

Technological Infrastructure and Economic Sustainability of Small and Medium Enterprises in Ebonyi State

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Abstract

The study examined Technological Infrastructure and economic sustainability of Small and Medium Enterprises in Ebonyi State. The specific objectives are to: Examine the relationship between internet connectivity and Operational efficiency; and evaluate the relationship between telecommunications networks and customer retention of small and Medium Enterprises in Ebonyi State. The study used the descriptive survey design approach. The primary source of data was the administration of questionnaire. A total population of 1994 owners and managers of Small and medium enterprises were used. The adequate sample size of 333, using Freund and William's statistic formula at 5 percent margin of error was used. 267 staff returned the questionnaire and accurately filled. Data was presented and analyzed and the hypotheses were tested using Z - test. The findings indicated i. internet connectivity had a significant positive relationship with the operational efficiency of Small and Medium Enterprises (SMEs) in Ebonyi State, $Z = 10.542$, $p < .05$ and Telecommunications networks had a significant positive relationship with customer retention of SMEs in Ebonyi State, $Z = 10.848$, $p < .05$. The study concluded that technological infrastructure plays a significant role in promoting the economic sustainability of Small and Medium Enterprises (SMEs) in Ebonyi State. The study recommended among others that SME owners and managers should invest in reliable and high-speed internet services and adopt suitable internet-enabled business tools to improve communication, online transactions, information access, and overall operational efficiency.

Keywords: Economic sustainability, internet connectivity, Operational efficiency, Technological Infrastructure.

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Introduction

Technological infrastructure has become a fundamental driver of economic development and business sustainability in contemporary economies. In developing countries such as Nigeria, technological infrastructure plays a crucial role in enhancing the productivity and sustainability of Small and Medium Enterprises (SMEs), which are widely recognized as the backbone of economic growth. SMEs contribute significantly to employment generation, poverty reduction, and economic diversification (Aremu & Adeyemi, 2021).

Economic sustainability refers to the ability of enterprises to maintain steady growth, profitability, and operational efficiency over time while adapting to changing environmental conditions. For SMEs, achieving economic sustainability requires access to essential resources, including reliable technological infrastructure such as internet connectivity, telecommunications networks, stable electricity, and digital tools. These technologies facilitate efficient communication, enhance market access, and improve service delivery. According to Oyelaran-Oyeyinka and Lal (2026), the adoption of ICT significantly improves productivity and innovation among SMEs in developing economies. Similarly, the World Bank (2020) emphasized that digital technologies reduce transaction costs, enhance efficiency, and enable firms to participate in broader markets.

In Nigeria, efforts to improve technological infrastructure have been supported by regulatory and developmental bodies such as the Nigerian Communications Commission and the National Information Technology Development Agency. These institutions have contributed to the expansion of telecommunications services and digital inclusion across the country. Despite these efforts, significant infrastructural challenges persist, particularly in less developed states such as Ebonyi State. The state is characterized by limited internet penetration, unstable electricity supply, and low digital literacy among SME operators, all of which constrain the effective use of technology in business operations.

Therefore, the study seeks to investigate the relationship between technological infrastructure and the economic sustainability of SMEs in Ebonyi State. By examining the role of internet connectivity, telecommunications networks, and ICT adoption in enhancing business performance, the study aims to provide valuable insights for policymakers, business owners, and development agencies.

Statement of the Problem

Ideally, Small and Medium Enterprises (SMEs) are expected to operate in an environment supported by reliable and efficient technological infrastructure, including stable internet connectivity, functional telecommunications networks, and consistent electricity supply. Such an enabling environment allows SMEs to adopt digital technologies, improve operational efficiency, enhance customer engagement, and achieve long-term economic sustainability. In a digitally driven global economy, SMEs should be able to leverage technological tools such as e-commerce platforms, mobile applications, and online communication systems to expand their market reach, reduce operational costs, and remain competitive. Furthermore, government agencies such as the Nigerian Communications Commission and the National Information Technology Development Agency are expected to ensure widespread access to affordable and reliable technological infrastructure across all regions, including rural and less developed states.

However, the reality in Ebonyi State reveals a significant gap between this ideal and actual practice. Many SMEs in the state operate under conditions characterized by poor internet connectivity, inadequate telecommunications networks, erratic power supply, and limited access to modern ICT tools. These infrastructural deficiencies hinder the ability of business owners to effectively integrate technology into their operations. As a result, many SMEs continue to rely on traditional and less efficient methods of conducting business, which limits their productivity,

innovation capacity, and overall performance. Additionally, low levels of digital literacy among some SME operators further compound the problem, reducing their ability to fully utilize available technological resources.

If these challenges are not addressed, the consequences could be severe for both SMEs and the broader economy. SMEs in Ebonyi State may continue to experience low productivity, high operational costs, and limited market access, ultimately affecting their profitability and long-term survival. The inability to adopt modern technologies may also result in reduced competitiveness, especially in comparison to businesses in more technologically advanced regions. Over time, this could lead to increased business failures, job losses, and a slowdown in local economic development. Furthermore, the persistence of these problems may widen the digital divide between urban and rural areas, undermining national efforts toward inclusive economic growth and digital transformation in Nigeria.

Objectives of the Study

The main objective of the study was to examine Technological Infrastructure and economic sustainability of Small and Medium Enterprises in Ebonyi State.

The specific objectives are to:

- i. Examine the relationship between internet connectivity and Operational efficiency of small and Medium Enterprises in Ebonyi State.
- ii. Evaluate the relationship between telecommunications networks and customer retention of small and Medium Enterprises in Ebonyi State.

Research Questions

The following research questions guide the study:

- i. What is the relationship between internet connectivity and Operational efficiency of small and Medium Enterprises in Ebonyi State?
- ii. What is the relationship between telecommunications networks and customer retention of small and Medium Enterprises in Ebonyi State?

Statement of Research Hypothesis

The following hypotheses guide the study:

- i. Internet connectivity has no relationship with Operational efficiency of small and Medium Enterprises in Ebonyi State.
- ii. Telecommunications networks has no relationship with customer retention of small and Medium Enterprises in Ebonyi State.

Review of Related Literature

Conceptual Review

Technological

Technology in the context of Small and Medium Enterprises (SMEs) refers to the use of modern tools, systems, and digital innovations to enhance business operations, improve efficiency, and support decision-making processes. It includes information and communication technology (ICT), internet connectivity, software applications, and telecommunications systems that facilitate production, communication, and service delivery. Recent studies show that technology adoption enables SMEs to improve productivity, enhance customer relationship management, and gain competitive advantage in the global market (Ndum, 2024; Onileowo & Fasiku, 2021). Furthermore, technological capability is increasingly recognized as a key driver of innovation and operational efficiency, particularly in developing economies where SMEs dominate business activities (Yuwono et al., 2024).

In addition, technology in SMEs encompasses digital platforms such as e-commerce, mobile applications, cloud computing, and social media tools that allow businesses to expand market reach and improve customer engagement. Empirical evidence indicates that SMEs that adopt digital technologies experience significant improvements in performance, efficiency, and customer satisfaction (Nwanmuoh et al., 2024; Sheikh Khairuddin & Olowosuyi, 2020). However, the effective utilization of these technologies depends on access to adequate infrastructure, financial resources, and digital skills. As a result, technology remains a critical factor in achieving growth, competitiveness, and long-term sustainability among SMEs in developing countries like Nigeria.

Infrastructure

Infrastructure in Small and Medium Enterprises (SMEs) refers to the essential systems, resources, and facilities that support business operations, growth, and competitiveness. It encompasses physical infrastructure such as offices, factories, machinery, and utilities; technological infrastructure including computers, software, and internet connectivity; organizational systems that guide workflows and human resource management; financial infrastructure like access to banking, credit, and accounting systems; and communication channels for internal coordination and customer engagement. Robust infrastructure provides SMEs with the foundation to operate efficiently, manage resources, and deliver products or services reliably (Yuwono, Suroso & Novandari, 2024; Orji & Abijiia, 2024).

Physical and technological infrastructure are particularly critical for SMEs. Reliable utilities and equipment directly affect production capacity, while information and communication technology (ICT) systems enable process automation, market engagement, and timely decision-making. SMEs with strong digital infrastructure are better positioned to scale, access new markets, and respond to changing business conditions, whereas those with inadequate infrastructure often face operational delays, higher costs, and limited growth potential (Yuwono et al., 2024).

Technological Infrastructure

Technological infrastructure in Small and Medium Enterprises (SMEs) refers to the collection of digital tools, systems, and platforms that support business operations, communication, and decision-making. It includes hardware such as computers, servers, networking devices, and mobile devices; software like enterprise resource planning (ERP), customer relationship management (CRM), and accounting systems; as well as internet connectivity, cloud computing, and cybersecurity solutions. This infrastructure enables SMEs to automate processes, store and

analyze data, and efficiently coordinate tasks across departments, forming a critical backbone for operational efficiency and competitiveness (Yuwono, Suroso & Novandari, 2024; Kumalasari & Al-Amin, 2025).

Technological infrastructure significantly enhances productivity and agility within SMEs. With reliable ICT systems, businesses can streamline workflows, improve communication, and facilitate remote collaboration, allowing employees to work effectively regardless of location. Advanced tools such as data analytics, cloud platforms, and digital marketing software help SMEs make informed strategic decisions, optimize resource allocation, and reach broader markets. Conversely, inadequate technological infrastructure can limit operational efficiency, hinder growth, and increase vulnerability to cybersecurity threats (Orji & Abijia, 2024).

Beyond operational efficiency, technological infrastructure also drives innovation and competitiveness in SMEs. Access to digital platforms and modern tools empowers enterprises to develop new products, improve customer service, and respond quickly to market changes. It also enables better integration with suppliers, partners, and customers, fostering stronger networks and business resilience. In today's digital economy, technological infrastructure is therefore not just a support system but a strategic asset that underpins the sustainability, scalability, and long-term success of SMEs (Yuwono et al., 2024; Kumalasari & Al-Amin, 2025).

Components of Technological Infrastructure

Components of Technological Infrastructure in SMEs: Hardware, Software Systems, Networking and Connectivity, Data Management and Storage, Cybersecurity Infrastructure, Digital Communication Tools, Business Intelligence and Analytics Tools, according to the following authors (Orji & Abijia, 2024; Yuwono et al., 2024; Kumalasari & Al-Amin, 2025).

Components of Technological Infrastructure that formed part of the objectives

Internet connectivity

Internet Connectivity in Small and Medium Enterprises (SMEs) refers to the ability of these businesses to access and use the internet through reliable network connections such as broadband, mobile data, or fibre to support their operations, communication, and digital activities. It is a core element of technological infrastructure that enables SMEs to connect with customers, suppliers, digital platforms, and global markets. Internet connectivity allows businesses to carry out online transactions, use cloud services, engage in e-commerce, access real-time information, and communicate efficiently both internally and externally (OECD, 2024).

In the context of SMEs, effective internet connectivity goes beyond mere access; it includes the quality and speed of online connections, which influence how well a business can perform digital tasks such as online marketing, remote collaboration, data management, and customer engagement. Research indicates that increased internet use significantly enhances SME sustainability and market reach by facilitating digital communication, improving operational efficiency, and enabling participation in the digital economy (Saragih et al., 2025).

Telecommunications networks

Telecommunications networks in SMEs refer to the systems and infrastructure that enable voice, data, and video communication both within the organization and with external stakeholders. These networks include landline telephony, mobile networks, Voice over Internet Protocol (VoIP), and internet-based communication platforms that allow businesses to maintain connectivity with customers, suppliers, and partners. They are an essential part of technological infrastructure, supporting daily operations, remote collaboration, customer service, and access to digital business services (Yuwono, Suroso & Novandari, 2024).

Effective telecommunications networks enhance SME efficiency by facilitating fast, reliable, and cost-effective communication. They enable real-time decision-making, coordination across departments, and engagement in e-commerce and digital marketing. For SMEs, robust telecommunication systems also support cloud-based tools, video conferencing, and collaboration platforms, which are critical for remote work and operational flexibility (Saragih et al., 2025). Moreover, the quality and reliability of these networks directly impact customer satisfaction, supply chain management, and the ability to scale operations in the digital economy (OECD, 2024).

However, SMEs often face challenges such as limited network coverage, high connectivity costs, and cybersecurity risks, which can hinder communication efficiency and business growth. Strengthening telecommunications networks is therefore a strategic priority for SMEs aiming to improve operational performance, expand market reach, and integrate digital solutions into their core business processes. In the modern business environment, telecommunications networks are not just support systems—they are critical enablers of competitiveness and innovation.

Economic

Economics in the context of Small and Medium Enterprises (SMEs) refers to the study and application of how these businesses manage scarce resources to produce goods or services, generate revenue, and achieve sustainable growth. It encompasses decision-making processes related to investment, production, pricing, cost management, and market engagement. For SMEs, understanding economic principles is essential because it enables owners and managers to optimize resource allocation, minimize costs, maximize profits, and respond effectively to market changes (Beck & Demirgüç-Kunt, 2020).

Economic considerations in SMEs include factors such as demand and supply analysis, cost structures, pricing strategies, capital investment decisions, and financial sustainability. SMEs operate in dynamic and often resource-constrained environments, where efficient economic management directly influences survival, competitiveness, and long-term growth. Sound economic practices allow SMEs to make informed decisions about product development, expansion, hiring, and technology adoption while balancing risks and opportunities (OECD, 2021).

Moreover, SMEs' economic performance is influenced by external macroeconomic factors such as interest rates, inflation, taxation, market trends, and government policies. An understanding of economics helps SME managers anticipate challenges, leverage market opportunities, and contribute to broader economic development, including employment generation, innovation, and regional growth. In essence, economics in SMEs provides a framework for rational decision-making, resource optimization, and sustainable business development.

Sustainability

Sustainability in Small and Medium Enterprises (SMEs) refers to the ability of a business to operate in a manner that meets present needs while ensuring the long-term viability of the enterprise, society, and the environment. It involves integrating economic, social, and environmental considerations into decision-making, resource management, and business strategy. For SMEs, sustainability is not only about reducing environmental impact but also about ensuring financial stability, resilience to market fluctuations, and responsible engagement with employees, customers, and communities (Lozano et al., 2022).

Economic sustainability in SMEs focuses on efficient resource utilization, cost management, profitability, and long-term growth. Social sustainability emphasizes fair labor practices, employee well-being, customer satisfaction, and contributions to local communities. Environmental sustainability includes minimizing waste, reducing carbon footprint, adopting renewable energy, and ensuring eco-friendly production processes. Research indicates that

SMEs adopting sustainable practices tend to enjoy improved brand reputation, enhanced operational efficiency, and better access to financing, as investors increasingly prioritize environmentally and socially responsible enterprises (Adebayo & Oladele, 2023).

Economic sustainability

Economic sustainability in SMEs refers to the ability of a business to maintain financial health and operational viability over the long term while efficiently using resources and generating consistent profits. It focuses on strategies that ensure the business can survive economic fluctuations, grow steadily, and remain competitive without overextending its financial or operational capacity. For SMEs, economic sustainability involves prudent cost management, effective resource allocation, investment in innovation, and careful planning of production, marketing, and expansion activities (Beck & Demirgüç-Kunt, 2020).

Achieving economic sustainability also requires SMEs to balance short-term performance with long-term growth objectives. This includes managing cash flow, diversifying revenue streams, adopting digital technologies for efficiency, and responding proactively to market trends. Research shows that SMEs with strong economic sustainability practices are better positioned to withstand shocks such as economic downturns, supply chain disruptions, or changes in consumer demand, thereby ensuring continuity and growth (OECD, 2021; Yuwono, Suroso & Novandari, 2024).

Components of Economic sustainability

Components of Economic Sustainability in SMEs includes: Financial Stability, Cost Management, Revenue Diversification, Investment in Innovation, Strategic Planning, Risk Management, Access to Capital and Sustainable Growth according to the following authors (Beck & Demirgüç-Kunt, 2020; OECD, 2021, Yuwono, Suroso & Novandari, 2024).

Components of Economic sustainability that formed part of the objectives

Operational efficiency

Operational efficiency in Small and Medium Enterprises (SMEs) refers to the ability of a business to maximize outputs while minimizing inputs, including time, costs, and resources. It reflects how effectively an SME uses its resources such as labor, materials, technology, and capital to deliver products or services at optimal quality and speed. High operational efficiency allows SMEs to reduce waste, lower costs, improve productivity, and enhance competitiveness in dynamic market environments (OECD, 2021; Yuwono, Suroso & Novandari, 2024).

Achieving operational efficiency involves streamlining business processes, adopting technology and automation, optimizing supply chain management, and ensuring effective workforce utilization. For SMEs, operational efficiency is closely linked to profitability and sustainability, as efficient operations enable them to deliver value to customers while maintaining manageable costs. Research shows that SMEs with higher operational efficiency are better positioned to respond to market changes, scale operations, and leverage technological innovations (Beck & Demirgüç-Kunt, 2020). Operational efficiency is not limited to cost reduction but also encompasses quality improvement, customer satisfaction, and timely delivery of services or products. It requires continuous monitoring, performance evaluation, and process improvement to maintain competitiveness. For SMEs, cultivating operational efficiency is critical for long-term growth, resilience against market fluctuations, and sustainable business development (OECD, 2021).

Medium Enterprises

Medium enterprises are a category of businesses within the broader SME framework, characterized by their size, workforce, and turnover. While the exact definitions can vary by country, medium enterprises generally have more employees, higher revenue, and larger operational capacity than small enterprises, but are smaller than large corporations. Typically, medium enterprises employ between **50 and 250 employees** and have annual revenues ranging from **\$1 million to \$50 million**, depending on regional standards (OECD, 2021).

Medium enterprises play a critical role in national economies. They bridge the gap between small startups and large corporations, contributing significantly to employment, innovation, and industrial growth. Compared to small enterprises, medium enterprises often have more structured management systems, better access to financing, and greater capacity to adopt advanced technologies, enabling higher operational efficiency and market competitiveness (Beck & Demirgüç-Kunt, 2020).

These enterprises often face challenges similar to small businesses, such as market competition, regulatory compliance, and resource limitations, but on a larger scale. Their size allows them to pursue strategic investments, scale operations, and implement sustainable business practices more effectively. Overall, medium enterprises are vital drivers of economic development, providing employment opportunities, fostering innovation, and contributing to the stability and growth of supply chains and local economies (OECD, 2021).

Theoretical Framework

The following theories guide the study **Technological Infrastructure and Economic Sustainability**.

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by **Fred D. Davis (1989)**, explains how users come to accept and use technology. TAM posits that perceived usefulness and perceived ease of use determine an individual's or organization's adoption of technological tools. In the context of SMEs, this theory helps explain how technological infrastructure such as ICT systems, internet connectivity, and digital platforms is adopted and integrated into business operations. By adopting technology effectively, SMEs can optimize processes, reduce operational costs, improve decision-making, and ultimately enhance economic sustainability.

TAM is particularly relevant to SMEs in Ebonyi State because many businesses face challenges in technology adoption due to limited skills, resources, or awareness. Understanding the factors that influence technological acceptance helps policymakers and managers design interventions, training programs, and infrastructure investments that improve adoption rates, leading to enhanced efficiency, productivity, and long-term economic sustainability.

Resource-Based View (RBV)

The Resource-Based View (RBV), proposed by **Jay Barney (1991)**, posits that a firm's competitive advantage and performance are determined by its internal resources and capabilities, especially those that are valuable, rare, inimitable, and non-substitutable (VRIN). For SMEs, technological infrastructure such as enterprise software, data analytics systems, communication networks, and digital tools constitutes a key strategic resource. When properly deployed, these resources enable SMEs to reduce costs, improve productivity, innovate, and achieve economic sustainability.

Applying RBV to SMEs in Ebonyi State emphasizes that merely having technological infrastructure is not enough; the ability to effectively leverage these resources determines the firm's long-term economic success. This framework also helps to explain variations in economic sustainability among SMEs with similar external environments but differing internal capabilities in managing and using technology.

Empirical Review

Internet connectivity and Operational efficiency

Waribugo & Ndukauba (2021) investigated Information Technology Adoption and Operational Performance of Small and Medium Enterprises in Rivers State, Nigeria. This study investigated information technology adoption (IT adoption) and operational performance of Small and Medium Enterprises in Rivers State, Nigeria. Data was collected from 103 SMEs owners and managers. Three hypotheses were tested with the Partial Least Squares-Structural Equation Modeling (PLS-SEM), with the aid of SmartPLS 3.2.6, while ordinal regression was used to determine the combined effect of the exogenous variables on the endogenous variable. Results indicated that Information Technology Adoption promotes Operational Performance, wherein information technology infrastructure and technology alignment moderately amplify operational performance, while individual learning had a weak effect.

Ibrahim et al (2024) conducted study on Online Technology and Business Performance of SMEs in Osun State. Businesses are shifting from conventional methods of purchasing and selling to adopting online technology platforms due to advancements that enhance business performance. Despite the significant advantages of Internet technology in business, trade, industry, and commerce, many small and medium-sized business owners in Nigeria have yet to fully embrace the Internet's limitless benefits in their operations. This research, therefore, investigates the influence of online payment integration on SMEs' performance and examines the role of social media in enhancing the business performance of SMEs in the Osogbo Metropolis. Questionnaires were distributed to SMEs in Osogbo, with a sample size of 250. The descriptive statistical method employed included a frequency distribution table and simple percentages, while the stated hypothesis was tested using multiple linear regression. The findings indicate that the adoption of online technology has effectively improved SMEs' operations and performance, enhanced their methods of operation, and enabled them to expand across markets. Social media and online payment integration continue to play a crucial role in the performance of many SMEs' online technology strategies. Additional data analysis reveals that business performance increases by 0.394 and 0.295 for every unit increase in social media and online payment integration, respectively.

Onwe (2024) Assessing the Operational Difficulties and Coping Strategies of Journalists in Ebonyi State in the Age of Internet Revolution. This study investigated the self-perception and coping strategies among journalists who lack internet literacy in Ebonyi State. The major objective of the study was to determine how journalists that lack requisite knowledge of internet cope with their job of filing in their reports to their organizations. Situated within the framework of the Technological Determinism Theory, the research was designed as a survey on ninety-four (94) out of the Two Hundred and Sixty-Two registered journalists in the state who indicated lack of full Internet literacy. A structured questionnaire was employed as the data collection tool. Findings show that the journalists in Ebonyi State who lack internet literacy experience operational difficulties in gathering, writing, editing and filing their reports. It was equally discovered that the majority of these journalists adopt certain survival strategies to circumvent these difficulties and these include dependence on internet literate colleagues; employment of services of cybercafé operators and handing over of their hardcopy reports to the office for completion. The research further found that the journalists perceive their lack of internet literacy as some form of deficiency particularly with reference to speed of operation, finesse and professional growth. However, majority of the respondents are not taking the necessary steps to solve their internet deficiency.

Musa et al (2025) in their study Analyzing the Economic Effects of Digital Infrastructure and Internet Accessibility on Nigeria's Sustainable Development. Digital infrastructure and Internet access have emerged as critical enablers of economic growth and sustainable development, particularly in underserved and rural regions. This study investigates the economic impact of digital technologies in Ebonyi State, Nigeria, highlighting their role in promoting inclusive development and addressing persistent socio-economic challenges. Employing a mixed-methods research design, the paper combines quantitative data from government agencies and telecommunications providers with qualitative insights from interviews conducted with community leaders, business owners, and policy stakeholders. The analysis reveals that enhanced Internet connectivity significantly contributes to increased productivity, improved access to education, healthcare, financial services, and broader economic participation, particularly for marginalized populations. Despite these benefits, the study identifies substantial barriers that hinder the optimal utilization of digital infrastructure. These include inadequate broadband coverage, unreliable power supply, high service costs, and limited digital skills among the populace.

Ezenyimulu et al (2025) conducted a study on Digital Transformation and Strategic Positioning of Beverage Firms in South-East, Nigeria. The Beverage industry is confronted with disruptive effects of rapid technological advancement and dynamic market conditions, understanding the factors that improve strategic positioning becomes imperative. This study examines the effect of digital transformation on strategic positioning of beverage firms in South-East, Nigeria. The specific objectives were to determine the effect of data analytics, leadership commitment and ecosystem partnerships on the selling proposition of beverage firms in South-East, Nigeria. This study adopts a descriptive research design. A sample size of 385 respondents was selected from a population of 10,384 employees of five selected beverage firms in Southeast Nigeria. Primary data were collected using structured questionnaire. The research questions were analyzed using frequency distribution while the hypotheses were tested using linear regression analysis. The result revealed that: data analytics has a positive and significant effect on selling proposition of beverage firms in South-East Nigeria ($\beta = 0.436$, $p = 0.000$); leadership commitment has a positive and significant effect on selling proposition of beverage firms in South-East Nigeria ($\beta = 0.442$, $p = 0.000$); ecosystem partnership has a positive but statistically insignificant effect on selling proposition of brewery firms in Southeast Nigeria ($\beta = 0.025$, $p = 0.534$). The study concluded that, internal capabilities particularly data analytics and leadership commitment significantly shape the selling proposition of beverage firms in South-East Nigeria, while ecosystem partnerships currently exert minimal influence.

Telecommunications networks and customer retention

Kunle et al (2020) carried out a study an investigation of brand equity dimensions and customer retention: A perspective of postpaid telecom subscribers in Lagos State, Nigeria. This study investigates brand equity dimensions and customer retention of the Nigerian telecommunications industry. Cross-sectional research design was adopted to survey 368 postpaid subscribers. The respondents were selected through multistage sampling techniques. The four dimensions of brand equity (brand awareness, brand association, perceived quality, and brand loyalty) were found to be correlated with one another and with overall brand equity. Similarly, the four dimensions were correlated to and significantly predicted customer retention. The study concluded that improvement of all the four dimensions of brand equity is indispensably vital to customer retention in the mobile telecom industry.

Etim et al (2021) investigated the Effect of Relationship Marketing on Customer Retention in the Telecommunications Industry. This study centered on the effect of relationship marketing on customer retention in the telecommunications industry. It was conducted to assess the effects of customer care, communication, trust-building and service quality on customer retention in the telecommunications context. The study adopted survey research design. A structured questionnaire was used to obtain primary data from 198 customers of MTN Nigeria Plc and Globacom Nigeria Plc in Calabar. The data were analyzed and interpreted using descriptive statistics, while

the hypotheses developed for the study were tested using multiple linear regression. Consequently, the findings of the study revealed that customer care, communication, trust building and service quality had significant positive effects on customer retention of telecommunication firms in Calabar.

Adejuwon & Lawal (2022) conducted study on Social Media Marketing and Customer Retention of Selected Small and Medium Enterprises (SMEs) In South-West Nigeria. The study adopted descriptive survey research design. The population used in this study comprises of the SMEs in Lagos, Oyo and Osun States as these states have the largest concentration of SMEs in Southwest, Nigeria. The sample size of 489 was determined using the Raosoft Sample Size calculator. The primary source of data collection (questionnaire) was adopted. Reliability test of the questionnaire was carried out and the Cronbach alpha coefficient was 0.889. Data were analyzed using descriptive and inferential statistics (Statistical Package for Social Sciences (SPSS) version 24 and SmartPLS version 3.3.3). The PLS-SEM results revealed that at 95% confidence level, customer engagement ($\beta = 0.366$, $t = 2.671$), customization ($\beta = 0.356$, $t = 2.679$) and social interaction ($\beta = 0.255$, $t = 2.154$) are significant however, branded entertainment ($\beta = -0.047$, $t = 0.281$), and E-Word of mouth ($\beta = -0.024$, $t = 0.163$) are statistically insignificant.

Christian et al (2023) conducted a study on Mobile Banking Service Quality and Customer Retention among Commercial Banks' Customers: The study used an explanatory research design method using quantitative approach. The sample, consisting of 400 respondents was drawn from a cross-section of commercial banks customers with mobile banking access in Southeast Nigeria. From the 400 copies of questionnaire distributed 395 were returned valid and useful for the final analysis study used Pearson's Correlation Coefficient to measure the relationship between mobile banking service quality and customer retention. Then regression analysis was used to estimate the cause-and-effect relationship between the variables of the mobile banking service quality and customer retention. The result showed that a positive effect for responsiveness, systems quality, and information quality on customer retention while privacy and reliability of mobile banking service quality was not significant. Among all, responsiveness, system quality and information quality have a significant effect on customer retention while reliability and privacy issues do not affect customer retention in mobile services.

Banabo & Ndiomu (2023) conducted study on Experience Marketing and Customer Retention in the Nigerian Telecommunications Industry. The study made use of primary data gotten through a validated set of structured questionnaires which was distributed to a selected sample of 402 respondents within the six states of the south-south geo-political zone of the Niger Delta Area of Nigeria, which are Akwa-Ibom, Bayelsa, Calabar, Edo, Delta and River States. The paper adopted correlation and regression analysis to test the formulated research questions and hypotheses. After the analysis, it was discovered that there was a strong and positive effect of experience marketing on customer retention in the Nigerian Telecommunications industry.

Mbamalu et al (2026) conducted study on Customer Relation Management Practices and Organizational Performance: A Study of Mobile Telecommunication Firms in Anambra State. This study examined the influence of Customer Relationship Management (CRM) practices on the performance of mobile telecommunication firms in Anambra State, Nigeria. The study was driven by persistent performance challenges in the sector, including network inconsistency, weak customer engagement, inadequate complaint resolution, and declining customer trust, all of which continue to undermine organizational performance despite heightened competition among operators. Customer knowledge as a dimension of CRM was evaluated to determine its effect on firm performance, with customer retention serving as a key performance indicator. Anchored on the Commitment–Trust Theory of Relationship Marketing, the study emphasizes that sustained organizational performance is a product of trust, commitment, and value-driven interactions between firms and customers.

Summary of Empirical Review

The empirical review shows that technological infrastructure has a significant positive influence on the economic sustainability of Small and Medium Enterprises (SMEs). Internet connectivity, telecommunications networks, digital technologies, and other technological facilities enhance operational efficiency, improve customer retention, reduce business costs, and increase competitiveness. The reviewed studies generally indicate that SMEs with adequate technological infrastructure are better positioned to sustain their operations and achieve long-term growth. However, limited access, high costs, and unreliable technological services remain challenges for SMEs in Ebonyi State.

Methodology

The area of the study was Ebonyi State, Nigeria. The small and Medium Enterprises in Ebonyi State were used. Choice of these firms was due to high number of staff. The study used the descriptive survey design approach. The primary source of data was the administration of questionnaire. The population of the study consisted of one thousand nine hundred and ninety-four (1994) small and Medium Enterprises owners and managers in Ebonyi State. The adequate sample size of three hundred and thirty-three (333) using Freund and William's statistic formula at 5 percent margin of error. Two hundred and sixty-seven (267) respondents returned the questionnaire and accurately filled. The reliability was tested using the Pearson correlation coefficient (r). It gave a reliability co-efficient of 0.770 which was also good. Data was presented and analyzed by mean score and standard deviation. The hypotheses were analyzed using Z - test statistic tool.

Data Presentation and Analyses

The relationship between internet connectivity and Operational efficiency of small and Medium Enterprises in Ebonyi State.

Table 4.1.1.1: Responses on the relationship between internet connectivity and Operational efficiency of small and Medium Enterprises in Ebonyi State.

		5	4	3	2	1	ΣFX	-	SD	Decisio n
		SA	A	N	DA	SD		X		
1	Strong internet connectivity enables Small and Medium Enterprises to communicate quickly with customers and suppliers, thereby improving operational efficiency in business activities.	735	356	9	22	17	1139			Agree
		147	89	3	11	17	267			
		55.1	33.3	1.1	4.1	6.4	100%	4.27	1.111	
2	Reliable internet access helps SMEs automate transactions and manage digital records effectively, which enhances operational efficiency in Ebonyi State.	720	356	9	38	12	1135			Agree
		144	89	3	19	12	267			
		53.9	33.3	1.1	7.1	4.5	100%	4.25	1.087	
3	Internet connectivity allows SMEs to access online platforms for marketing and customer service, leading to faster service delivery	750	356	9	24	13	1152			Agree
		150	89	3	12	13	267	4.31	1.047	

	and improved operational efficiency.	56.2	33.3	1.1	4.5	4.9	100%		
4	With stable internet connectivity, SMEs can adopt digital tools that streamline internal processes and reduce operational delays.	750	356	9	24	13	1152		Agree
		150	89	3	12	13	267	4.31	1.047
		56.2	33.3	1.1	4.5	4.9	100%		
5	Improved internet connectivity supports real-time information sharing and coordination within SMEs, which positively enhances their operational efficiency	745	356	9	22	15	1147		Agree
		149	89	3	11	15	267	4.30	1.075
		55.8	33.3	1.1	4.1	5.6	100%		
Total Grand mean and standard deviation								4.252	1.0734

Source: Field Survey, 2026

Table 4.1.1.1, 236 respondents out of 267 representing 88.4 percent agreed that Strong internet connectivity enables Small and Medium Enterprises to communicate quickly with customers and suppliers, thereby improving operational efficiency in business activities with mean score of 4.27 and standard deviation of 1.111. Reliable internet access helps SMEs automate transactions and manage digital records effectively, which enhances operational efficiency in Ebonyi State 233 respondents representing 87.2 percent agreed with mean score of 4.25 and standard deviation of 1.087. Internet connectivity allows SMEs to access online platforms for marketing and customer service, leading to faster service delivery and improved operational efficiency 239 respondents representing 89.5 percent agreed with mean score of 4.31 and standard deviation of 1.047. With stable internet connectivity, SMEs can adopt digital tools that streamline internal processes and reduce operational delays 239 respondents representing 89.5 percent agreed with mean score of 4.31 and 1.047. Improved internet connectivity supports real-time information sharing and coordination within SMEs, which positively enhances their operational efficiency 238 respondents representing 89.1 percent agreed with a mean score of 4.30 and standard deviation 1.075.

The relationship between telecommunications networks and customer retention of small and Medium Enterprises in Ebonyi State

Table 4.1.2.1: Responses on the relationship between telecommunications networks and customer retention of small and Medium Enterprises in Ebonyi State

		5	4	3	2	1	ΣFX	-	SD	Decision
		SA	A	N	DA	SD		X		
1	Effective telecommunications networks enable SMEs to maintain constant communication with customers, thereby improving customer retention in Ebonyi State.	775	356	9	30	5	1175			Agree
		155	89	3	15	5	267	4.40	.910	
		58.1	33.3	1.1	5.6	1.9	100%			
2	Reliable telecommunications networks help SMEs respond quickly to customer inquiries and	735	332	9	44	12	1132	4.24	1.115	Agree

	complaints, which strengthens customer loyalty and retention.	147	83	3	22	12	267			
		55.1	31.1	1.1	8.2	4.5	100%			
3	Telecommunications networks support digital communication channels such as calls, SMS, and online platforms, helping SMEs maintain strong relationships with their customers.	755	332	9	34	13	1143			Agree
		151	83	3	17	13	267	4.28	1.093	
		56.6	31.1	1.1	6.4	4.9	100%			
4	With efficient telecommunications networks, SMEs can provide timely updates about products and services, which encourages customers to continue patronizing the business.	710	332	9	50	14	1115			Agree
		142	83	3	25	14	267			
		53.2	31.1	1.1	9.4	5.2	100%	4.18	1.168	
5	Improved telecommunications networks enhance service delivery and communication efficiency, thereby promoting higher customer retention among SMEs in Ebonyi State	730	332	9	52	9	1132			Agree
		146	83	3	26	9	267	4.24	1.095	
		54.7	31.1	1.1	9.7	3.4	100%			
Total Grand mean and standard deviation								4.268	1.0762	

Source: Field Survey, 2026

Table 4.1.2.1, 244 respondents out of 267 representing 91.4 percent agreed that Effective telecommunications networks enable SMEs to maintain constant communication with customers, thereby improving customer retention in Ebonyi State with mean score of 4.40 and standard deviation of .910. Reliable telecommunications networks help SMEs respond quickly to customer inquiries and complaints, which strengthens customer loyalty and retention 230 respondents representing 86.2 percent agreed with mean score of 4.24 and standard deviation of 1.115. Telecommunications networks support digital communication channels such as calls, SMS, and online platforms, helping SMEs maintain strong relationships with their customers 234 respondents representing 87.7 percent agreed with mean score of 4.28 and standard deviation of 1.093. With efficient telecommunications networks, SMEs can provide timely updates about products and services, which encourages customers to continue patronizing the business 225 respondents representing 84.3 percent agreed with mean score of 4.18 and 1.168. Improved telecommunications networks enhance service delivery and communication efficiency, thereby promoting higher customer retention among SMEs in Ebonyi State 229 respondents representing 85.8 percent agreed with a mean score of 4.24 and standard deviation 1.095.

Test of Hypotheses

Test of Hypotheses One: Internet connectivity has no relationship with Operational efficiency of small and Medium Enterprises in Ebonyi State.

One-Sample Kolmogorov-Smirnov Test

		Strong internet connectivity enables Small and Medium Enterprises to communicate quickly with customers and suppliers, thereby improving operational efficiency in business activities.	Reliable internet access helps SMEs automate transactions and manage digital records effectively, which enhances operational efficiency in Ebonyi State.	Internet connectivity allows SMEs to access online platforms for marketing and customer service, leading to faster service delivery and improved operational efficiency.	With stable internet connectivity, SMEs can adopt digital tools that streamline internal processes and reduce operational delays.	Improved internet connectivity supports real-time information sharing and coordination within SMEs, which positively enhances their operational efficiency
N		267	267	267	267	267
Uniform Parameters ^{a,b}	Minimum	1	1	1	1	1
	Maximum	5	5	5	5	5
Most Extreme Differences	Absolute	.634	.623	.645	.645	.641
	Positive	.064	.045	.049	.049	.056
	Negative	-.634	-.623	-.645	-.645	-.641
Kolmogorov-Smirnov Z		10.358	10.174	10.542	10.542	10.480
Asymp. Sig. (2-tailed)		.000	.000	.000	.000	.000

a. Test distribution is Uniform.

b. Calculated from data.

Decision Rule:

Since the calculated z-value (10.542) > critical z-value (.000) at the 5% significance level, we reject the null hypothesis (H_{01}).

Decision:

Furthermore, comparing the calculated Z- value ranges from $10.174 < 10.542$ against the critical Z- value of .000 (2-tailed test at 95percent level of confidence) the null hypothesis were rejected. Thus the alternative hypothesis was accepted which states that **Internet connectivity had significant positive relationship with Operational efficiency of small and Medium Enterprises in Ebonyi State**

Test of Hypotheses Two: Telecommunications networks has no relationship with customer retention of small and Medium Enterprises in Ebonyi State.

One-Sample Kolmogorov-Smirnov Test

	Effective telecommunications networks enable SMEs to maintain constant communication with customers, thereby improving customer retention in Ebonyi State.	Reliable telecommunications networks help SMEs respond quickly to customer inquiries and complaints, which strengthens customer loyalty and retention.	Telecommunications networks support digital communication channels such as calls, SMS, and online platforms, helping SMEs maintain strong relationships with their customers.	With efficient telecommunications networks, SMEs can provide timely updates about products and services, which encourages customers to continue patronizing the business.	Improved telecommunications networks enhance service delivery and communication efficiency, thereby promoting higher customer retention among SMEs in Ebonyi State	
N	267	267	267	267	267	
Uniform Parameters ^{a,b}	Minimum	1	1	1	1	
	Maximum	5	5	5	5	
Most Extreme Differences	Absolute	.664	.611	.626	.593	.608
	Positive	.019	.045	.049	.052	.034
	Negative	-.664	-.611	-.626	-.593	-.608
Kolmogorov-Smirnov Z	10.848	9.991	10.236	9.685	9.930	
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	

a. Test distribution is Uniform.

b. Calculated from data.

Decision Rule:

Since the calculated z-value (10.848) > critical z-value (.000) at the 5% significance level, we reject the null hypothesis (H_{01}).

Decision:

Furthermore, comparing the calculated Z- value ranges from 9.685< 10.848 against the critical Z- value of .000 (2-

tailed test at 95percent level of confidence) the null hypothesis were rejected. Thus the alternative hypothesis was accepted which states that **Telecommunications networks had significant positive result relationship with customer retention of small and Medium Enterprises in Ebonyi State**

Discussion of Findings

From the result of hypotheses one, the calculated Z- value ranges from $10.174 < 10.542$ against the critical Z- value of .000, which implies that **Internet connectivity had significant positive relationship with Operational efficiency of small and Medium Enterprises in Ebonyi State. In support of the result in the literature review,**

Furthermore, comparing the calculated Z- value ranges from $9.685 < 10.848$ against the critical Z- value of .000 which implies that **Telecommunications networks had significant positive result relationship with customer retention of small and Medium Enterprises in Ebonyi State. In support of the result in the literature review,**

Summary of findings, Conclusion and Recommendations

Summary of findings,

- i. Internet connectivity had a significant positive relationship with the operational efficiency of Small and Medium Enterprises (SMEs) in Ebonyi State, $Z = 10.542$, $p. < .05$. This suggests that SMEs with better and more reliable internet connectivity are more likely to perform business activities efficiently, communicate faster, access information, and reduce delays in their operations.
- ii. Telecommunications networks had a significant positive relationship with customer retention of SMEs in Ebonyi State, $Z = 10.848$ $p. < .05$. This implies that reliable telecommunications networks enable SMEs to maintain effective communication with customers, respond promptly to enquiries, provide better customer service, and encourage customers to continue patronizing their businesses.

Conclusion

Technological infrastructure plays a significant role in promoting the economic sustainability of Small and Medium Enterprises (SMEs) in Ebonyi State. Adequate access to reliable digital technologies, internet services, and communication systems can improve operational efficiency, reduce costs, enhance competitiveness, and support long-term business growth.

Recommendations

- i. SME owners and managers should invest in reliable and high-speed internet services and adopt suitable internet-enabled business tools to improve communication, online transactions, information access, and overall operational efficiency.
- ii. SMEs should use reliable telecommunications networks and maintain multiple communication channels, such as phone calls, SMS, and internet-based communication platforms, to ensure continuous and effective interaction with customers and strengthen customer loyalty.

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