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Digital Infrastructure and E-Commerce Adoption Among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

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Abstract: *The rapid growth of digital technology has transformed retail business operations globally, yet many supermarket stores in Awka Metropolis, Anambra State, Nigeria, face challenges in adopting e-commerce due to inadequate digital infrastructure. This study investigates the relationship between digital infrastructure and e-commerce adoption among supermarket stores in the area, with a focus on how various digital factors influence online sales volume. The problem stems from the low uptake of e-commerce platforms despite increasing internet penetration, which hampers revenue growth and competitive advantage for local supermarkets. The study employed a descriptive research design, utilizing a structured questionnaire to gather data from 117 respondents comprising supermarket managers and staff. Data analysis involved descriptive statistics like percentages, means, and standard deviations to describe the variables, coupled with an inferential econometric regression technique, specifically Ordinary Least Squares (OLS), to determine the impact of independent variables on e-commerce adoption. The independent variables examined include internet access, website presence, POS systems, mobile network coverage, digital payment options, security measures, and staff digital skills. The results indicate that all the independent variables significantly influence online sales volume. Specifically, internet access ($\beta = 0.245$, $p < 0.01$), website presence ($\beta = 0.180$, $p < 0.05$), POS systems ($\beta = 0.192$, $p < 0.05$), mobile network coverage ($\beta = 0.210$, $p < 0.01$), digital payment options ($\beta = 0.230$, $p < 0.01$), security measures ($\beta = 0.155$, $p < 0.05$), and staff digital skills ($\beta = 0.198$, $p < 0.05$) all positively impact e-commerce adoption as proxied by online sales volume. The model explains a significant portion of the variance in online sales ($R^2 = 0.68$), indicating that digital infrastructure plays a critical role in e-commerce success. Based on these findings, it is recommended that supermarket*

stores in Awka invest in reliable internet services, develop user-friendly websites, integrate secure digital payment systems, and enhance staff digital literacy to boost online sales. Policymakers should also focus on improving digital infrastructure to facilitate broader e-commerce adoption among retail businesses in the region.

Keywords: *Digital Infrastructure, E-Commerce Adoption, Supermarket Stores, Awka Metropolis, Internet Access, Online Sales, OLS Regression, Digital Payment, Digital Skills.*

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1. INTRODUCTION

The rapid advancement of digital technology over the past few decades has fundamentally transformed the landscape of commerce worldwide. The emergence of e-commerce as a dominant mode of retail has been driven by various technological innovations that have made transactions more efficient, accessible, and convenient for consumers and businesses alike. Historically, the concept of electronic commerce can be traced back to the 1960s with the advent of Electronic Data Interchange (EDI), which facilitated the exchange of business documents electronically (Onuegbu & Ezekwere, 2025). However, it was not until the proliferation of the internet in the 1990s that e-commerce gained significant momentum, opening new pathways for retail businesses to reach consumers beyond geographical boundaries. The basic characteristics of e-commerce include digital transactions, online product catalogs, electronic payment systems, and digital marketing, all of which foster a seamless shopping experience (Anikwe, Nwankwo, Anayochukwu; Kanyangale, and Chendo, 2025). In Nigeria, the adoption of e-commerce has been gradually increasing, yet it remains relatively low compared to global standards, especially among traditional retail outlets such as supermarkets, due to infrastructural and socio-economic challenges (Anikwe, Nwankwo, Kanyangale & Chendo, 2025). Digital infrastructure serves as the backbone for e-commerce adoption, especially in developing countries like Nigeria where infrastructural deficits are prevalent. This infrastructure encompasses internet connectivity, reliable power supply, website and mobile application platforms, point-of-sale (POS) systems, digital payment gateways, cybersecurity measures, and staff digital literacy skills. The quality and availability of these digital components significantly influence the extent to which retail businesses can adopt and expand e-commerce activities (Adebayo & Salami, 2023; Adelakun & Ogunyemi, 2020; Okoli, Okonkwo. & Michael, 2020; Okoli, Ezeanolue & Edoko, 2019). For supermarkets in Awka Metropolis, Nigeria, the adequacy of digital infrastructure determines their capacity to transition from traditional brick-and-mortar outlets to online platforms, thereby expanding their market reach and operational efficiency. Without robust digital infrastructure, supermarkets face limitations in online product listing, order processing, payment collection, and customer engagement, which ultimately impedes the growth of online sales volume (Afolabi & Musa, 2023; Afolabi & Olayemi, 2022). Consequently, understanding how various facets of digital infrastructure impact e-commerce adoption becomes crucial, particularly in the Nigerian context where infrastructural deficiencies are widespread.

The impact of internet access and website presence on e-commerce adoption among supermarkets in Awka is profound. Reliable internet connectivity ensures that supermarkets can maintain continuous online operations, communicate effectively with consumers, and update their product offerings promptly. A functional website serves as the primary interface for online shopping, providing consumers with information, ease of navigation, and a secure platform for transactions (Anbukarasi & 2024; Chauhan & Sharma, 2024). Additionally, Point-of-Sale (POS) systems integrated with online platforms facilitate smooth payment processing and inventory management, bridging the gap between offline and online sales channels. Mobile network coverage, particularly

in Nigeria where mobile phones are the primary means of internet access, plays a pivotal role in enabling consumers to engage with e-commerce platforms remotely (Afolabi & Musa, 2023; Afolabi & Olayemi, 2022). The proliferation of digital payment options, such as mobile money, card payments, and third-party payment gateways, further encourages online shopping by providing secure and convenient transaction methods. These digital payment systems reduce the reliance on cash transactions, which are often associated with risks and logistical difficulties, thereby fostering greater trust and adoption among consumers (Anbukarasi & 2024; Chauhan, & Sharma, 2024). Security measures constitute another critical aspect influencing e-commerce adoption. Concerns over cyber threats, data breaches, and fraud have historically hindered consumer confidence in online transactions, especially in developing nations with weak cybersecurity frameworks (Nwosu, Nwokoye & Okoro, 2023). Supermarket stores that implement robust security protocols, including encryption, secure payment gateways, and customer data protection measures, are more likely to attract and retain online customers. Staff digital skills also significantly affect e-commerce adoption; employees need to be proficient in handling online platforms, troubleshooting technical issues, and engaging with customers digitally (Obinna-Azubuike, Herrieth, & Rahim, Zairah. 2026). In Awka, many supermarkets face challenges related to staff capacity in digital literacy, which limits their ability to effectively manage online sales channels and provide quality digital customer service. This skill gap underscores the importance of investing in staff training and capacity building to realize the full potential of e-commerce.

Despite the growing recognition of the importance of digital infrastructure, several efforts by stakeholders including government agencies, telecommunication companies, financial institutions, and the private sector have attempted to address infrastructural deficits in Nigeria. Initiatives such as the National Broadband Plan aimed to expand internet access nationwide, while mobile network operators have invested heavily in expanding coverage and improving network quality (Okoye, Nwankwo, Okeke, Nwankwo & Eze, 2023). Financial institutions have also introduced mobile money and digital payment solutions to facilitate cashless transactions. However, these efforts have often fallen short of achieving widespread e-commerce adoption among supermarkets due to persistent infrastructural deficiencies, high costs, regulatory challenges, and low levels of digital literacy among business owners and staff (Njoku, Musa, & Magaji, 2025; Kekeocha, Ugwu, Azike, & Okudo, 2026). Many supermarkets remain dependent on traditional methods because their digital systems are incompatible with available infrastructure, or because they lack the financial and technical capacity to upgrade their systems. These shortcomings reveal a significant gap between infrastructural policy intentions and actual implementation, which hampers the growth of e-commerce in the region. Addressing these infrastructural and capacity gaps is critical given the economic benefits that could accrue from enhanced e-commerce adoption. Digitally enabled supermarkets can reach wider markets, reduce operational costs, and improve customer satisfaction through faster and more efficient services (Njoku, Musa, & Magaji, 2025; Kekeocha, Ugwu, Azike, & Okudo, 2026). Moreover, e-commerce can stimulate local economic growth, generate employment, and foster innovation in retail practices. For Awka Metropolis, Nigeria, where retail remains predominantly traditional, harnessing digital infrastructure could serve as a catalyst for modernizing the retail sector, improving competitiveness, and integrating local businesses into the global digital economy. The failure to adequately address infrastructural deficits, however, risks leaving supermarkets behind in the digital age, limiting their growth potential and overall contribution to the local economy. Consequently, there is a pressing need for focused research to identify the specific infrastructural deficiencies, understand their effects on e-commerce adoption, and develop targeted strategies for stakeholders to foster a conducive environment for digital retail growth. Filling this gap in understanding is essential for policymakers and business stakeholders aiming to leverage digital infrastructure for socio-economic development in Awka and similar Nigerian cities. This study shows that while the global transition to digital commerce is well

underway, the potential for e-commerce growth in Nigeria particularly in the retail sector is hampered by infrastructural and capacity constraints. Supermarkets in Awka Metropolis stand at a crossroads, where leveraging digital infrastructure could significantly boost their operational efficiency and market reach, thereby contributing to local economic development. However, persistent infrastructural gaps such as unreliable internet, inadequate digital payment systems, limited cybersecurity, and low staff digital literacy continue to impede e-commerce adoption. Previous stakeholder efforts, though well-intentioned, have not achieved the desired scale or impact, highlighting the need for more targeted, comprehensive interventions. Addressing these issues holds the promise of transforming traditional retail into a vibrant, digitally-driven sector that can compete nationally and globally.

Statement of the problem

The immediate problem that has prompted this study is the low level of e-commerce adoption among supermarket stores in Awka Metropolis, Nigeria, despite the increasing global shift towards digital retailing. In recent years, digital infrastructure such as internet access, website presence, POS systems, mobile network coverage, digital payment options, security measures, and staff digital skills have been recognized as critical enablers of e-commerce growth (Ekwugha & Obiorah, 2026; Ifeoma & Chikwado, 2019). However, many supermarkets in Awka remain primarily dependent on traditional brick-and-mortar operations, with only a few engaging actively in online sales. This disconnect between the technological potential and actual practice raises concerns because, in today's digital economy, the lack of adequate digital infrastructure directly hampers the ability of supermarkets to expand their market reach, improve operational efficiency, and meet consumers' evolving expectations. The core issue is that despite the technological advancements and the apparent benefits of e-commerce, infrastructural deficiencies are preventing supermarkets from fully embracing online retailing, which is vital for their competitiveness and sustainability. This problem is both topical and urgent because the global retail landscape has been reshaped by the COVID-19 pandemic, which accelerated e-commerce adoption worldwide. Nigeria, like many emerging economies, is experiencing a digital transformation that offers significant economic opportunities but also presents infrastructural challenges (Ekwugha & Obiorah, 2026; Ifeoma & Chikwado, 2019). The situation in Awka, however, falls short of the expected progress: while internet penetration and mobile usage have increased, the integration of digital infrastructure into retail operations remains limited and fragmented. The current state of affairs marked by poor internet reliability, inadequate website functionalities, limited digital payment options, and low staff digital literacy is unacceptable because it constrains the growth potential of supermarkets and leaves them vulnerable to losing customers to more digitally savvy competitors. This gap underscores the need for empirical investigation to understand the underlying infrastructural barriers and how they influence e-commerce adoption, especially in the context of Nigeria's rapidly evolving digital economy.

The potential impact of improved digital infrastructure on e-commerce adoption among supermarkets in Awka is substantial. Enhanced internet access, robust website presence, and effective POS systems can streamline order processing and customer engagement, leading to increased online sales. Additionally, widespread mobile network coverage and diverse digital payment options can foster consumer trust and convenience, encouraging more supermarket customers to shop online. Security measures are equally vital; without adequate data protection and fraud prevention, consumers will remain hesitant to complete online transactions. Moreover, staff digital skills are crucial for managing online platforms and providing quality digital customer service. If these infrastructural components are adequately developed, supermarkets could see a significant increase in online sales volume, which would not only boost their profitability but also contribute to the broader economic development of Awka by fostering digital literacy and

innovation in the retail sector. Previous efforts by researchers and policymakers to address infrastructural deficits in Nigeria have yielded limited success. Initiatives like the National Broadband Plan and mobile network expansions have increased connectivity but have not sufficiently translated into widespread e-commerce adoption among local supermarkets (Lawal, 2010; Len, 2015). Factors such as high costs of digital infrastructure, low digital literacy among business owners and staff, cybersecurity concerns, and regulatory bottlenecks have hampered the effectiveness of these interventions. As a result, many supermarkets continue to operate in a largely traditional manner, missing out on the benefits of digital retailing. If this research is not conducted, the consequence will be a continued digital divide, where supermarkets remain unable to leverage digital infrastructure to enhance their competitiveness, thus limiting their growth prospects and economic contribution. The failure to empirically identify specific infrastructural gaps and their effects on e-commerce adoption will perpetuate ineffective policies and interventions, making this study both timely and necessary. This study seeks to fill a critical knowledge gap by examining how components of digital infrastructure such as internet access, website presence, POS systems, mobile network coverage, digital payment options, security measures, and staff digital skills affect e-commerce adoption, as proxied by online sales volume among supermarkets in Awka. Without empirical evidence, stakeholders are left without actionable insights needed to develop targeted interventions that can accelerate digital transformation in the retail sector. The inevitable consequence of neglecting this research is the continued underperformance of supermarkets in embracing e-commerce, which would hinder their growth and limit the socioeconomic benefits that digital retailing could bring to Awka. Therefore, this study is essential for informing policy, guiding infrastructural investments, and designing capacity-building programs that will foster a thriving digital retail environment in Nigeria's emerging urban centers.

Objectives of the study

The main objective is to examine Digital Infrastructure and E-Commerce Adoption among Supermarket Stores in Awka Metropolis Anambra State, Nigeria. The specific objectives are to:

1. Determine the effect of Internet access on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria
2. Ascertain the effect of Website presence on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria
3. Evaluate the effect of POS systems on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria
4. Assess the effect of Mobile network coverage on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria
5. Examine the effect of Digital payment options on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria
6. Ascertain the effect of Security measures on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria
7. Evaluate the effect of Staff digital skills on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

Hypotheses of the Study

H_{O1}: Internet access has no significant effect on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

H_{o2}: Website presence has no significant effect on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

H_{o3}: POS systems has no significant effect on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

H_{o4}: Mobile network coverage has no significant effect on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

H_{o5}: Digital payment options has no significant effect on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

H_{o6}: Security measures has no significant effect on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

H_{o7}: Staff digital skills has no significant effect on Online sales volume among Supermarket Stores in Awka Metropolis Anambra State, Nigeria

2. REVIEW OF LITERATURE

Digital Infrastructure

Digital infrastructure forms the backbone of e-commerce development, especially in emerging economies where infrastructural deficits hinder technological adoption. It encompasses internet connectivity, reliable power supply, digital platforms, cybersecurity, and digital literacy, all of which are essential for enabling online commercial activities (Lawal, 2010; Len, 2015). In Nigeria, inadequate digital infrastructure remains a significant barrier to e-commerce expansion, with many small and medium enterprises (SMEs) struggling to integrate digital tools into their operations (Ma & Liu, 2017; MacGregor, 2011; Onwuteaka, Ezeanolue,. & Okoli, 2020; Anigbogu, Onwuteaka & Okoli, 2019). Improving this infrastructure is crucial for fostering a conducive environment for e-commerce growth, especially among retail outlets like supermarkets that require efficient online platforms to serve customers effectively. Furthermore, the quality and reach of digital infrastructure directly influence consumer confidence and transaction volume. Studies indicate that regions with better internet access, security, and digital literacy tend to experience higher e-commerce activity (Mutia, Ahmad, Aziz & Mohamad, 2014). In Nigeria, infrastructural gaps such as unstable electricity and poor internet coverage limit the potential of e-commerce, emphasizing the need for targeted investments to bridge these gaps. Strengthening digital infrastructure can thus catalyze increased e-commerce adoption among supermarkets, leading to higher online sales and broader market penetration.

E-Commerce Adoption

E-commerce adoption involves the integration of digital platforms into business operations to facilitate online buying and selling. It is influenced by factors such as technological readiness, consumer trust, regulatory environment, and organizational capacity (Mutia, Ahmad, Aziz & Mohamad, 2014; Olise, Anigbogu, Edoko & Okoli, 2014). Despite Nigeria's rapid growth in mobile and internet penetration, many supermarkets remain hesitant to fully adopt e-commerce due to infrastructural constraints, security concerns, and limited digital skills among staff (Okeke, Oboreh & Ezeaghaego, 2016). This slow adoption rate results in missed opportunities for expanding market reach and improving operational efficiency. Recent studies highlight that e-commerce adoption in Nigeria is positively correlated with technological literacy, internet access, and digital payment infrastructure (Oke & Adeyemi, 2020; Anigbogu & Okoli, 2018; Dibua, Idemobi & Okoli, 2018). However, the adoption process is often hindered by low levels of trust in online transactions and inadequate regulatory support. Therefore, understanding the determinants and barriers to e-commerce adoption is critical for developing strategies to accelerate digital retailing, particularly in

traditional sectors like supermarkets, where consumer habits are still largely offline. Empirical investigation can provide insights into how infrastructural improvements could foster wider e-commerce acceptance.

Supermarket Stores

Supermarket stores in Nigeria are pivotal players in the retail sector, serving as primary distribution points for consumer goods. Traditionally, these stores have relied heavily on face-to-face transactions and in-store sales, with limited integration of digital channels (Nasir, 2009). However, the increasing digitization trend calls for supermarkets to leverage e-commerce platforms to reach a wider customer base, especially in urban centers like Awka. Despite this, many supermarkets lack the necessary digital infrastructure and skills to transition smoothly into online retailing, limiting their growth potential. The competitive landscape is shifting as consumers increasingly demand convenient shopping options, including online ordering and home delivery. Studies suggest that supermarkets that adapt by adopting e-commerce can significantly increase their online sales volume and customer satisfaction (Okeke, Oboreh & Ezeaghaego, 2016). Nonetheless, infrastructural limitations, such as poor internet connectivity and weak digital payment systems, continue to constrain these stores' digital transformation. This underscores the importance of targeted interventions to enhance digital capabilities among supermarket stores in Nigeria to stay competitive in a rapidly evolving retail environment.

Internet access and online sales volume

Internet access remains a fundamental factor influencing online sales volume in Nigeria. Reliable connectivity enables supermarkets to establish and maintain user-friendly websites, mobile applications, and communication channels that facilitate online transactions (Oluwafemi, Christopher, Joel & Adeyinka, 2016). Current statistics show that Nigeria's internet penetration has been steadily increasing, yet rural and semi-urban areas like Awka still face significant connectivity challenges, which directly impact the volume of online sales for retail outlets (Oluwafemi, Christopher, Joel & Adeyinka, 2016; Elumaro, Otugo & Okoli, 2018; Orajaka & Okoli, 2018). Without consistent internet access, supermarkets struggle to serve customers effectively, leading to underperformance in their online sales channels. Research indicates that improved internet access correlates positively with higher e-commerce activity, as it enhances consumers' ability to browse, compare, and purchase products online (Lawal, 2010; Len, 2015). For supermarkets in Awka, expanding internet reach and ensuring affordable, high-speed connectivity could significantly boost online sales volume. Furthermore, internet access influences other critical factors such as staff digital skills and website engagement, reinforcing the importance of infrastructure development in fostering a vibrant digital retail environment.

Website presence and online sales volume

A strong website presence is critical for supermarkets aiming to expand their e-commerce footprint. It serves as the primary interface for customers, providing product information, order processing, and customer service (Chauhan & Sharma, 2024). Supermarkets with well-designed, mobile-responsive, and user-friendly websites tend to attract more visitors and convert them into buyers, thereby increasing online sales volume. Conversely, poorly maintained or outdated websites can deter customers and diminish trust, resulting in lower online transaction rates. Empirical evidence suggests that website quality, including ease of navigation, load speed, and security features, directly impacts online purchase behavior (Chauhan & Sharma, 2024). For supermarkets in Awka, investing in professional website development and digital marketing strategies can significantly enhance visibility and customer engagement. This, in turn, can lead to higher online sales volumes, especially as consumers increasingly prefer online shopping for convenience and safety. Therefore,

strengthening online presence through improved website functionality is vital for supermarket growth in Nigeria's digital economy.

POS systems and online sales volume

Point-of-Sale (POS) systems have become essential tools for integrating offline and online retail processes, enabling supermarkets to manage transactions efficiently and accurately. Advanced POS systems facilitate real-time inventory updates, sales tracking, and seamless integration with e-commerce platforms (Lawal, 2010; Len, 2015). In Nigeria, supermarkets that adopt modern POS systems are better positioned to handle online orders, process digital payments, and deliver improved customer service, all of which contribute to increased online sales volume. Research demonstrates that the adoption of POS technology correlates with improved operational efficiency and customer satisfaction, leading to higher online transaction rates (Ekwugha & Obiorah, 2026; Ifeoma & Chikwado, 2019). In the context of Awka, upgrading POS systems can help supermarkets streamline their sales operations, reduce errors, and support various digital payment methods, which are vital for boosting online sales. The integration of POS systems with digital platforms thus plays a significant role in expanding e-commerce activities, making it a critical area for investment in Nigeria's retail sector.

Mobile network coverage and online sales volume

Mobile network coverage is vital for the success of e-commerce in Nigeria, where the majority of internet access occurs via mobile devices. Widespread mobile coverage enables consumers to browse, purchase, and communicate with supermarkets conveniently, thereby increasing online sales volume (Ifeoma & Chikwado, 2019). However, in many parts of Nigeria, including Awka, network instability and poor coverage limit the frequency and reliability of online transactions, discouraging consumers from engaging in digital shopping (Ifeoma, A. R., & Chikwado, N. C. (2019; Onugu & Okoli, 2012; Olise, Anigbogu, Okoli. & Anyanwu, 2013). Research shows that strong mobile network coverage enhances consumer trust and facilitates access to digital payment options, both of which are crucial for e-commerce growth (Ekwugha & Obiorah, 2026; Ifeoma & Chikwado, 2019). For Nigerian supermarkets, expanding and improving mobile network coverage can lead to higher online sales, especially as mobile commerce becomes the dominant retail channel. Addressing coverage issues will therefore be instrumental in unlocking the full potential of e-commerce in Awka and similar urban centers across Nigeria.

Digital payment options and online sales volume

The availability and security of digital payment options significantly influence online sales volume among supermarkets in Nigeria. Mobile money, card payments, and third-party gateways like Paystack or Flutterwave enable consumers to transact securely and conveniently, reducing the reliance on cash (Anikwe, Nwankwo, Kanyangale, & Chendo, 2025). The proliferation of these options has been instrumental in boosting e-commerce activities, as they build consumer trust and facilitate faster payment processing, leading to increased online purchase frequency. However, many supermarkets in Nigeria still face challenges related to limited access to reliable digital payment systems and cybersecurity concerns. These issues deter consumers from completing online transactions, thus hindering sales growth (Anikwe, Nwankwo, Kanyangale, Chendo, 2025). Improving digital payment infrastructure and promoting secure, user-friendly payment platforms are essential steps toward increasing online sales volume. For supermarkets in Awka, adopting diverse and trustworthy digital payment methods can be a game-changer, fostering consumer confidence and expanding their online market share.

Security measures and online sales volume

Security measures are critical for building consumer confidence in online transactions, especially in Nigeria where cybercrime remains a concern. Implementing encryption, secure payment gateways, and data protection protocols can reduce fraud risks and ensure safe online shopping experiences (Onuegbu & Ezekwere, 2025). Supermarkets that prioritize cybersecurity create a trustworthy environment that encourages consumers to increase their online purchases, thereby boosting sales volume. Despite the importance of security, many Nigerian supermarkets still grapple with inadequate cybersecurity infrastructure, which exposes both businesses and consumers to risks. Research indicates that the perception of online transaction insecurity significantly hampers e-commerce growth (Okeke, Oboreh & Ezeaghaego, 2016). Therefore, strengthening security measures is essential for expanding online sales, particularly as consumers become more aware of cyber threats. For supermarkets in Awka, investing in robust security systems is a strategic move to enhance consumer confidence and drive higher online sales.

Staff digital skills and online sales volume

Staff digital skills are crucial for the successful management and operation of e-commerce platforms in supermarkets. Employees need to be proficient in digital literacy, including website management, digital marketing, customer service, and cybersecurity awareness (Raheem, Vishnu & Ahmed, 2014). Lack of digital skills among staff can lead to poor online customer experiences, operational inefficiencies, and ultimately, lower online sales volume. Empirical studies emphasize that training staff in digital competencies significantly enhances a supermarket's ability to leverage e-commerce effectively (Rita. & John, 2015). In Nigeria, many supermarkets face a digital skills gap that limits their capacity to implement and sustain online sales channels. Addressing this gap through targeted training programs can improve staff performance, increase online transaction volumes, and foster long-term digital transformation, which is essential for staying competitive in the evolving retail landscape.

3. THEORETICAL FRAMEWORK

This study is anchored on the Technology Acceptance Model (TAM), developed by Davis (1989), which remains one of the most influential theories in understanding technology adoption behaviors. TAM posits that users' acceptance and subsequent use of technology are primarily determined by two factors: perceived usefulness and perceived ease of use. Perceived usefulness refers to the degree to which an individual believes that using a particular system would enhance their performance, while perceived ease of use pertains to the degree of effort required to operate the system. In the context of e-commerce adoption, TAM suggests that the decision of supermarket stores to embrace online retailing is significantly influenced by how useful and user-friendly they perceive digital infrastructure and systems to be (Venkatesh & Davis, 2000). The relevance of TAM to this study lies in its emphasis on individual perceptions which influence behavioral intentions to adopt e-commerce platforms. Digital infrastructure components such as internet access, website quality, POS systems, and digital payment options shape perceptions of usefulness and ease of use among supermarket staff and management. When digital infrastructure is perceived as beneficial and straightforward to operate, the likelihood of e-commerce adoption increases. Empirical studies support this application, indicating that perceived ease of use and usefulness are critical determinants of e-commerce implementation in developing countries (Ajzen & Fishbein, 1980; Davis, 1989). Therefore, TAM provides a robust framework to analyze how infrastructural factors influence supermarket stores' decisions to adopt e-commerce in Awka.

The assumptions of TAM are that users' behavioral intentions are directly influenced by their perceptions of usefulness and ease of use, which in turn are shaped by external variables such as infrastructure quality, organizational support, and technical support (Venkatesh & Davis, 2000). It

assumes rational decision-making, where individuals evaluate the benefits and costs associated with technology use before adopting it. Moreover, TAM assumes that external variables impact technology acceptance indirectly through perceived usefulness and ease of use, emphasizing the mediating role of perceptions. Applying these assumptions to the Nigerian supermarket context, it can be posited that infrastructural deficiencies may negatively influence perceptions, thereby hindering e-commerce adoption, while improvements in digital infrastructure could enhance perceptions and promote adoption behaviours.

In application to this study, TAM helps to elucidate the relationship between digital infrastructural elements such as internet access, mobile network coverage, security, and staff skills and the propensity of supermarket stores to adopt e-commerce. By understanding how these infrastructural factors influence perceptions of usefulness and ease of use, stakeholders can develop targeted interventions to improve infrastructure quality, thereby fostering a more favorable attitude towards online retailing. This theoretical foundation underscores the importance of investing in digital infrastructure as a means of increasing e-commerce adoption, ultimately driving online sales volume among supermarkets in Awka.

4. METHODOLOGY OF THE STUDY

Research Design

The study adopts a descriptive research design, which is appropriate for systematically describing the characteristics of the population involved and examining the relationships between the variables related to online sales and the factors influencing them. This design enables the researcher to gather detailed data that reflect the current state of online retail activities among supermarkets in Awka Metropolis.

Area of Study

The research is conducted in Awka Metropolis, the capital city of Anambra State, Nigeria. Awka is characterized by a diverse population engaged in various socio-economic activities including trading, manufacturing, education, and services. The city's geographical landscape is predominantly flat with urban and semi-urban areas, fostering a conducive environment for commercial activities. Culturally, Awka is rich with Igbo traditions, which influence local business practices. The environment features a mix of residential, commercial, and industrial zones, with a growing emphasis on technological adoption and modernization in retail sectors.

Population of the Study

The population encompasses all supermarkets operating within Awka Metropolis. This includes both large-scale and small-scale supermarkets actively engaged in or with the potential for online retail activities.

Sample Size and Sampling Technique

A sample size of 117 supermarkets was determined using the Cochran's formula, a scientific method for calculating an appropriate sample size to ensure representativeness and statistical validity. The formula considers the total population, desired confidence level (typically 95%), and margin of error (usually 5%). A simple random sampling technique was employed to select the supermarkets, ensuring each unit in the population had an equal chance of being included, thereby minimizing bias and enhancing the generalizability of the findings.

Method of Data Collection

Primary data was collected directly from the respondents through structured questionnaires. This approach enables the researcher to obtain firsthand information regarding the supermarkets' online sales practices, infrastructural factors, and other relevant variables.

Data Collection Instrument

The instrument used for data collection was a structured questionnaire designed to capture quantitative data related to the research variables. The questionnaire included sections on demographic information, technological infrastructure, security measures, staff skills, and other factors influencing online sales.

Method of Data Analysis

Data collected were analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequency distributions, simple percentages, means, and standard deviations were used to summarize the data. Inferential statistics involved the application of the Ordinary Least Square (OLS) regression technique to examine the relationships between the independent variables (e.g., internet access, website presence, digital payment options) and the dependent variable (online sales performance). This combination of analysis methods provides a comprehensive understanding of the data and the factors influencing online retail success.

5. PREDENTATION OF EMPIRICAL RESULTS

Demographic Profile

Table 1: Demographic Profile of Respondents

Demographic Variable	| Category	Frequency	Percentage (%)
Gender	Male	65	55.56
	Female	52	44.44
Age Group	18-25	22	18.80
	26-35	50	42.74
	36-45	28	23.93
	46-55	10	8.55
	56 and above	7	6.00
Educational Level	Secondary Education	45	38.46
	Tertiary Education	72	61.54
Marital Status	Single	55	47.00
	Married	62	47.00
Income Size (Monthly in ₦)	Low (Below 50,000)	30	25.64
	Medium (50,000 - 150,000)	65	55.56
	High (Above 150,000)	22	18.80
		117	100

Source: Field Survey, 2025

The sample comprises 65 males (55.56%) and 52 females (44.44%), indicating a fairly balanced gender representation among respondents. This balance allows for gender-based comparisons in perceptions and behaviors related to e-commerce in the study area. The slight male predominance may reflect underlying population distributions or sampling tendencies.

Respondents are predominantly within the 26-35 age bracket, constituting 42.74% of the sample, followed by those aged 36-45 years (23.93%) and 18-25 years (18.80%). The older respondents, aged 46 and above, account for only 14.55%. This distribution suggests that most participants are young to middle-aged adults, likely to be active internet users and consumers of online shopping services. The dominance of the 26-35 age group underscores their potential influence and engagement with digital commerce.

All respondents have formal education, with 61.54% holding tertiary education (university or college degrees) and the remaining 38.46% having secondary education. This high level of education indicates that the sample is relatively well-educated, which is positively associated with digital literacy and the likelihood of engaging in e-commerce activities. The educational profile enhances the reliability of responses related to digital infrastructure and online behaviours.

About half of the respondents are single (47%), while the other half are married (53%), reflecting a balanced marital status distribution. This balance allows for examining whether marital status influences online shopping behavior or perceptions of digital services. Married respondents may have different purchasing patterns or financial priorities compared to singles, which could impact their engagement with e-commerce.

Most respondents fall within the medium-income category (55.56%), earning between ₦50,000 and ₦150,000 monthly. Approximately 25.64% are in the low-income group (below ₦50,000), and 18.80% belong to the high-income category (above ₦150,000). The prominence of middle-income earners suggests that a significant portion of the population has sufficient disposable income to participate actively in e-commerce. Income levels are important in understanding affordability, access to digital devices, and payment preferences.

Descriptive Statistics

Table 2: Descriptive statistics on Digital Infrastructure and E-Commerce Adoption

Variable	Mean	Std Dev
Internet Access	4.2	0.8
Website Presence	3.8	0.9
POS Systems	3.9	0.7
Mobile Network Coverage	4.1	0.6
Digital Payment Options	4.0	0.8
Security Measures	3.7	0.9
Staff Digital Skills	3.6	1.0

Source: Field Survey, 2025

The mean score of 4.2 with a standard deviation of 0.8 indicates that respondents generally perceive internet access as high within the supermarkets, with relatively moderate variability. This suggests that most supermarkets have good internet connectivity, which is essential for e-commerce activities. With a mean of 3.8 and a standard deviation of 0.9, respondents believe that website presence is fairly well established among supermarkets, though there is some variation. This reflects a moderate level of online visibility, which can be improved further to enhance e-commerce adoption. The average score of 3.9 and a standard deviation of 0.7 indicate that most supermarkets have adopted POS systems, with a slightly lower degree of variability. This suggests a general acknowledgment of POS system integration, which supports online and offline transactions. A mean of 4.1 and a standard deviation of 0.6 demonstrate that mobile network coverage is perceived as very good across the supermarkets, with most respondents rating it highly. This is critical for mobile commerce and customer accessibility. Supermarkets are rated highly in digital payment options with a mean of 4.0 and a standard deviation of 0.8, suggesting widespread availability of

secure digital payment methods. This is a vital factor in increasing online sales. With a mean of 3.7 and a standard deviation of 0.9, respondents view security measures as moderately implemented, but with some variability. Security remains a concern that needs ongoing attention to build customer confidence. The mean score of 3.6 and a standard deviation of 1.0 indicate that staff's digital skills are moderate, with considerable variation among respondents. Enhancing staff digital literacy could further facilitate e-commerce growth.

Table 3: Regression Results on Digital Infrastructure and E-Commerce Adoption

Variable	Coefficient (β)	Std. Error	t-Statistic	p-value
Constant	0.150	0.080	1.875	0.063
Internet Access	0.245	0.085	2.882	0.005
Website Presence	0.180	0.075	2.400	0.018
POS Systems	0.192	0.078	2.462	0.015
Mobile Network Coverage	0.210	0.072	2.917	0.004
Digital Payment Options	0.230	0.070	3.286	0.001
Security Measures	0.155	0.082	1.890	0.061
Staff Digital Skills	0.198	0.076	2.605	0.010
R	0.826			
R^2	0.682			
Adjusted R^2	0.668			
F-Statistic	45.32			
Sig. F				0.000

Source: Field Survey, 2025

The regression analysis indicates that the model explains approximately 68.2% of the variance in online sales volume among supermarket stores in Awka Metropolis, Nigeria, demonstrating a strong fit. The overall F-statistic of 45.32 with a significance level of 0.000 confirms that the model is statistically significant, and the independent variables collectively influence e-commerce adoption. Internet Access ($\beta = 0.245$, $p = 0.005$) has a positive and statistically significant effect on online sales volume, implying that better internet connectivity substantially enhances e-commerce activities for supermarkets. This underscores the importance of reliable internet infrastructure in facilitating online retail operations. Website Presence ($\beta = 0.180$, $p = 0.018$) also significantly influences online sales, highlighting that having an accessible and functional website encourages customer engagement and transactions. Similarly, POS Systems ($\beta = 0.192$, $p = 0.015$) facilitate seamless online and offline integration, positively impacting e-commerce growth. Mobile Network Coverage ($\beta = 0.210$, $p = 0.004$) is a key driver, suggesting that extensive mobile coverage allows customers to access online platforms easily, thus boosting online sales. Digital Payment Options ($\beta = 0.230$, $p = 0.001$) exhibit the strongest positive effect, indicating that secure and diverse digital payment methods are critical in increasing online transaction volumes. Security Measures ($\beta = 0.155$, $p = 0.061$) show a marginally significant positive relationship, emphasizing that security enhances customer trust and online sales. Lastly, Staff Digital Skills ($\beta = 0.198$, $p = 0.010$) significantly contribute to e-commerce success, emphasizing the need for staff training and digital literacy. These results advocate for strategic investments in digital infrastructure by improving internet access, developing user-friendly websites, expanding mobile coverage, integrating secure digital payments, and enhancing staff skills. Policymakers and business owners should prioritize these areas to foster robust e-commerce ecosystems in Awka Metropolis, ultimately boosting sales and competitiveness.

Hypotheses Testing

Table 4: Regression Results for Test of Hypotheses on Digital Infrastructure and E-Commerce Adoption

Variable	t-Statistic	p-value
Constant	1.875	0.063
Internet Access	2.882	0.005
Website Presence	2.400	0.018
POS Systems	2.462	0.015
Mobile Network Coverage	2.917	0.004
Digital Payment Options	3.286	0.001
Security Measures	1.890	0.061
Staff Digital Skills	2.605	0.010

Source: Field Survey, 2025

$H0_1$: Internet access has no significant effect on online sales volume among supermarket stores in Awka Metropolis, Nigeria.

Coefficient = 0.245, p-value = 0.005

Since the p-value is less than 0.05, we reject the null hypothesis. This indicates that internet access has a significant positive effect on online sales volume. Improving internet infrastructure can therefore enhance e-commerce activities among supermarkets.

$H0_2$: Website presence has no significant effect on online sales volume among supermarket stores in Awka Metropolis, Nigeria.

Coefficient = 0.180, p-value = 0.018

The p-value is below 0.05, so we reject the null hypothesis. Website presence significantly influences online sales, emphasizing the importance of a well-maintained online storefront for boosting sales.

$H0_3$: POS systems have no significant effect on online sales volume among supermarket stores in Awka Metropolis, Nigeria.

Coefficient = 0.192, p-value = 0.015

With a p-value less than 0.05, we reject the null hypothesis. POS systems contribute positively and significantly to online sales, likely facilitating seamless transactions and integration between online and offline sales channels.

$H0_4$: Mobile network coverage has no significant effect on online sales volume among supermarket stores in Awka Metropolis, Nigeria.

Coefficient = 0.210, p-value = 0.004

The p-value indicates significance; thus, we reject the null hypothesis. Better mobile network coverage enables easier access for customers, thereby increasing online sales.

$H0_5$: Digital payment options have no significant effect on online sales volume among supermarket stores in Awka Metropolis, Nigeria.

Coefficient = 0.230, p-value = 0.001

Highly significant; we reject the null hypothesis. The availability of diverse and secure digital payment options strongly influences the volume of online sales.

$H0_6$: Security measures have no significant effect on online sales volume among supermarket stores in Awka Metropolis, Nigeria.

Coefficient = 0.155, p-value = 0.061

Since the p-value is slightly above 0.05, this effect is marginally significant. We fail to reject the null hypothesis at the 5% level but note that security measures tend to positively influence online sales. Improving security could further boost customer confidence.

$H0_7$: Staff digital skills have no significant effect on online sales volume among supermarket stores in Awka Metropolis, Nigeria.

Coefficient = 0.198, p-value = 0.010

The p-value is below 0.05, so we reject the null hypothesis. Staff digital literacy significantly impacts online sales, highlighting the importance of staff training and capacity building.

6. CONCLUSION AND RECOMMENDATIONS

1. The analysis shows that improved internet access significantly increases online sales volume among supermarkets, indicating that reliable and fast internet connectivity is crucial for expanding e-commerce activities.
2. Having a functional and user-friendly website positively influences online sales, suggesting that supermarkets with online storefronts can attract and retain more customers, thereby boosting sales.
3. The integration of Point-of-Sale systems has a significant positive effect on online sales, highlighting the importance of seamless transaction systems that connect online and offline retail operations.
4. Extensive mobile network coverage significantly enhances online sales, demonstrating that widespread mobile connectivity facilitates easier access and increased customer engagement with e-commerce platforms.
5. Offering diverse and secure digital payment methods significantly contributes to higher online sales volumes, emphasizing that payment convenience and security are key to customer trust and transaction volume.
6. While security measures show a positive relationship with online sales, the effect is marginally significant, implying that strengthening online security could further encourage customers to shop online confidently.
7. The digital literacy and skills of staff significantly influence online sales, underscoring the importance of staff training to effectively manage online platforms and enhance customer service in e-commerce.

Based on the analysis, it is evident that each of the coefficients plays a significant role in influencing online sales among supermarkets in Awka Metropolis. Improved internet access emerges as a fundamental driver, underscoring the necessity for robust telecommunications infrastructure to facilitate seamless online transactions. The presence of a functional website significantly enhances the supermarket's ability to attract and retain customers, highlighting the importance of digital visibility and user experience. The integration of POS systems demonstrates that technological synergy between online and offline operations can streamline sales processes and improve efficiency. Widespread mobile network coverage is crucial in extending the reach of e-commerce, particularly in regions where mobile devices are primary access points to the internet. Offering diverse, secure digital payment options builds customer confidence and simplifies the

purchasing process, directly contributing to increased sales volumes. Although security measures show a positive relationship, their marginal significance indicates that further strengthening online security protocols could foster greater customer trust and repeat business. Lastly, the digital skills of staff are vital; well-trained personnel ensure effective management of online platforms and superior customer service, ultimately elevating online sales performance. Collectively, these findings emphasize the multifaceted approach needed—combining infrastructure development, technological investments, security enhancements, and human resource capacity building to effectively boost online retail growth in the region. The study therefore recommends that:

1. The Government and Telecommunications Providers should invest in and improve internet infrastructure to ensure reliable, high-speed internet access across Awka Metropolis, enabling supermarkets and consumers to engage more effectively in online commerce.
2. Supermarket Management and Website Developers should develop and maintain professional, user-friendly websites that showcase products and services effectively, attracting more online customers and increasing sales.
3. Supermarket Owners and E-Commerce System Providers should implement and upgrade POS systems that integrate seamlessly with online platforms, facilitating smooth transactions and inventory management to enhance customer experience.
4. Telecommunications Companies and Policymakers should expand mobile network coverage, especially in underserved areas, to ensure that more customers can access online shopping platforms conveniently on their mobile devices.
5. Supermarket Management and Payment Service Providers should offer a variety of secure digital payment options (e.g., mobile money, card payments, e-wallets) to cater to diverse customer preferences and build trust in online transactions.
6. Supermarket IT Security Teams and Cybersecurity Firms should enhance online security measures such as SSL certificates, secure payment gateways, and regular security audits to protect customer data and increase trust in online shopping.
7. Supermarket Owners and Human Resource Managers should provide regular training and capacity-building programs to enhance staff digital skills, ensuring that employees can efficiently manage online sales platforms and customer interactions.

Implications of the Study to the Economy

The findings of this study have significant implications for the economy of Awka Metropolis, as they highlight the critical factors that can enhance the growth of online retailing, which in turn can stimulate economic activity, create employment opportunities, and increase revenue for local businesses. By improving internet infrastructure, digital payment systems, and technological capabilities, the region can attract more consumers to online platforms, expanding the market reach of supermarkets and fostering entrepreneurial ventures. This digital shift has the potential to reduce operational costs, increase competitiveness, and promote economic diversification, ultimately contributing to the overall economic development and resilience of the community.

Contribution of the Study to Knowledge

This study contributes to the existing body of knowledge by providing empirical evidence on the specific factors influencing online sales within the context of Nigerian supermarkets, particularly in Awka Metropolis. It underscores the importance of technological infrastructure, digital security, and human capital in driving e-commerce growth in emerging markets. Additionally, the research offers valuable insights into how different coefficients interact and influence online retail performance, thereby filling a gap in the literature on e-commerce adoption in developing economies. The

findings serve as a foundation for further research and policymakers aiming to foster a conducive environment for digital commerce expansion.

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