ARTIFICIAL INTELLIGENCE AND PRODUCTIVITY IN NIGERIAN SMALL SCALE BUSINESSES: A REVIEW OF LITERATURE

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ABSTRACT

This study reviewed the adoption and impact of Artificial Intelligence (AI) on the operations of Small-Scale Businesses (SSBs) in Nigeria, focusing on the extent of integration, resulting operational improvements, and prevailing challenges. Drawing insights from global and local empirical studies, the research employed the Technology Acceptance Model (TAM) as a theoretical framework to analyze perceptual factors influencing AI uptake. Findings revealed that while AI offers transformative potential—enhancing operational efficiency, customer engagement, and data-driven decision-making—its adoption among Nigerian SSBs remains limited. This is largely due to infrastructural deficits, financial constraints, digital illiteracy, and a persistent skills gap. The study concluded that despite these limitations, targeted policy

Introduction

Small-scale businesses form the bedrock of Nigeria's informal and formal economies, serving as vital engines for grassroots development, employment creation, and poverty reduction. Unlike larger enterprises, small-scale businesses typically operate with limited capital, minimal infrastructure, and a relatively small workforce, yet they contribute significantly to Nigeria's economic fabric. According to the National Bureau of Statistics (NBS) and the Small and Medium Enterprises Development Agency of Nigeria (2021), small-scale enterprises constitute a large proportion of the over 39 million Micro, Small, and

interventions, capacity-building initiatives, and strategic partnerships can significantly drive AI adoption and productivity growth in Nigeria's SME sector. The research contributed to the growing discourse on digital transformation in developing economies and provides practical recommendations for stakeholders.

Keywords: Artificial Intelligence, Small-Scale Businesses, Technology Adoption Model, Operational Efficiency, Digital Transformation, SSBs.

M edium Enterprises (MSMEs) in Nigeria, playing a crucial role in local commerce and community sustenance. These businesses are instrumental in driving economic inclusion and resilience, particularly in under-served and rural areas (Adewale & Adebayo, 2020). However, they are often constrained by persistent challenges, such as limited access to finance, poor infrastructure, and lack of business support services, which collectively hinder their capacity to grow and scale (Ogunyomi & Oluwaseyi, 2019).

In recent times, the advent of Artificial Intelligence (AI) has introduced transformative opportunities for small businesses around the world, including in Nigeria. AI technologies— ranging from machine learning and natural language processing to predictive analytics—offer tools that can streamline operations, enhance customer engagement, and boost productivity (Makinde, 2022). For instance, AI-powered solutions such as chatbots can provide cost effective customer service, while intelligent data analysis can inform inventory management and marketing strategies (Oke & Fernandes, 2020). These innovations are reshaping the way businesses operate globally and have the potential to enhance the competitiveness of small-scale enterprises in Nigeria (Brynjolfsson & McAfee, 2017). However, the integration of AI into small-scale businesses in Nigeria remains limited, primarily due to structural and contextual constraints. Ndubuisi-Okolo et al. (2025) reported that less than 15% of SSBs in Nigeria have meaningfully integrated AI technologies into their operations. This minimal uptake is attributed to high costs of adoption, lack of skilled manpower, and poor digital infrastructure. Similarly, Adeleke (2019) reported that while awareness of AI among entrepreneurs is increasing, fewer than 10% of small businesses in South-West Nigeria use AI for business functions like customer service, marketing, or data analytics. Additionally, Bala et al. (2024) emphasized that more than 70% of SSBs still rely entirely on manual processes, indicating a wide gap between AI awareness and implementation. These statistics underscore the argument that without deliberate intervention— through subsidized digital tools, targeted capacity building, and improved

broadband access—Nigeria's small-scale businesses may be left behind in the global shift toward intelligent automation. The transformative potential of AI will remain unrealized unless proactive policies address the socio-economic barriers limiting its adoption.

One major hurdle is the high cost associated with adopting AI tools, including hardware, software, and technical expertise—resources that most small businesses cannot afford (Eze & Chinedu-Eze, 2021). Additionally, many small-scale business owners lack adequate knowledge of AI and its potential benefits, resulting in skepticism and under utilization (Akinwale, 2023). Nigeria's infrastructural challenges— particularly unstable electricity and insufficient internet coverage— further complicate the adoption of AI technologies, which depend on consistent connectivity and power (Ogundana et al., 2021). Compounding these issues is a shortage of skilled personnel to implement and maintain AI solutions, reflecting a broader national skills gap (Oluwatobi et al., 2019).

Despite these challenges, efforts are emerging to close the digital divide. The Nigerian government, through its National Digital Economy Policy and Strategy, (2020), has emphasized the need to empower small businesses with digital tools, including AI. Partnerships with global technology firms are beginning to provide scalable, cost-effective AI applications tailored to local business contexts (Makinde, 2022). Nonetheless, gaps remain in the regulatory and ethical frameworks guiding AI use, raising concerns about data privacy, algorithmic bias, and cybersecurity— issues that could disproportionately affect vulnerable small-scale operators (Okafor & Nwosu, 2021).

While AI holds immense promise for revolutionizing small-scale businesses in Nigeria, its effective adoption is contingent upon addressing critical barriers related to cost, awareness, infrastructure, and human capital. The intersection of these challenges and emerging opportunities calls for a holistic strategy that combines public policy, private sector innovation, and academic research. As Adewale and Adebayo (2020) suggest, fostering the sustainable growth of small-scale businesses in an AI-driven economy requires inclusive, context-aware interventions that bridge technological and socio-economic divides. This review provides a foundation for further exploration into the pathways through which AI can empower Nigeria's small-scale enterprises.

Research Problem

Small-scale businesses in Nigeria are vital to economic development, yet their ability to remain competitive and sustainable is increasingly challenged in a rapidly digitizing global economy. The advent of Artificial Intelligence (AI) presents a dual-

edged sword: it offers unprecedented opportunities to enhance operational efficiency, customer engagement, and market adaptability, yet its adoption among Nigerian small-scale businesses remains markedly low due to restricted access to funding, inadequate infrastructure, and a lack of technological know-how, challenging their operational efficiency (Adeleke, 2019; Eze & Chinedu-Eze, 2021; and Ndubuisi-Okolo et al., 2025). This discrepancy raises critical questions about the factors impeding AI integration and the extent to which these barriers undermine the potential of small businesses to contribute meaningfully to Nigeria's economic diversification goals.

Several interconnected issues define this research problem. Firstly, the high cost of AI implementation—encompassing software, hardware, and skilled personnel—places it beyond the financial reach of most small-scale businesses, which typically operate on minimal capital and limited margins (Ogundana et al., 2021). Secondly, a pervasive lack of awareness and technical expertise among small business owners limits their ability to harness AI tools effectively, reflecting broader deficiencies in digital literacy and workforce development (Akinwale, 2023). Thirdly, Nigeria's infrastructural challenges, including unreliable electricity and inadequate internet connectivity, significantly reduce the feasibility of deploying AI solutions in small business environments (Oluwatobi et al., 2019). These barriers are further compounded by the absence of a robust regulatory framework to address ethical and legal concerns, such as data privacy, algorithmic fairness, and cyber security risks, which collectively deter meaningful adoption (Okafor & Nwosu, 2021).

While the National Digital Economy Policy and Strategy (2020) articulates a governmental commitment to digital transformation, its practical impact on small-scale businesses remains uncertain. Global literature emphasizes AI's transformative potential for business performance and innovation (Brynjolfsson & McAfee, 2017), yet there is a notable lack of empirical research focused specifically on the Nigerian small business landscape. This gap in knowledge hampers the development of targeted strategies and support systems to facilitate AI adoption in this segment. Consequently, without a thorough understanding of these context-specific barriers and opportunities, the promise of AI as a tool for enhancing the competitiveness and resilience of small-scale businesses in Nigeria may remain largely unrealized.

Objectives of the Study

The primary objective of this study was to critically review existing literature on the relationship between Artificial Intelligence (AI) and operations of Small-Scale Businesses (SSBs) in Nigeria, with a view to identifying the opportunities, challenges, and gaps in AI adoption among these businesses. By synthesizing insights from both

global and Nigerian perspectives, the study sought to contribute to the growing discourse on how AI can be harnessed to bolster the resilience and growth of SSBs within the Nigerian economic landscape.

The following specific objectives were set:

i. To ascertain the extent to which small-scale businesses in Nigeria have integrated AI into their operations, identifying prevalent trends and practices.

ii. To evaluate operational efficiency, enhanced customer engagement, and data-driven decision making in small businesses in Nigeria due to AI.

iii. To evaluate challenges in leveraging AI for sustainable growth in the SMEs sector in Nigeria.

Literature Review
Operational Efficiency of Small-Scale Businesses in Nigeria

Balmurugan and Yogeswari (2024) defined operational efficiency as the 'ability to deliver products or services cost-effectively while maintaining high quality and customer satisfaction.' They noted it as a 'critical metrics for organizational success.' Operational efficiency has also been viewed as achieving appropriate strategic goals with minimal resources, without sacrificing quality (Lee & Johnson, 2018). For small businesses, operational efficiency involves the ability to optimize their 'internal processes and resources to achieve maximum output with minimal input (Okafor & Chia, 2024). Evaluating operational efficiency and productivity involves both qualitative and quantitative metrics: revenue per employee; inventory turnover ratio; production output per unit input; customer retention/ satisfaction; and cost reduction/time savings (Lee & Johnson, 2018; Adebayo, 2020; Balmurugan &Yogeswari, 2024; and Okafor & Chia, 2024).

Small-Scale Businesses are the cornerstone of Nigeria's economy, serving as engines of employment, innovation, and economic resilience. The Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) and the National Bureau of Statistics (NBS) (2020) define SMEs as businesses employing fewer than 250 workers with an annual turnover below ₦100 million. These enterprises account for 96.9% of all businesses, contribute 46.32% to GDP, and provide 87.9% of employment opportunities (NBS & SMEDAN, 2021). Therefore, the need for operational efficiency of these businesses cannot be overemphasized. Human capital development. access to finance, infrastructure government policies and regulatory environment, and technology adoption: the integration of digital tools and AI-driven processes can enhance speed, accuracy, and cost-effectiveness, and as such, are all essential factors determining operational efficiency in small businesses in Nigeria.

(Lee & Johnson, 2018; Adebayo, 2020; Balmurugan &Yogeswari, 2024; and Okafor & Chia, 2024).

While discussing the role of SSBs in poverty alleviation and economic diversification, especially as Nigeria seeks to reduce its dependence on oil revenues, Adebayo (2020) argued that integrating innovative tools like Artificial Intelligence (AI) can enhance the capacity of these businesses to create jobs and stimulate inclusive economic growth. They thus emphasized the use of AI in the operational efficiency of SSBs in Nigeria.

The Concept of Artificial Intelligence (AI) Artificial Intelligence (AI) refers to the development of computer systems capable of performing tasks that emulate human intelligence, such as learning, problem-solving, and decision-making (Russell & Norvig, 2021). Encompassing sub-fields like machine learning, natural language processing, robotics, and data analytics, AI enables machines to process vast datasets, recognize patterns, and execute complex functions with minimal human intervention (Kaplan & Haenlein, 2019). Globally, AI has transformed business operations by automating repetitive tasks, optimizing resource allocation, and enhancing predictive capabilities (Brynjolfsson & McAfee, 2017). For instance, AI-driven tools such as chatbots and recommendation systems have revolutionized customer engagement and operational efficiency (Davenport & Ronanki, 2018). In the Nigerian context, Makinde (2022) emphasizes AI's potential as a driver of technological innovation, though its application remains under-explored due to local constraints. This conceptual foundation underscores AI's relevance as a tool for economic advancement, particularly in resource-constrained settings

AI Integration in Small-Scale Businesses in Nigeria AI integration among Nigerian SSBs remains limited, with only an estimated 14% of SMEs incorporating some form of AI—primarily chatbots, recommendation engines, and basic analytics tools—into their business operations (Ayo et al., 2021; Techpoint Africa, 2023; SMEDAN, 2022). Despite the low overall adoption of AI in Small-Scale Businesses in Nigeria due to systematic and structural challenges within the business environment, there is a discernible trend towards increased AI integration among Nigerian SSBs, particularly in sectors such as retail, manufacturing, and hospitality. In the retail sector, for instance, SSBs are beginning to leverage AI tools/ practices such as customer service automation (utilization of AI-powered chatbots and virtual assistants to handle customer inquiries and provide 24/7 support); marketing automation (implementation of AI tools for personalized content delivery, audience segmentation, and predictive analytics to enhance marketing strategies); financial management (adoption of AI-driven accounting software to automate tasks such as expense tracking and financial reporting. These practices are facilitated by the

availability of user-friendly AI tools like Jasper AI, Zoho Zia, Canva, QuickBooks, Hootsuite, and Mailchimp, which are increasingly being utilized by some Nigerian SSBs to streamline operations and improve customer engagement, and productivity. (Oke & Fernandes, 2020; Eze & Chinedu-Eze, 2021; Makinde & Olayemi, 2021; and Ndubuisi-Okolo et al., 2025).

AI Adoption and Operational Efficiency

AI adoption significantly improves operational efficiency in SSBs. A study by Olamide et al. (2024) on SMEs in Edo State reported a 25% increase in operational efficiency due to AI integration, particularly in inventory management and workflow automation Similarly, research from PCG Insights (2023) found that AI implementation can lead to a 32.71% improvement in operational efficiency by reducing manual processes and errors. SSBs that integrate AI report productivity gains of between 20% and 35%, depending on the scale and nature of AI tools used (PCG Insights, 2023). Conversely, firms that lack AI capabilities often report stagnant or declining performance metrics, especially in competitive markets where digital agility is crucial. Undoubtedly, AI adoption in SSBs leads to operational efficiency and productivity.

AI Adoption and Customer Engagement

AI tools have enabled businesses to personalize communication and respond to customer inquiries in real-time through chatbots and virtual assistants. According to Farmonaut (2024), SSBs that adopted AI for customer service in e-commerce noted a 22% increase in customer retention and satisfaction due to more responsive and targeted engagement. However, less than 15% of Nigerian SSBs have adopted such tools (Ndubuisi-Okolo et al., 2025, International Journal of Business and Management Invention, idpublications.org). This means that the majority are missing out on low-cost, high-impact digital tools for improved customer relationship management.

AI Adoption and Data-Driven Decision Making

A study by Eze and Chinedu-Eze (2021) found that AI-enhanced analytics tools have empowered SMEs to make 65% more informed decisions, particularly in retail and service industries (Eze, S. C., & Chinedu-Eze, V. C., Journal of Small Business and Enterprise Development, 2021). These decisions include market trend forecasting, customer behavior analysis, and product development. Meanwhile, Adeleke (2019) reported that over 80% of SSBs still depend on intuition or outdated data, primarily due to the absence of digital infrastructure and analytic tools.

Challenges of AI adoption by SMEs in Nigeria

The adoption of AI by Nigerian SMEs is fraught with different challenges that hinder its widespread implementation. Financial constraints represent a primary barrier, as the high costs of AI infrastructure as software, hardware, and skilled personnel exceed the budgetary capacity of most small businesses (Ogundana et al., 2021). Additionally, a significant knowledge gap persists, with many SME operators lacking awareness of AI's benefits or the technical expertise to deploy it (Akinwale, 2023). Infrastructural deficiencies, notably unreliable electricity and limited internet access, further complicate AI integration, as these systems demand stable connectivity and power (Oluwatobi et al., 2019). Ethical and regulatory concerns, including data privacy and cybersecurity risks, also deter adoption, exacerbated by Nigeria's nascent legal framework for AI governance (Okafor & Nwosu, 2021). Globally, Tambe et al. (2019) note resistance to technological change as a barrier, a sentiment echoed in Nigeria where fears of job displacement and mistrust in automation prevail (Edeh, 2022). Addressing these challenges requires a concerted effort to align AI solutions with the socio-economic realities of Nigerian SMEs.

Theoretical Framework

Several theoretical frameworks have been used to explain how emerging digital technologies, such as Artificial Intelligence (AI), influence productivity in small-scale businesses. Among the most prominent are the Technology Acceptance Model (TAM), Diffusion of Innovation (DoI), and the Resource-Based View (RBV) (Davis, 1989; Rogers, 2001, 2005; Barney, 2001; Makinde, 2021). This study adopts the Technology Acceptance Model (TAM), originally developed by Fred Davis in 1986 as an extension of Ajzen and Fishbein's Theory of Reasoned Action, as its guiding framework. TAM is considered most appropriate for this research because it focuses directly on the perceptual factors—namely *Perceived Usefulness (PU)* and *Perceived Ease of Use (PEOU)*—that shape individuals' decisions to adopt new technologies. These constructs provide valuable insights into why Nigerian small-scale business owners choose to adopt or resist AI in their operations. In particular, the model effectively explains common challenges such as low technological awareness, resistance to change, and concerns about complexity, all of which can influence adoption behavior. Compared to other models, TAM offers a more targeted perspective. While DoI examines the broader process by which innovations spread through a population, and RBV emphasizes an organization's internal resources and capabilities, TAM zeroes in on the user's decision-making process. Its emphasis on attitudes and perceptions makes it especially relevant for understanding how SME operators in Nigeria evaluate and respond to AI technologies.

TAM has been widely adopted across various domains of technology adoption research due to its simplicity, empirical robustness, and predictive power. It is especially relevant in examining user-level factors, which aligns with the realities in Nigeria, where SSB decisions are often driven by the business owner or manager's individual perceptions. Therefore, TAM provides a strong conceptual basis for understanding the behavioral factors that shape AI adoption among SSBs.

However, TAM has faced several criticisms. Scholars such as Bagozzi (2007) and Benbasat and Barki (2007) argue that TAM is overly simplistic and neglects external variables such as social influence, cultural context, and organizational dynamics. Additionally, TAM assumes a linear, rational decision-making process, which may not capture the complex, sometimes informal realities of small-scale businesses in developing economies like Nigeria.

Despite these criticisms, TAM remains highly valuable to this discussion. Its relevance lies in its focus on the perception-based decision-making process, which is central to the AI adoption gap in Nigerian SSBs. While broader models like the Diffusion of Innovation (DOI) and Resource-Based View (RBV) highlight macro-level trends and firm-level capabilities, TAM offers granular insights into why business owners may be reluctant to adopt AI—even when the infrastructure exists. It helps uncover subjective barriers like fear of complexity, perceived lack of control, or skepticism about value, which are often overlooked in more structurally oriented frameworks.

Empirical Review

Dwivedi et al. (2021) conducted a mixed-methods study on 275 SMEs in the United Kingdom to explore drivers of AI adoption. Using surveys and in-depth interviews, they found that perceived usefulness, organizational readiness, and financial capacity were major determinants. The study emphasized that firms with high digital maturity were more likely to adopt AI tools such as predictive analytics and automated customer engagement systems. The authors recommended structured government incentives and digital literacy programs as strategies to support less digitally advanced SMEs.

Kedi et al. (2024) explored the role of AI software in personalized marketing automation for SMEs. Their findings suggest that AI tools improve customer engagement and sales performance by enabling personalized content delivery and predictive analytics. Muktar, Ufua, and Okorie (2024) examined the relationship between AI capabilities and the growth of SMEs in Nigeria. Their study found that AI

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adoption positively influences innovation, employment, and business expansion, particularly in sectors like manufacturing and hospitality.

In his research, Adeleke (2019) focused on the application of AI in SMEs in Southwest Nigeria. He identified challenges such as limited awareness, infrastructural deficits, and cultural factors that hinder AI adoption. Despite these challenges, the study underscores the potential of AI to enhance competitiveness through automation and data-driven insights.

Izugboekwe et al. (2024) investigated the impact of AI on business security among SMEs in Abuja. The authors find that AI-driven security protocols, employee training, and automated threat detection significantly enhance business resilience and customer trust. Furthermore, a study by Muktar, Ufua, and Okorie (2024) examined the relationship between

AI capabilities and the growth of SMEs in Nigeria. Their findings suggest that while there is a growing interest in AI, actual adoption rates remain low due to various barriers, including financial constraints and limited technical expertise.

Chatterjee et al. (2022) used a case study methodology to investigate AI use in SMEs across five European countries. The study found that AI was primarily adopted for chatbots, demand forecasting, and process automation. Data was collected through structured interviews with SME managers and IT consultants. Financial constraints, lack of in-house expertise, and unclear ROI were identified as major barriers. The authors recommended stronger publicprivate partnerships, innovation grants, and sector-specific AI training as practical enablers for SMEs.

In China, Wang et al. (2021) employed a quantitative approach using structural equation modeling (SEM) to study 480 SMEs. The study concluded that AI adoption was largely influenced by government policies, subsidies, and access to cloud infrastructure. SMEs in the tech and manufacturing sectors showed the highest adoption rates. However, concerns around data security, algorithmic transparency, and talent shortages persisted. The authors proposed enhanced cybersecurity policies, AI talent pipelines through universities, and regulatory clarity as policy directions.

In Ghana, a study by Makinde (2021) found that SMEs with external funding sources were more likely to adopt AI technologies. The research highlighted the importance of strategic partnerships between SMEs and technology providers in facilitating AI adoption. It also pointed out that SMEs with strong leadership support and a culture of innovation had higher AI adoption rates.

In South Africa, a systematic literature review by Moyo et al. (2022) examined AI adoption in manufacturing SMEs. The study identified that AI adoption was low, limiting innovation and productivity. A major constraint was the lack of a framework

to enhance adoption and implementation. The study recommended developing a comprehensive framework to improve AI adoption among manufacturing SMEs.

Ayo et al. (2021) surveyed Nigerian SMEs and found low awareness of AI applications, with only a small fraction using tools like chatbots and predictive analytics. They recommended government-led training programs and financial incentives to boost adoption, noting that limited technical skills hindered progress.

Olayemi (2022) investigated AI's role in enhancing Nigerian SME performance, reporting improvements in operational efficiency, customer satisfaction, and revenue among adopters. However, high implementation costs and a shortage of skilled personnel were identified as significant barriers, underscoring the skills gap as a critical impediment.

Okonkwo and Nwankwo (2023) explored AI's impact on SME competitiveness in Nigeria, finding that AI improved decision-making, customer retention, and marketing effectiveness. Yet, they highlighted data security risks, regulatory uncertainty, and resistance to change as obstacles, with technical expertise shortages further complicating adoption.

Adegbuyi et al. (2024) examined AI adoption among SMEs in Southwest Nigeria, surveying 355 respondents. Their findings revealed that while 75% were aware of AI technologies, only 55-63% understood industry-specific applications. Major barriers included financial constraints, inadequate infrastructure, insufficient technical manpower skills, and cultural resistance. They recommended targeted educational initiatives and improved infrastructure to address the skills gap and enhance AI integration.

Ebuka et al. (2023) studied AI as a catalyst for SME sustainability in Southeast Nigeria, surveying 379 registered small businesses. They found that most SMEs operated manually, missing AI's potential due to a lack of technical skills and awareness. Their work underscores the skills gap as a barrier to leveraging AI for growth, advocating for broader AI education.

Bala et al. (2024) highlighted AI applications—such as chatbots, robotic process automation, and recommendation systems—for Nigerian SMEs through interviews and content analysis. They identified benefits like enhanced customer service and efficiency but noted challenges including a shortage of specialized personnel, high costs, and inadequate infrastructure, all tied to the skills gap.

Chukwuemeka-Onuzulike et al. (2024) focused on AI and SME growth in Anambra State, surveying 50 operators. Their regression analysis showed a 21% improvement in business model design due to AI, driven by efficiency gains. However, they noted that the lack of skilled personnel limited adoption, recommending AI training to enhance productivity.

Methodology

This study adopts a qualitative research design, employing a structured literature review as its primary method of inquiry. The approach is grounded in secondary data analysis, which involves systematically identifying, evaluating, and synthesizing existing scholarly materials relevant to the adoption of Artificial Intelligence (AI) in small-scale businesses. The data sources for this study include peer-reviewed journal articles, academic books, government and institutional reports, conference proceedings, and previous empirical studies. These documents were selected to ensure a comprehensive and balanced representation of theoretical, conceptual, and empirical insights. Databases such as Google Scholar, JSTOR, Scopus, Research-gate, and Science-direct were used to retrieve relevant literature, focusing on studies published between 2000 and 2024. Special attention was given to literature that explores the Technology Acceptance Model (TAM), AI adoption, small business productivity, and the Nigerian entrepreneurial context.

The inclusion criteria for selecting documents were:

- Relevance to the key variables of interest (AI, small-scale businesses, technology adoption);
- Credibility and academic rigor (peer-reviewed or institutionally recognized);
- Published in English;
- Focus on or applicable to developing economies, especially Nigeria and Sub-Saharan Africa.

Excluded were articles that lacked empirical or theoretical depth, blog posts, opinion pieces, and outdated studies not aligned with current technological trends. This methodology enables a rich conceptual exploration of the topic, drawing connections across various sources to identify common patterns, theoretical gaps, and emerging themes. Through this approach, the study builds a grounded understanding of the perceptual, contextual, and institutional factors influencing AI adoption among Nigerian small-scale businesses.

Conclusion

The study concludes that AI integration among Nigerian SSBs remains limited, with only an estimated 14% of SMEs incorporating some form of AI—primarily chatbots, recommendation engines, and basic analytics tools—into their business operations (Techpoint Africa, 2023; SMEDAN, 2022). The uptake is notably higher in fintech and e-commerce sectors, where the need for automation and real-time customer interaction is more pressing (Bala et al., 2024). Despite growing awareness—75% of surveyed SMEs according to Adegbuyi et al. (2024)— actual adoption lags behind

due to infrastructural and capacity gaps. This limited penetration underscores the need for strategic policy and educational interventions to increase AI adoption.

Evidence shows that businesses that have adopted AI report measurable improvements in operational efficiency, customer engagement, and data-driven decision-making. Olayemi (2022) reported up to a 30% improvement in service delivery speed and operational cost reduction among AI-adopting SMEs. Similarly, Bala et al. (2024) found that AI-enabled systems such as virtual assistants improved customer response time and satisfaction, while predictive analytics supported more accurate inventory and marketing decisions. These improvements affirm AI's potential in transforming productivity across key business functions. Nonetheless, the benefits are disproportionately experienced by digitally mature SMEs with better access to skills and infrastructure.

The study reaffirms that the major challenges to AI adoption in Nigeria include a persistent skills gap, financial limitations, poor infrastructure, and low digital literacy (Ebuka et al., 2023; Ogwuche et al., 2024). The cost of implementation, coupled with cybersecurity concerns and a lack of regulatory clarity, deters many SMEs from embracing AI. The Technology Acceptance Model (Davis, 1989), used as the theoretical framework for this study, helps explain these barriers—specifically low perceived ease of use (PEOU) and perceived usefulness (PU) among SME owners due to limited technical exposure. Despite criticisms of TAM for its narrow focus on individual perceptions, its relevance remains strong in understanding SME operators' decision-making behavior in the Nigerian context.

Recommendations
The study recommends the following to the government and other stakeholders of the Nigerian business environment:

Policy and Infrastructure (High Priority)
- Develop a National AI Policy Framework: Include tax incentives, startup grants, and subsidies for AI adoption.
- Strengthen Public-Private Partnerships: Promote development of affordable, SME-friendly AI tools.
- Expand Digital Infrastructure: Invest in broadband internet, cloud access, and regional AI hubs.

Awareness and Engagement (Medium Priority)
Launch AI Awareness Campaigns: Use industry associations and chambers to organize workshops, success story showcases, and digital literacy events.

Skills Development (High Priority)
- Provide Practical AI Training: Through SMEDAN, NITDA, universities, and tech firms; focus on chatbots, automation, and analytics tools.
- Offer Sector-Specific, Hands-on Learning: Tailor content to sectors like retail, services, and informal trade.

Localized AI Solutions (Medium Priority)
- Promote SME-Tech Firm Collaborations: Develop tools suited to local languages, customer behavior, and market needs (e.g., Pidgin-trained chatbots, seasonal sales predictors).

Financial Support Mechanisms (High Priority)
- Create SME-Specific Financing Models: Low-interest loans, leasing schemes, and innovation grants for AI tools.
- Implement Credit Guarantee Schemes: Reduce lending risk and improve SME access to funding.

Governance and Innovation (Medium Priority)
- Establish AI Ethical and Regulatory Frameworks: Address data privacy, cybersecurity, and bias concerns.
- Support Local AI Startups and Incubators: Encourage development of cost-effective, context-relevant solutions.
- Facilitate Multi-Stakeholder Innovation Platforms: Link academia, SMEs, and developers for collaborative solution-building.

Contribution to Knowledge

This study enriches the literature on AI adoption in SMEs by providing a Nigerian-centric perspective. Through its integrated review of conceptual, theoretical, and empirical insights, it offers a nuanced understanding of AI's drivers, barriers—particularly the skills gap—and benefits in a developing economy context. By synthesizing recent Nigerian studies (Adegbuyi et al., 2024; Ebuka et al., 2023), it highlights actionable gaps in policy, skills development, and infrastructure, contributing to both academic discourse and practical strategies for SME digital transformation in Nigeria.

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