforts into sustainable outcomes. This suggests that innovation yields stronger sustainability benefits when supported by appropriate technological capabilities. Anchored on the Resource-Based View (RBV) and Dynamic Capability Theory (DCT), the study concludes that SMEs must integrate innovation strategies with digital resources to enhance adaptability, competitiveness, and long-term sustainability. Overall, the study contributes to the SME sustainability literature by providing context-specific evidence from Imo State and by demonstrating the interactive role of IT adoption in strengthening innovation-driven sustainability outcomes.

RECOMMENDATIONS

The under listed recommendations were put forward for adoption by SMEs owners and their managers:

1. Adopt relevant IT solutions by integrating appropriate IT tools and systems to complement their innovation practices, thereby enhancing efficiency and decision-making.
2. Develop innovation-focused strategies by deliberately plan and implement product, process, and marketing innovations to improve sustainable business performance.
3. Promote employee training and information technology literacy on the effective use of IT resources alongside innovation initiatives, ensuring maximum impact on sustainability outcomes.
4. Monitor and evaluate sustainability outcomes by regularly assessing economic, social, and environmental performance aimed at identifying areas for improvement and aligning innovation and IT adoption with long-term sustainability goals.
5. Future research should extend this study by adopting longitudinal designs or sector-specific analyses and region-based context (not single-state context) to further explore how innovation and technology adoption jointly influence sustainability outcomes over time.

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