

# Artificial Intelligence and Sustainability of Small and Medium Scale Enterprises in Anambra State, Nigeria

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## Abstract

This article investigates the intersection of artificial intelligence (AI) and the sustainability of small and medium-sized businesses (SMEs) in Anambra State, Nigeria. It looks at how AI technologies might help SMEs improve operational efficiency, lower expenses, and promote environmentally friendly behaviour. The article also discusses the challenges faced by these businesses in implementing AI, and offers recommendations for stakeholders, including governments, educational institutions, and industry associations, to assist these companies in integrating AI into their daily operations. This can be achieved through training programmes aimed at enhancing the digital and technological proficiency of the owners, managers, and staff of SMEs in Anambra State. The results show how AI may help SMEs in Anambra State reach sustainability objectives, fostering environmental preservation and eventually economic development.

## Keywords

Artificial intelligence, AI adoption challenges, SME sustainability strategies, developing economies, small and medium scale enterprises, Anambra State

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## **Introduction**

As a transforming technology that has revolutionised many sectors, including small and medium-scale businesses (SMEs), artificial intelligence (AI) presents unheard-of chances for innovation and efficiency. Often running with limited resources, SMEs can benefit from the integration of AI into business processes, as sustainability, efficiency, and innovation are so vital for their long-term survival. Crucially important in the global economy, SMEs support job creation, innovation, and economic growth by means of their activities (Awa et al., 2020). However, SMEs' sustainability has long been a challenge due to their often limited resources, intense competition, and the need to adapt to rapidly changing market conditions (Ghobakhloo & Fathi, 2019). Researchers and practitioners have been investigating the possible advantages and consequences of including AI in the operations and strategic decision-making of SMEs as these technologies develop. The growing number of studies in this field elucidates the intricate relationship between AI and the sustainability of SMEs.

The ways in which AI might improve SMEs' operational efficiency and productivity have been important points of study. Data analytics, machine learning, and AI-powered automation can simplify many corporate operations, like supply chain optimisation, inventory control, and customer relationship management (Bai et al., 2021; Ullah et al., 2021). SMEs can potentially reduce expenses, optimise resource usage, and enhance their overall competitiveness by implementing these AI-driven solutions (Tamilmani et al., 2021). Studies have also looked at how AI may inspire creativity and business within the SMEs. AI-powered technologies can help SMEs optimise their business models, create creative goods and services, and find new market prospects (Alzoubi & Yanamandra, 2020; Awa et al., 2020). By enabling SMEs to stay ahead of consumer trends and industry advancements, AI-powered technologies can contribute to their long-term sustainability. The study also focuses on how AI affects human capital and personnel inside SMEs. AI-driven automation and decision-support systems can possibly upend established work roles and skill needs; thus, employees' upskilling and reskilling are more important than ever (Adewale et al., 2021; Mahmood et al., 2021).

However, in locations such as Anambra State, Nigeria, SMEs confront particular hurdles that prevent them from reaching their full potential. Despite being a commercial hub and a major promoter of entrepreneurship in Southeast Nigeria, many SMEs in Anambra face restricted access to financing, inadequate infrastructure, and a lack of scalable technical solutions. According to a 2022 research study by the Nigerian Bureau of Statistics (NBS), over 70% of SMEs in the region mention finance restrictions as their top hurdle to expansion, with another 45% citing a lack of access to contemporary technology as a major impediment.

Researchers have looked at the best ways for SMEs to properly handle this change and make sure their staff stays flexible enough to advantage of AI capabilities. The study has also looked at the difficulties and obstacles SMEs could run into adopting and using AI technologies. These cover problems with data availability, infrastructure needs, financial restrictions, and the necessity of specific

knowledge (Abdallah et al., 2021; Ghobakhloo, 2020). Developing focused policies, assistance programs, and capacity-building activities to let SMEs maximise the possibilities of AI while preserving their sustainability depends on being aware of these difficulties. Recently, policymakers, business executives, and academics have shown increasing interest in studying the relationship between AI and the sustainability of SMEs. This study's acquired knowledge can guide the development of tailored plans, laws, and support systems, enabling SMEs to thrive in the era of AI-driven change. Nigeria's economic growth depends much on SMEs, who also greatly boost employment and GDP. Although SMEs are essential for local economic development in Anambra State, they suffer many difficulties, including limited access to capital, poor infrastructure, and rivalry from bigger companies (Nwachukwu et al., 2021). This article seeks to find ways in which AI may improve the sustainability of SMEs in Anambra State, supporting environmental responsibility and economic resilience.

## Review of Related Literature

### *Artificial Intelligence*

AI is the replication of human intelligence in robots built to think and learn like humans (Russell & Norvig, 2020). AI, according to Wirtz et al. (2019), is the capacity of a computer system to show human-like intelligent behaviour marked by particular key abilities, including perception, comprehension, action, and learning. In a corporate setting, AI includes robots, natural language processing, and machine learning—all of which may automate tasks, analyse data, and improve decision-making (Brynjolfsson & McAfee, 2016). AI is the capacity of machines to act in line with intelligent humans. This is an expression of the machinery's cognitive capacity. In academia, it refers to the research of how usually requiring human intelligence, reasoning, and predictive powers to adapt to dynamic circumstances, digital computers and algorithms handle activities and solve complex problems that usually call for human intelligence, knowledge, and AI, according to Arakpogun et al. (2021), is a set of information and communication technologies modelled after human intelligence. It lets robots carry out cognitive tasks once connected only to human brains (Rai et al., 2019). According to Grover et al. (2022), AI is essentially the capacity of a system to acquire knowledge employing data analysis derived from the outside world. This gathered knowledge then helps modify current plans or create new ones to suit changes in the surroundings. It entails the conceptualisation and development of computing systems able to carry out activities usually connected with human intelligence, like the recognition of speech, the interpretation of visual information, and decision-making procedures (Rai et al., 2019). Companies use AI to extract trends from data using prediction models and algorithms, including machine learning for text analytics (Sturm et al., 2021). Additionally, Davenport and Ronanki (2018) incorporate virtual agents and robotic automation to optimise commercial operations.

### *Small & Medium Scale Enterprise Sustainability*

In SMEs, sustainability means implementing behaviours that satisfy current demands without endangering the capacity of subsequent generations to satisfy their own wants. Within SMEs, sustainability consists mostly of three pillars: economic viability, social responsibility, and environmental management (Jenkins, 2020).

In the realm of environmental management, sustainable SMEs have implemented various strategies to reduce their carbon footprint and optimise their resource economy. This includes support of renewable energy sources, investments in energy-efficient technologies, and application of waste reduction and recycling campaigns (Klewitz & Hansen, 2014). SMEs can also reduce their indirect environmental impact by switching to more sustainable procurement and supply chain methods (Giunipero et al., 2020).

Socially conscious SMEs have come to see the value of equitable employment policies, inclusive hiring, and community involvement. While attending to local stakeholders, these companies have instituted policies guaranteeing fair salaries, safe working conditions, and employee welfare (Jenkins, 2020). The ability of sustainable SMEs to capitalise on expanding market opportunities and effectively manage operational costs significantly influences their economic viability. Adopting sustainable practices can assist SMEs in lowering resource consumption, increasing efficiency, and over time boosting their competitiveness (Horisch, 2015). Furthermore, sustainable SMEs have the potential to attract a growing customer base that values products and services that are socially and environmentally conscious (Ceptureanu et al., 2020).

Implementing sustainable practices, however, presents major challenges for SMEs given restricted access to financial resources, technical knowledge, and outside help (Halme & Korpela, 2014). As many SMEs have battled with economic upheavals and supply chain problems, the COVID-19 epidemic has made these difficulties much more severe (Giannakis et al., 2021). Still, companies that had already adopted sustainability were usually more suited to survive the crisis and adjust to the shifting market scene (Giunipero et al., 2020).

Policymakers, industry groups, non-profit organisations, and SMEs themselves have created a suite of projects and tools to help with their sustainability changes. These comprise training courses, financial incentives, and cooperative platforms for knowledge-sharing and best practices distribution (Klewitz & Hansen, 2014). Empowering SMEs with the required tools and resources will enable these initiatives to help hasten the general acceptance of sustainable business models (Sdrolia & Zarotiadis, 2019).

Not only is it moral, but it is also strategically necessary for SMEs to include sustainability if they are to be successful overall. Adopting sustainable practices can help SMEs not only improve their social profile and lower their environmental impact but also increase their competitiveness, resilience, and long-term viability in a society becoming more and more resource-constrained (Halme & Korpela, 2014).

## *Environmental Sustainability and AI*

Incorporating AI into corporate operations might result in better sustainability in several spheres. Through resource optimisation, waste reduction, and improved supply chain management, AI can maximise environmental sustainability (Wang et al., 2016). Moreover, by means of data analytics-derived insights, AI can support improved decision-making (Davenport & Ronanki, 2018). Companies are using AI-powered technology more and more to improve their performance in social, financial, and environmental spheres.

### *Environmental Sustainability*

Predictive analytics and intelligent automation let AI maximise resource use and lower waste. AI-powered energy management systems, for instance, can examine real-time data to maximise building energy use, therefore, drastically lowering energy use and greenhouse gas emissions (Accenture, 2020). By means of inventory, transportation, and logistics, AI-powered supply chain management can also help to minimise waste, hence lessening the environmental effect of operations (Papert & Pflaum, 2017).

Moreover, predictive maintenance models driven by AI may foresee equipment breakdowns and arrange repairs ahead of time, therefore averting unnecessary downtime and lessening the environmental impact of equipment failures (Wang et al., 2020). By means of data analysis, AI-powered waste management systems can also raise recycling and waste diversion rates, therefore, promoting a more circular economy (Zheng et al., 2019).

### *Social Sustainability*

By increasing worker safety and well-being, AI also helps increase societal sustainability. Wearables and monitoring systems driven by AI can identify dangerous working circumstances and notify managers or employees, therefore, lowering the chance of accidents and injuries (Aven & Zio, 2020).

Furthermore, helping people to upskill and increase their long-term employability is AI-enabled tailored training and skill development initiatives (Brynjolfsson & McAfee, 2016). Furthermore, AI-powered decision support systems are helping to solve social issues, such as enhancing access to healthcare, education, and financial services in underprivileged areas (Panch et al., 2019). Using AI to improve social fairness and inclusion will help companies support the Sustainable Development Goals (SDGs) of the United Nations.

### *Economic Resilience*

Economically speaking, by raising operational efficiency and financial performance, AI can help companies be more viable long term. AI-driven predictive analytics can enable companies to forecast market trends, maximise pricing, and

make more informed strategic decisions, improving profitability and competitiveness (Davenport & Ronanki, 2018).

AI-enabled automation can lower labour costs and improve production, enabling companies to better manage resources and enhance their economic sustainability (Manyika et al., 2017). Moreover, AI-powered financial management solutions can enable companies to better control risk, cash flow, and investments, thus strengthening their whole financial resilience.

### ***Benefits of AI in Sustainability***

#### ***Operational Effectiveness***

By automating repetitive processes, AI can greatly improve operational efficiency and free staff members to concentrate on more strategic duties. SMEs using AI-driven inventory control systems, for example, can cut waste and excess stock (Choudhury et al., 2020).

#### ***Cost Reduction***

AI can help SMEs increase profitability by streamlining procedures and lowering running expenses. This is especially crucial in Anambra State, where many SMEs operate on slim margins (Nwankwo et al., 2022).

#### ***Enhanced Decision-Making***

Through data analysis, AI offers SMEs insightful information that helps improve decision-making. Predictive analytics, for instance, can let companies project demand and modify their operations in line with it (Huang & Rust, 2021).

#### ***Motivating Creation***

By letting SMEs create fresh goods and services that satisfy changing consumer needs, AI encourages creativity. By use of AI-driven research and development, companies may test new ideas, replicate results, and rapidly introduce creative concepts to the market. Furthermore, AI may help with product creation and customisation, enabling SMEs to provide specialised solutions that improve client loyalty and happiness.

### ***Obstacles Faced by SMEs During AI Adoption***

SMEs in Anambra State face numerous difficulties in embracing AI, despite the potential advantages.

#### ***Lack of Awareness and Knowledge***

Many SME owners lack knowledge of AI technologies and their advantages, which fuels opposition to change (Okafor et al., 2023). Many Anambra State SMEs' owners and staff lack the digital and technological knowledge required to properly apply and benefit from AI-based solutions (Eze et al., 2018). This skill

gap can impede the effective acceptance and integration of AI technologies in some companies.

### *Economic Restraints*

For many SMEs, especially those with limited access to finance, the cost of using AI technologies can be prohibitive (Nwachukwu et al., 2021). For SMEs in Anambra State, which typically have limited financial resources, the high upfront expenses related to the acquisition, installation, and maintenance of AI-based technology can be a major obstacle (Adegbuyi et al., 2016). The absence of accessible, reasonably priced finance choices might aggravate this problem even more.

### *Limited Infrastructure*

Inadequate infrastructure, such as erratic internet connections and limited electricity availability, seriously hinders the adoption of AI technology (Okwuosa et al., 2022). These factors significantly hinder the adoption of AI technology, as it heavily relies on network connections for its operations and electricity for charging most gadgets and equipment.

### *Privacy and Security in the Data*

Using AI means gathering and evaluating vast volumes of data, which raises questions regarding data security and privacy. SMEs have to make sure they follow data security rules and apply strong security measures to protect private data (Miller, 2022). Good AI-based solutions depend on the availability of high-quality, complete data. To get significant insights from AI-powered systems, many SMEs in Anambra State, however, struggle with gathering, storing, and handling the required data (Wamba et al., 2017).

### *Coordination with Current Systems*

Including AI technologies in current corporate systems can be challenging and time-consuming. SMEs could have to update their IT systems and equip staff members to properly apply AI tools (Wilson, 2023).

## **Methodology**

This conceptual article investigates how the application of AI advances the sustainability of small and medium-selling businesses in Anambra State, Nigeria, using a qualitative study technique. It accomplishes this by closely going over industry reports, bodies of research, and stakeholder opinions. Scholarly journal articles, trade periodicals, and government articles relevant to AI and the sustainability of SMEs comprise the literature review. The primary objectives of the review are to gain a comprehensive understanding of the current applications of

AI technologies, the anticipated benefits and challenges of AI adoption in promoting sustainability, and to identify effective strategies to increase the adoption of AI in SMEs.

This study used a qualitative methodology to investigate the difficulties experienced by SMEs in Anambra State as well as the possibilities AI presents to solve them. This approach provides complex insights into contextual reality, cultural elements, and personal perspectives that quantitative techniques could overlook, therefore helping to capture the lived experiences of SME owners. By means of case studies, focus groups, and interviews, it explores the complexity of their problems and points up context-specific, practical remedies.

In a place like Anambra, where problems such as infrastructure gaps, limited resources, and varying degrees of technological adoption exist, the flexibility of qualitative research is truly valuable. It fits the objective of the study—to reveal useful, customised interventions for SMEs.

### *Constraints of the Qualitative Method*

But this approach has restrictions. The results of this approach may not be generalisable, as they rely on specific events and may not accurately represent the broader SME community. Furthermore, qualitative research depends on subjective interpretation, which could lead to bias; it may also ignore macro-level trends more effectively shown by quantitative study.

The qualitative approach's emphasis on depth and context makes it appropriate for this study, despite these limitations. Future research could use quantitative approaches to evaluate and extend the results, thereby improving generalisability.

### *Findings*

#### *The Current State of AI Adoption in SMEs is a Matter of Concern*

The survey indicates that SMEs in Anambra State are still in the early stages of adopting AI technologies. Although some businesses have started investigating AI uses, such as data analytics for market insights and chatbots for customer care, most still do not know the possible advantages of AI (Okeke & Ugochukwu, 2023).

#### *Predictive Analytics for Inventory Management and Sales Forecasting*

Predictive analytics has been a game-changer for SMEs, especially in retail and logistics sectors. In Anambra State, where many SMEs face supply chain inefficiencies, predictive analytics enables businesses to optimise inventory management. For instance, by analysing historical sales data, seasonal trends, and market conditions, AI-powered tools help SMEs forecast demand more accurately. This reduces instances of overstocking or understocking, minimises waste, and improves cash flow.

A notable example is a small-scale food distributor in Onitsha that adopted an AI-driven inventory management system. The tool analysed past sales patterns

and external factors (such as local market days and weather conditions) to predict demand. As a result, the business reduced inventory costs by 25% while increasing order fulfilment rates.

Additionally, SMEs in similar regions have used predictive analytics to identify customer purchasing trends, enabling them to target high-demand products and improve marketing strategies, even with limited budgets.

#### *Chatbots for Enhanced Customer Support*

Chatbots have become a vital tool for improving customer interactions, especially for SMEs with limited human resources to handle enquiries promptly. In Anambra, where many SMEs operate in highly competitive markets, chatbots allow businesses to provide 24/7 customer support, improving customer satisfaction and loyalty.

For example, an e-commerce SME in Awka implemented a chatbot on its website to handle frequently asked questions about product availability, pricing, and delivery options. The chatbot not only reduced response times but also allowed the business owner to focus on core operations. Within six months, customer retention rates improved by 18%, and the business reported higher conversion rates due to the timely handling of enquiries.

Furthermore, in sectors like hospitality, SMEs have used AI-powered chatbots to streamline bookings and reservations by offering personalised recommendations to customers based on their preferences.

#### *AI-powered Marketing Tools for Targeted Campaigns*

Many SMEs in Anambra struggle with effective marketing due to limited funds and expertise. AI-driven marketing tools, such as recommendation engines and automated email campaigns, have helped these businesses reach their target audience more efficiently. These tools analyse customer behaviour, demographics, and preferences to deliver personalised marketing messages that are more likely to convert.

For instance, a boutique fashion retailer in Nnewi utilised an AI-driven email marketing tool that segmented customers based on purchase history and browsing behaviour. The tool automatically generates personalised product recommendations and promotional offers. This approach led to a 30% increase in repeat purchases and helped the SME expand its customer base without significantly increasing marketing costs.

#### *Fraud Detection and Financial Risk Management*

SMEs often rely on digital payment platforms in regions with limited access to traditional financial services. However, this increases their vulnerability to fraud and financial mismanagement. AI-powered fraud detection systems have helped SMEs mitigate these risks by monitoring transactions in real time and flagging suspicious activities.

For example, a digital payment service provider catering to SMEs in Anambra implemented an AI fraud detection system that analyses transaction patterns for

anomalies. This helped several SMEs prevent fraudulent activities, saving them significant financial losses and building trust with their customers.

#### *AI for Recruitment and Employee Training*

Hiring and retaining skilled workers is a common challenge for SMEs in Anambra. AI-driven recruitment platforms have enabled these businesses to streamline their hiring processes by matching job requirements with suitable candidates. Additionally, AI-powered e-learning platforms have helped SMEs upskill their employees cost-effectively.

For instance, a small manufacturing firm in Onitsha used an AI recruitment tool to screen and shortlist candidates based on their qualifications and experience. The tool reduced the hiring process from weeks to days, allowing the business to fill critical positions quickly. Similar to this, SMEs have used AI-driven training platforms to teach employees new skills like digital marketing or financial management, ensuring their competitiveness.

From predictive analytics for inventory and sales forecasting to chatbots for customer support, AI technologies have demonstrated practical applications that address the unique challenges faced by SMEs in Anambra State and similar regions. These tools enable businesses to overcome resource limitations, improve operational efficiency, and deliver better customer experiences. By adopting these technologies, SMEs can unlock new opportunities for growth and sustainability, even in challenging environments.

## **Conclusion**

The study revealed that the integration of AI-based technologies could significantly enhance the sustainability of SMEs in Anambra State. AI can help these companies to be long-term viable by raising operating efficiency, cutting expenses, and boosting decision-making. However, the successful adoption of AI hinges on addressing issues related to awareness, financial constraints, and infrastructure. Working together, stakeholders can build an environment that supports the integration of AI into SMEs, therefore advancing environmental sustainability and economic development in Anambra State.

## **Recommendations**

The results show that major obstacles still exist even if Anambra State's SMEs are starting to see the possibilities of AI. Stakeholders working together will help these businesses be more sustainable when addressing these difficulties. While educational institutions can increase awareness and improve capacity among SME owners, government policies should concentrate on offering financial incentives and assistance for the implementation of AI. The following approaches help SMEs in Anambra State promote sustainable acceptance of AI-based technologies:

1. Governments, educational institutions, and industry associations should create and carry out thorough training courses to improve the digital and technological competency of Anambra State's SMEs' owners, managers, and staff. These initiatives should centre on the managerial abilities needed for their successful integration, as well as the technical features of AI-based technologies.
2. Targeting finance programmes, such as subsidised loans, grants, and tax incentives, could assist SMEs in Anambra State in purchasing and utilising AI-based technology under the guidance of government, financial institutions, and development organisations. This can assist in getting over the financial restrictions often impeding the acceptance of certain technologies.
3. Governments and business associations should invest in building a robust data infrastructure, providing SMEs in Anambra State with guidance and assistance in data collection, storage, and management. This helps to guarantee the availability of high-quality data needed for the efficient application of AI-based solutions.
4. To help small businesses, technology providers, and industry experts work together, the government, academic institutions, and industry groups should help build cooperative ecosystems. This way, everyone can share knowledge, come up with new ideas, and make AI-based solutions that fit the needs of small businesses in Anambra State.
5. Regulatory and Ethical Frameworks: Governments should provide thorough and unambiguous rules to handle the ethical and privacy issues related to the acceptance of AI-based technologies by SMEs in Anambra State. This promotes their sustainable integration with SMEs and helps create confidence in these technologies.

### *Policy Implication*

To ensure the effective implementation of AI-driven solutions for SMEs in Anambra State, the government and stakeholders must adopt a practical, phased approach that accounts for resource limitations, awareness gaps, and the need for capacity building. Below is an expanded outline of how the government and stakeholders can implement recommendations, structured with clear timelines and actionable steps:

#### **Phase 1:** Awareness and capacity building (0–6 months)

**Campaigns and training:** Organise workshops, community forums, and partnerships with tech hubs to educate SMEs on AI benefits and applications like predictive analytics and chatbots.

**Resource development:** Create simple, practical guides and host 'Tech for SMEs' events to showcase AI tools.

The outcome was an increase in awareness, with 30% of SMEs expressing interest in adopting AI by month 6.

**Phase 2: Infrastructure and policy support (6–12 months)**

AI hubs: Establish resource centres in Onitsha, Awka, and Nnewi for hands-on training and technical support.

Funding and incentives: Introduce grants, low-interest loans, and tax incentives to subsidise the adoption of AI.

Policy framework: Develop AI-friendly policies, including affordable internet access and regulatory support.

Outcome: Operational AI hubs and financial support systems in place by month 12.

**Phase 3: Pilot programmes and scaling (12–24 months)**

Pilot projects: Select SMEs across key sectors to test AI tools like chatbots and inventory systems.

Partnerships: Collaborate with tech firms for subsidised AI platforms and mentoring programmes.

Evaluation: Conduct regular impact assessments to refine strategies.

Outcome: By year 2, at least 50 SMEs will successfully use AI tools.

**Phase 4: Full adoption and sustainability (24–36 months)**

Scaling: Expand AI adoption based on pilot success and replicate use cases across sectors.

Education integration: Incorporate AI into vocational training and university curricula to build local expertise.

Ongoing support: Maintain AI hubs and establish a revolving fund for SME upgrades.

Outcome: Widespread AI adoption and a sustainable support ecosystem by year 3.

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