

Original Research Article

ARTIFICIAL INTELLIGENCE ADOPTION AND ORGANIZATIONAL PERFORMANCE OF SMEs IN ANAMBRA STATE, NIGERIA

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Abstract: The growing accessibility of artificial intelligence (AI) technologies presents new opportunities for small and medium-sized enterprises (SMEs) to improve efficiency, customer engagement, decision-making and competitiveness. However, the level of AI adoption among SMEs remains uneven, particularly in developing economies where financial, technological and infrastructural constraints may limit effective utilization. This study examined the extent of AI adoption, its relationship with organizational performance, and the major constraints affecting adoption among SMEs in Anambra State, Nigeria, with particular focus on the Onitsha and Nnewi business clusters. A descriptive cross-sectional survey design was employed. From a population of 1,200 registered SMEs, a sample of 300 owner-managers and managers was determined using Taro Yamane's formula and selected through proportionate stratified sampling. Data were collected using a structured questionnaire and analysed using descriptive statistics and simple linear regression with SPSS version 27 at the 5% level of significance. The findings revealed a moderate overall level of AI adoption, with relatively higher use of AI-supported customer communication and generative AI applications for marketing and content creation, while advanced applications for sales analysis, inventory management and personalization recorded lower usage. The regression results showed that AI adoption was positively associated with organizational performance ($B = 0.576$, $\beta = .518$, $R^2 = .268$, $p < .001$), indicating that higher levels of AI adoption corresponded with improved organizational performance. The major constraints to AI adoption were high implementation cost, inadequate AI and digital literacy, unreliable electricity supply, lack of technical expertise and poor or expensive internet connectivity. The study concludes that although AI adoption among SMEs in Anambra State remains moderate and uneven, its effective integration into business activities is associated with improved organizational performance. It therefore recommends practical AI-literacy programmes, affordable digital-financing support and improved

electricity and internet infrastructure to facilitate wider and more effective adoption among SMEs.

Keywords: Artificial Intelligence, AI Adoption, SMEs, Organizational Performance, Anambra State, Digital Literacy

1. Introduction

1.1 Background to the Study

Small and medium-sized enterprises play a major role in employment creation, entrepreneurship, innovation and local economic development. Their importance is especially visible in Anambra State, where Onitsha is a major trading centre and Nnewi is widely associated with manufacturing, automobile-related enterprise and indigenous entrepreneurship. The performance and competitiveness of SMEs in these clusters therefore have implications for economic activity within and beyond the state.

Artificial intelligence has become an increasingly important component of business digitalization. For SMEs, relevant applications include generative AI, automated customer-response systems, chatbots, AI-supported design and marketing tools, intelligent accounting applications, sales forecasting and inventory-support systems. These tools can reduce repetitive work, improve response speed, support content creation and strengthen managerial decision-making.

Recent SME research shows that AI adoption is shaped by technological, organizational and environmental conditions. Nigerian evidence also suggests that owner-manager capability, employee skills, perceived complexity, cost and infrastructure influence whether AI is adopted and whether it translates into performance improvements. A recent Nigerian SME study used a structured five-point Likert questionnaire and reported acceptable construct reliability after contextual adaptation and pilot testing, reinforcing the suitability of survey measurement for this topic.

However, access to AI does not automatically produce performance gains. SMEs may lack the financial resources, digital skills, data practices or infrastructure needed to integrate AI effectively. This makes localized evidence important, particularly in commercially distinctive environments such as Onitsha and Nnewi.

1.2 Statement of the Problem

AI offers SMEs opportunities to improve customer service, reduce operating costs, strengthen marketing, support decision-making and increase productivity. Nevertheless, many SMEs in Anambra State still depend substantially on manual or semi-digital methods for customer communication, inventory, record keeping, marketing and routine administration.

Possible explanations include perceived implementation cost, inadequate AI and digital literacy, lack of technical expertise, unstable electricity supply, weak internet connectivity and uncertainty about the business value of AI. Although Nigerian research on AI and SMEs is expanding, evidence specific to the Onitsha and Nnewi clusters remains limited. This study therefore, investigates the extent of AI adoption, its relationship with organizational performance, and the principal barriers to adoption among SMEs in Anambra State.

1.3 Objectives of the Study

The broad objective is to examine artificial intelligence adoption and organizational performance of SMEs in Anambra State. Specifically, the study seeks to:

1. Determine the extent of artificial intelligence adoption among SMEs in Onitsha and Nnewi;
2. Examine the effect of artificial intelligence adoption on the organizational performance of SMEs; and
3. Identify the major challenges constraining artificial intelligence adoption among SMEs in the study area.

1.4 Significance of the Study

The study provides SME owners and managers with evidence on practical AI use and its relationship with performance. It may assist SMEDAN, business associations and the Anambra State Government in designing digital-literacy, technology-financing and SME-support interventions. Academically, it extends the application of the Technology-Organization-Environment framework to AI adoption in a Nigerian SME context.

2. Literature Review

2.1 Conceptual Review

2.1.1 Artificial Intelligence

Artificial Intelligence (AI) broadly refers to computer-based systems and technologies capable of performing tasks that ordinarily require aspects of human intelligence, including learning, reasoning, prediction, pattern recognition, natural-language processing and decision support. In the contemporary business environment, AI encompasses applications such as machine learning, generative AI, chatbots, recommendation systems, intelligent analytics, automated administrative systems and predictive tools. The increasing accessibility of these technologies has expanded opportunities for firms of different sizes to integrate AI into routine business operations.

Historically, sophisticated AI applications were concentrated largely among large corporations because their implementation required substantial financial resources, advanced computing infrastructure and specialized technical expertise. However, the emergence of cloud computing, software-as-a-service applications and generative AI has reduced some of these barriers. SMEs can now access AI capabilities through

subscription-based platforms and commercially available applications without necessarily developing proprietary AI systems. Nevertheless, AI adoption among SMEs remains uneven. The Organisation for Economic Co-operation and Development (OECD, 2025) notes that SME adoption of AI remains lower than that of larger firms and identifies connectivity, data availability, skills, computing resources and access to finance as important conditions for successful adoption.

The relevance of AI to SMEs is particularly evident in its potential to augment limited financial and human resources. SMEs often operate with relatively small workforces, restricted managerial capacity and constrained marketing and administrative budgets. AI applications can potentially assist such firms by automating repetitive tasks, facilitating customer interaction, improving information processing and supporting decision-making. However, the benefits of these technologies depend on the capacity of the enterprise to identify suitable applications and integrate them effectively into existing business processes.

2.1.2 Artificial Intelligence Adoption

Technology adoption involves more than awareness of an innovation. At the organizational level, adoption represents the acceptance, implementation and actual use of a technology in business activities. Accordingly, AI adoption in this study refers to the extent to which an SME actually uses AI-enabled applications in its operations, managerial activities and decision-making processes.

This definition distinguishes actual adoption from mere awareness, intention or experimentation. An owner-manager may be familiar with generative AI without incorporating it into organizational activities. Similarly, an employee may occasionally experiment with an AI platform without such usage representing organizational adoption. Meaningful adoption therefore implies deliberate and regular application of AI in identifiable business functions.

The OECD (2025) observes that SME adoption of AI varies according to firms' digital maturity, the complexity of AI use and the scope of application. This suggests that AI adoption is not necessarily an all-or-nothing phenomenon. Some SMEs may use AI only for basic functions such as drafting advertisements, while others may employ it across customer service, analytics, inventory decisions, marketing and forecasting.

Arroyabe et al. (2024), using evidence from 12,108 European SMEs, found that digital capabilities and innovation capabilities were important determinants of AI adoption. Their findings demonstrate that the availability of AI technologies alone does not guarantee effective use. Firms also require complementary internal resources and organizational capabilities to derive value from such technologies.

In the present study, AI adoption is operationalized through six functional areas: customer communication, marketing and content creation, accounting and administration, sales and demand analysis, inventory support, and data analysis and decision support.

AI for Customer Communication

Customer communication is one of the most visible areas in which SMEs can deploy AI. Applications such as chatbots, automated messaging systems and AI-assisted customer-service tools can provide faster responses to routine enquiries, generate personalized messages and assist employees in managing customer interactions.

For resource-constrained SMEs, these tools are particularly useful because such firms may not be able to maintain dedicated customer-service departments. AI can help enterprises respond to customers more quickly and consistently, while allowing employees to devote attention to more complex customer needs. Kehinde et al. (2025) found that SMEs in Ondo Central perceived AI as capable of improving customer experience and business efficiency.

However, AI-mediated customer communication still requires human oversight. Incorrect responses, impersonal interaction and excessive dependence on automated systems may negatively affect customer relationships. Thus, the effectiveness of AI in customer communication is likely to depend on the degree to which technology complements rather than replaces human judgment.

AI for Marketing and Content Creation

Marketing and content creation have become prominent areas of AI application, especially following the rapid expansion of generative AI. SMEs can use AI tools to create advertising copy, social-media captions, product descriptions, email messages, promotional concepts and other forms of marketing content.

AI may also assist firms with customer segmentation, campaign planning and personalization of promotional communication. For SMEs operating with limited marketing budgets, these applications can reduce the amount of time and financial resources required to maintain a regular market presence.

Nevertheless, AI-generated marketing content still requires human supervision to ensure factual accuracy, brand consistency, ethical appropriateness and relevance to the intended audience. The potential performance benefits of AI-assisted marketing therefore, depend not merely on content generation but on the strategic use of such tools in supporting the wider marketing objectives of the enterprise.

AI for Accounting and Administration

Accounting and administrative activities frequently involve repetitive processes that may be suitable for automation. AI-enabled applications can assist with transaction classification, document preparation, invoice processing, scheduling, financial reporting and other routine administrative functions.

The automation of such tasks may reduce administrative workload, increase processing speed and enable owners or employees to devote greater attention to strategic and revenue-generating activities. However, AI use in accounting and administration also raises concerns about accuracy, confidentiality and data protection. Human verification

remains essential, especially where AI-generated outputs influence financial records and business decisions.

AI for Sales and Demand Analysis

Sales and demand analysis involves the use of business information to understand customer purchasing patterns, market trends and likely future demand. AI can support SMEs by analysing historical sales data, identifying trends and producing insights that may assist managers with sales planning.

Improved demand analysis may enable SMEs to make more informed decisions regarding purchasing, pricing, product assortment and promotional strategies. Soomro et al. (2025) found that AI adoption was associated with improved economic and operational outcomes among SMEs, suggesting that AI-supported business analysis can contribute to organizational performance when appropriately implemented.

AI for Inventory Support

Inventory management is particularly important for SMEs involved in retail, wholesale and manufacturing activities. Excess inventory may tie down scarce working capital, whereas inadequate stock may result in lost sales and dissatisfied customers.

AI-enabled inventory applications can assist businesses in monitoring stock movement, identifying demand patterns and supporting reorder decisions. By linking current sales information with historical patterns, such systems may help managers make more timely inventory decisions.

However, the usefulness of AI-based inventory recommendations depends substantially on the availability and quality of business data. SMEs that maintain incomplete or inconsistent records may obtain limited value from predictive applications. This underscores the importance of broader digital readiness in the effective use of AI.

AI for Data Analysis and Decision Support

One of the most significant applications of AI relates to business data analysis and managerial decision support. SMEs generate information relating to sales, customers, costs, inventory and employees, but many lack the capacity to analyse these data systematically.

AI-enabled analytics can assist managers in identifying patterns, comparing alternatives and generating forecasts. Consequently, business owners may be able to make more timely and evidence-based decisions.

Onenyi et al. (2026) found that technological readiness and organizational support significantly contributed to AI-enabled analytics capability among Nigerian SMEs. The study further showed that AI-enabled analytics capability was positively associated with operational performance. This suggests that analytical AI applications may be particularly valuable where firms possess the supporting technological and organizational infrastructure necessary for effective use.

2.1.3 Organizational Performance

Organizational performance refers to the extent to which an enterprise achieves its stated objectives and desired outcomes. The concept is multidimensional because the success of an enterprise cannot be adequately represented by a single indicator.

Traditional approaches to organizational performance often emphasized financial indicators such as profitability, return on investment and sales growth. While such measures remain important, they may not capture improvements in areas such as customer satisfaction, employee productivity, operational efficiency and managerial effectiveness.

For SMEs, non-financial indicators may be especially important because improvements in customer service, response speed and decision-making may eventually contribute to longer-term financial outcomes. Accordingly, the present study conceptualizes organizational performance through both financial and non-financial measures.

Specifically, organizational performance in this study refers to the extent to which an SME achieves favourable outcomes in sales growth, cost efficiency, employee productivity, customer satisfaction, response speed, decision quality and competitiveness.

Sales Growth

Sales growth refers to an increase in the value or volume of goods and services sold by an enterprise over a given period. AI adoption may contribute to sales growth through improved marketing, better targeting of customers, personalized communication and more informed demand analysis.

AI-generated customer insights can help SMEs identify relevant market segments and improve promotional decisions. Faster responses to customer enquiries may also improve customer conversion and retention.

Cost Efficiency

Cost efficiency concerns the ability of an enterprise to achieve desired outcomes while minimizing unnecessary expenditure. AI can potentially enhance cost efficiency by reducing repetitive manual activities, improving resource allocation and increasing the speed of administrative processes.

Soomro et al. (2025) reported that AI adoption contributed to economic and operational dimensions of SME sustainable performance, including efficiency-related improvements.

Employee Productivity

Employee productivity refers to the effectiveness with which employees convert time, effort and organizational resources into useful outputs. AI may enhance productivity by assisting with repetitive tasks, information retrieval, content generation and analytical activities.

The value of AI in this context lies not necessarily in replacing employees but in allowing them to focus on tasks that require creativity, interpersonal engagement and

managerial judgement. The OECD (2026) similarly emphasizes that workers' skills and training are important in determining whether organizations can realize productivity gains from AI.

Customer Satisfaction and Response Speed

Customer satisfaction reflects customers' assessment of whether an enterprise adequately meets their expectations. Response speed concerns how quickly a business attends to enquiries, complaints and customer needs.

AI applications may improve both outcomes through automated responses, faster access to information and personalized communication. However, the quality and accuracy of AI-generated responses remain important. Rapid but incorrect communication may weaken rather than strengthen customer satisfaction.

Decision Quality

Decision quality refers to the extent to which managerial decisions are timely, informed and appropriate to prevailing organizational circumstances. AI-supported analytics may enhance decision quality by identifying patterns within business data and presenting managers with alternative courses of action.

Nevertheless, AI output should serve as decision support rather than as an unquestioned substitute for managerial judgment. This is particularly important where available data are incomplete or where business problems involve ethical, social or contextual considerations.

Competitiveness

Competitiveness refers to the capacity of an enterprise to maintain or strengthen its market position relative to competing firms. SMEs may derive competitive benefits from AI where the technology enables greater efficiency, responsiveness, personalization and innovation.

Thus, the effect of AI on competitiveness is likely to depend on the extent to which the enterprise translates technological applications into distinctive organizational capabilities.

2.2 Theoretical Framework

2.2.1 Technology–Organization–Environment Framework

The study is anchored on the Technology–Organization–Environment framework developed by Tornatzky and Fleischer (1990). The framework explains organizational adoption and implementation of technological innovations through three broad contexts: the technological context, organizational context and environmental context.

The TOE framework is particularly appropriate for this study because it operates at the organizational level rather than concentrating primarily on individual behavioural intentions. Baker (2012) notes that the framework has been widely applied to the study of

technological innovation because its three contextual dimensions can be adapted to different organizational and technological settings.

The technological context concerns the characteristics of the technology available to an organization. The organizational context relates to internal resources and capabilities, while the environmental context concerns the external business environment in which the firm operates.

Technological Context

The technological context includes the characteristics of the technologies available to an enterprise. In relation to AI adoption, relevant factors include relative advantage, compatibility, complexity and cost.

Relative advantage refers to the extent to which an organization perceives AI as offering benefits over existing ways of carrying out business activities. SMEs may be more willing to use AI where managers believe that the technology can reduce costs, improve customer service, save time or enhance sales.

Soomro et al. (2025) identified relative advantage as one of the significant factors associated with AI adoption among SMEs.

Compatibility concerns the extent to which AI applications fit an organization's existing practices, systems and processes. A technology that aligns with the current operations of an SME is more likely to be accepted than one that requires major restructuring.

Complexity refers to the extent to which a technology is perceived as difficult to understand or use. AI systems that require advanced technical knowledge may discourage SMEs that lack qualified personnel.

Cost is also important because SMEs often operate with restricted financial resources. AI-related expenditure may include software subscriptions, training, internet access, consultancy services and complementary digital infrastructure. Kehinde et al. (2025) identified high implementation costs as an important challenge confronting SMEs adopting AI in Ondo Central.

Organizational Context

The organizational context refers to internal characteristics and resources that may support or constrain AI adoption. These include top-management support, employee capability, financial resources and digital readiness.

Top-management support is particularly important in SMEs because owners and managers frequently exercise direct control over investment decisions. Management determines whether resources will be allocated to AI technologies, whether employees will be trained and whether AI experimentation will become part of routine organizational practice.

Soomro et al. (2025) identified top-management support and employee capability as significant predictors of AI adoption. Similarly, Akinruwa et al. (2025) found that employee capability and managerial support were associated with SME performance in Southwest Nigeria.

Employee capability concerns the ability of workers to understand and effectively use AI applications. A lack of relevant knowledge and skills can prevent firms from deriving value from available technologies.

Digital readiness refers to the availability of appropriate digital infrastructure, data, software and organizational routines required to support AI. Arroyabe et al. (2024) found that digital capabilities were important in explaining AI adoption among European SMEs.

Environmental Context

The environmental context relates to factors outside the organization that may influence technological adoption. These include competitive pressure, customer expectations, government policy, regulation, infrastructure and vendor support.

Competitive pressure may encourage SMEs to adopt AI when competitors use similar technologies to provide faster service or improve efficiency. Customer expectations may also influence adoption, particularly where customers increasingly demand fast and personalized service.

Vendor support is especially relevant because SMEs often lack internal technical specialists. Technology providers may assist with configuration, implementation, maintenance and training.

Soomro et al. (2025) found that customer pressure and vendor support were associated with AI adoption among SMEs. Government policies and institutional support may also influence adoption through investment in digital infrastructure, training programmes, financing and regulatory frameworks.

2.2.2 Relevance of the TOE Framework to the Present Study

The TOE framework is relevant to the present study because SME adoption of AI does not occur simply because AI technologies are available. The decision to adopt and effectively use AI reflects the combined influence of technological characteristics, internal organizational capability and the external business environment.

For example, an SME may recognize the potential value of AI for marketing but may still fail to use it effectively if employees lack the necessary skills. Similarly, management may support AI adoption, but poor digital infrastructure or inadequate data may prevent the technology from generating meaningful benefits.

The TOE framework therefore provides a suitable theoretical basis for understanding the organizational conditions surrounding AI adoption. However, the present study moves beyond adoption determinants by examining whether the actual use of AI in key business functions is associated with improved organizational performance.

2.3 Empirical Review

Soomro et al. (2025) examined the effect of AI adoption on the sustainable performance of SMEs. Data were obtained from 305 SME owners and managers, and the study employed Partial Least Squares Structural Equation Modelling and Artificial Neural Networks. The findings showed that relative advantage, top-management support, employee capability, customer pressure and vendor support significantly influenced AI adoption. AI adoption was also positively related to economic, social and environmental performance.

The study is relevant because it demonstrates that AI can contribute to multiple dimensions of organizational performance. However, the study was conducted in Pakistan, where the socio-economic and technological environment differs from Nigeria. Its focus on sustainable performance also differs from the broader organizational-performance orientation of the present study.

Arroyabe et al. (2024) examined AI adoption among 12,108 SMEs within the European Union. The study employed regression and machine-learning techniques and found that digital capability and innovation capability significantly influenced AI adoption. External environmental support produced a more conditional effect.

Although the study benefits from a large sample, its European context limits direct generalization to Nigerian SMEs, particularly those operating in Anambra State.

Kehinde et al. (2025) investigated AI implementation among SMEs in Ondo Central, Ondo State. A descriptive survey was conducted among 150 managers and employees. The study found that AI was perceived as having the potential to improve efficiency, customer experience and business opportunities. However, important constraints included data-privacy concerns, high implementation costs and inadequate expertise.

The study provides useful Nigerian evidence but focused mainly on implementation benefits and challenges rather than comprehensively examining the relationship between actual functional use of AI and organizational performance.

Olawale et al. (2025) examined AI adoption and operational efficiency among SMEs in Oyo State, Nigeria. The study focused on robotic process automation and machine-learning automation. The findings indicated that the selected automation dimensions did not strongly predict operational efficiency.

The study is important because it suggests that the relationship between AI adoption and performance may not always be automatic. The mere introduction of technology may fail to produce performance gains where the technology is not strategically integrated into business processes.

Akinruwa et al. (2025) investigated AI adoption and SME performance in Southwest Nigeria, with particular emphasis on management support. Using data from 220 respondents and Structural Equation Modelling, the study found that perceived relative advantage was positively related to SME performance. Employee capability also influenced

management support, while management support had a significant positive effect on performance.

The study highlights the importance of managerial commitment and workforce capability in translating AI adoption into organizational outcomes. However, its geographical scope does not specifically reflect the SME environment in Anambra State.

Oneniyi et al. (2026) investigated AI-enabled human-resource analytics capability and operational performance among Nigerian SMEs. The study surveyed 296 respondents from Lagos, Abuja, Port Harcourt and Kano. Using PLS-SEM, the study found that technological readiness and organizational support significantly contributed to AI-enabled analytics capability. AI-enabled HR analytics capability also had a positive association with operational performance.

This study provides important recent Nigerian evidence supporting a relationship between AI capability and performance. However, its focus was specifically on human-resource analytics rather than broader functional applications of AI across different areas of SME operations.

Overall, the empirical literature presents both supportive and cautionary evidence. Studies such as Soomro et al. (2025), Akinruwa et al. (2025) and Oneniyi et al. (2026) suggest that AI-related capabilities can improve various dimensions of SME performance. In contrast, Olawale et al. (2025) found that specific forms of automation did not strongly predict operational efficiency. These differences suggest that the relationship between AI adoption and organizational performance is context-dependent and may vary according to the specific application of AI, organizational readiness and the manner in which performance is measured.

2.4 Research Gap

A critical synthesis of the reviewed literature reveals several gaps that justify the present study.

First, there is a geographical gap. Existing Nigerian studies have concentrated on areas such as Ondo Central, Oyo State, Southwest Nigeria and major cities including Lagos, Abuja, Port Harcourt and Kano (Akinruwa et al., 2025; Kehinde et al., 2025; Olawale et al., 2025; Oneniyi et al., 2026). There remains limited empirical evidence specifically examining AI adoption and organizational performance among SMEs in Anambra State.

This gap is important because technology adoption occurs within specific economic, institutional and infrastructural environments. Findings obtained from other parts of Nigeria cannot automatically be generalized to SMEs in Anambra State without empirical investigation.

Second, there is a conceptual gap in the measurement of AI adoption. Previous studies often focused on specific technologies or specialized applications. Olawale et al. (2025), for instance, focused on robotic process automation and machine-learning

automation, while Oneniyi et al. (2026) focused specifically on AI-enabled human-resource analytics.

The present study adopts a broader functional approach by examining actual AI use in customer communication, marketing and content creation, accounting and administration, sales and demand analysis, inventory support, and data analysis and decision support.

Third, a performance-measurement gap exists. Some previous studies focused on operational efficiency or sustainable performance. While important, these constructs may not capture the wider range of outcomes through which SMEs experience performance changes. The present study therefore considers sales growth, cost efficiency, employee productivity, customer satisfaction, response speed, decision quality and competitiveness.

Fourth, the empirical findings are inconsistent. While Soomro et al. (2025), Akinruwa et al. (2025) and Oneniyi et al. (2026) reported positive relationships between AI-related capabilities and performance, Olawale et al. (2025) found that selected AI automation dimensions did not strongly predict operational efficiency. This inconsistency suggests the need for further context-specific investigation.

Finally, there is a functional-integration gap. Much of the existing literature focuses on whether firms have adopted AI rather than the extent to which AI has been integrated into multiple everyday business functions. The present study addresses this gap by examining the actual functional utilization of AI across major operational areas.

The study therefore contributes to existing knowledge by providing context-specific evidence on the relationship between multidimensional AI adoption and multidimensional organizational performance among SMEs in Anambra State, Nigeria.

2.5 Conceptual Framework

Based on the conceptual, theoretical and empirical literature reviewed, the study proposes that AI adoption constitutes the independent variable, while organizational performance constitutes the dependent variable.

AI adoption is represented by six dimensions:

1. AI for customer communication;
2. AI for marketing and content creation;
3. AI for accounting and administration;
4. AI for sales and demand analysis;
5. AI for inventory support; and
6. AI for data analysis and decision support.

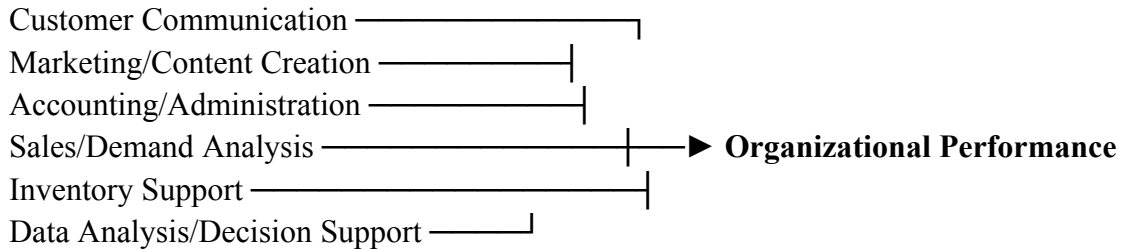
Organizational performance is represented by:

- sales growth;
- cost efficiency;
- employee productivity;
- customer satisfaction;

- response speed;
- decision quality; and
- competitiveness.

The conceptual relationship may be represented as follows:

Artificial Intelligence Adoption



Organizational Performance Indicators

- Sales Growth
- Cost Efficiency
- Employee Productivity
- Customer Satisfaction
- Response Speed
- Decision Quality
- Competitiveness

Figure 1. Conceptual framework of AI adoption and organizational performance of SMEs

The framework proposes that the functional use of AI across key business activities may influence the overall performance of SMEs. The TOE framework provides the broader theoretical explanation for the technological, organizational and environmental conditions surrounding AI adoption, while the conceptual framework focuses specifically on the relationship between actual AI utilization and organizational performance.

3. Methodology

3.1 Research Design and Study Area

The study adopts a descriptive cross-sectional survey design because it permits systematic collection of standardized data from SME owner-managers/managers at a single point in time and supports the examination of patterns of AI adoption, perceived organizational performance, and adoption constraints. The study is conducted in Onitsha and Nnewi, two major commercial and industrial clusters in Anambra State. Onitsha represents a predominantly trading and service-oriented commercial environment, while Nnewi has a strong manufacturing, automobile-related and entrepreneurial base. Their inclusion provides coverage of distinct SME activity profiles within the state.

3.2 Population, Sample and Sampling

The target population comprises 1,200 registered SMEs in the selected Onitsha and Nnewi clusters. The sample size is determined using Taro Yamane's formula, $n = N/[1 +$

$N(e^2)$], where $N = 1,200$ and $e = 0.05$. Thus, $n = 1,200/[1 + 1,200(0.05^2)] = 300$. The unit of analysis is the SME, while one knowledgeable respondent - preferably the owner-manager or a manager directly involved in business operations and technology decisions - is selected from each sampled enterprise. A proportionate stratified sampling procedure is used. First, the sampling frame is stratified by location (Onitsha and Nnewi); the 300 questionnaires are then allocated to each location in proportion to its share of the 1,200 registered SMEs. Within each location, enterprises should be further stratified by major business sector (trading, manufacturing, and services/other) where reliable frame information is available. SMEs within each stratum are selected using simple random or systematic random sampling from the registration list. This procedure improves representation and reduces the risk that the larger commercial cluster or a dominant business sector will disproportionately determine the findings. Eligibility requires that the enterprise meet the study's SME definition, operate within the selected cluster, and have an owner-manager/manager able to provide informed responses. Replacement of non-responding firms should follow the same stratum and selection rule, and the final manuscript should report questionnaires distributed, returned, excluded, and the achieved response rate.

3.3 Instrument, Validity and Reliability

Data are collected using the Artificial Intelligence Adoption and Organizational Performance of SMEs Questionnaire (AIAOPSQ), reproduced in Appendix A. Section A captures respondent and enterprise characteristics; Section B measures the extent of AI adoption using eight items; Section C measures organizational performance using ten items; and Section D measures ten constraints to AI adoption. Sections B-D use five-point response scales. Face and content validity should be established by experts in Business Administration, information systems, and measurement/research methods, with their comments used to refine wording, relevance, and coverage. A pilot study should be conducted among SME respondents outside the main study locations but with comparable characteristics. Internal consistency should be assessed separately for the AI Adoption, Organizational Performance, and Adoption Challenges scales using Cronbach's alpha, with $\alpha \geq .70$ treated as the planned minimum for acceptable reliability. The final article should report the pilot sample size and the obtained alpha coefficient for each scale rather than only stating the acceptance threshold.

3.4 Model Specification and Analysis

The effect model is specified as:

$$OP = \beta_0 + \beta_1 AIA + \epsilon$$

where OP = Organizational Performance; AIA = Artificial Intelligence Adoption; β_0 = intercept; β_1 = regression coefficient; and ϵ = error term. Composite scores are computed as $AIA_MEAN = MEAN(AIA1 \text{ TO } AIA8)$ and $OP_MEAN = MEAN(OP1 \text{ TO } OP10)$. Objective 1 is analysed using frequencies, percentages, means and standard deviations; Objective 2 is tested using simple linear regression with AIA_MEAN as the predictor and OP_MEAN as the dependent variable; and Objective 3 is analysed

using item means, standard deviations and descending rank order. Five-point means are interpreted as 1.00-1.80 = Very Low, 1.81-2.60 = Low, 2.61-3.40 = Moderate, 3.41-4.20 = High, and 4.21-5.00 = Very High. Before regression inference, linearity, normality and homoscedasticity of residuals, standardized residuals, and influential cases should be examined. Statistical tests are evaluated at $\alpha = .05$ using SPSS version 27.

4. Results

4.1 Respondent Characteristics

Table 1: Respondent Characteristics / Demographic Profile of Respondents

Variable	Category	Frequency	%
Gender	Male	178	59.3
	Female	122	40.7
Business age	Below 5 years	76	25.3
	5-10 years	130	43.3
	Above 10 years	94	31.3
Location	Onitsha	164	54.7
	Nnewi	136	45.3
Business type	Trading	124	41.3
	Manufacturing	76	25.3
	Services/others	100	33.3

Table 1 presents profile of 300 respondents. The frequencies have been reconciled so that every category within each variable sums to 300 and the reported percentages sum to approximately 100%, subject only to rounding. The profile indicates representation across gender, business age, location and enterprise type.

4.2 Extent of AI Adoption

Table 2: Extent of Artificial Intelligence Adoption

AI application	Mean	SD	Decision
AI-supported customer communication/chatbots	3.80	0.91	High
Generative AI for marketing/content	3.42	1.03	High
AI-enabled design/media tools	3.36	0.98	Moderate
AI-assisted accounting/administration	2.64	1.08	Moderate
AI sales/demand analysis	2.36	1.01	Low
AI-supported inventory management	2.10	0.96	Low
AI business-data analysis/decision support	2.88	1.04	Moderate
AI personalization/recommendation tools	2.47	1.00	Low
Grand mean	2.88	-	Moderate

Table 2 presents descriptive statistics for the eight AI-adoption items in the questionnaire. The overall mean of 2.88 indicates a Moderate extent of AI adoption under the stated decision rule. AI-supported customer communication/chatbots ($M = 3.80$, $SD = 0.91$) and generative AI for marketing/content ($M = 3.42$, $SD = 1.03$) show High use, whereas sales/demand analysis, inventory support and customer personalization remain Low. The pattern suggests that respondents are more likely to use accessible, front-end AI applications than more integrated analytical applications.

4.3 Effect of AI Adoption on Organizational Performance

Table 3: Model Summary and Regression Results for AI Adoption and Organizational Performance

Variable	B	Std. Error	B	t	p
Constant	1.284	0.221	-	5.81	<.001
AI Adoption	0.576	0.055	0.518	10.45	<.001

Model summary: $R = .518$; $R^2 = .268$; Adjusted $R^2 = .266$; $F(1, 298) = 109.11$, $p < .001$; $n = 300$.

Table 3 reports an internally reconciled simple linear regression for 300 respondents. AI adoption is positively associated with organizational performance ($B = 0.576$, $SE = 0.055$, $\beta = 0.518$, $t = 10.45$, $p < .001$). The model explains 26.8% of the variance in organizational performance ($R^2 = .268$; adjusted $R^2 = .266$), $F(1, 298) = 109.11$, $p < .001$. Thus, within this model, higher AI-adoption scores correspond with higher organizational-performance scores. The coefficient, standard error, t statistic, R^2 and F statistic have been aligned mathematically for $n = 300$.

4.4 Challenges to AI Adoption

Table 4: Challenges Constraining AI Adoption

Challenge	Mean	SD	Rank
High cost of acquisition/implementation	4.31	0.84	1 st
Inadequate AI/digital literacy	4.16	0.89	2 nd
Unreliable electricity supply	4.02	0.94	3 rd
Lack of technical expertise	3.89	0.96	4 th
Poor or expensive internet connectivity	3.82	0.99	5 th
Data-security/privacy concerns	3.63	1.02	6 th
Difficulty integrating AI with existing processes	3.58	1.00	7 th
Inadequate knowledge of available AI tools	3.54	1.05	8 th
Uncertainty about benefits/returns	3.45	1.07	9 th
Limited external technical/financial/government support	3.38	1.09	10 th

Table 4 presents the ranking of the ten constraints measured in Section D of the questionnaire. High cost of acquiring or implementing AI tools ranks first ($M = 4.31$), followed by inadequate AI/digital literacy ($M = 4.16$) and unreliable electricity supply ($M = 4.02$). Limited external support and uncertainty about returns are comparatively lower, although their means still indicate Moderate-to-High perceived constraints. The table now corresponds to all ten challenge items in the instrument.

5. Discussion of Findings

The results indicate a moderate but uneven pattern of AI adoption. SMEs appear more likely to use relatively accessible applications for customer interaction, content generation and media/design support than applications requiring deeper data integration, such as demand forecasting, inventory support and personalization. This pattern is consistent with the study's TOE framing, in which adoption depends not only on perceived technological advantage but also on organizational capability and the surrounding infrastructure.

The reconciled regression model shows a positive association between AI adoption and organizational performance, with AI adoption accounting for 26.8% of the variance in the performance composite. This direction is consistent with studies reporting that AI can support efficiency, faster customer response and managerial decision-making. However, the literature is not uniformly positive; some Nigerian evidence suggests that isolated automation dimensions may not strongly predict operational efficiency. Accordingly, the empirical interpretation should focus on the degree and integration of AI use rather than mere access to AI tools.

The constraint pattern also aligns with the TOE framework. Acquisition cost and integration difficulty represent technological conditions; digital literacy and technical expertise reflect organizational readiness; and electricity, internet connectivity and external support represent environmental conditions. Data-privacy concerns and uncertainty about returns further indicate that adoption decisions involve both perceived risk and expected business value.

6. Conclusion and Recommendations

6.1 Conclusion

The study examines the extent of AI adoption, its relationship with organizational performance, and the challenges constraining adoption among SMEs in Onitsha and Nnewi. In the analysis, overall adoption is moderate and uneven, with more frequent use of customer-facing and content-generation applications than advanced analytical tools. The reconciled regression indicates a positive association between AI adoption and organizational performance, while cost, digital capability and infrastructure emerge as prominent constraints.

6.2 Recommendations

1. Anambra State Government, SMEDAN and business associations should organize practical, subsidized AI-literacy programmes for SME owners and employees in Onitsha and Nnewi.
2. SMEs should adopt AI incrementally, beginning with affordable tools for customer response, marketing, administrative support and routine analysis before investing in more complex systems.
3. Government and development-finance institutions should support SME digitalization through targeted grants or affordable finance and improved electricity and broadband infrastructure.

6.3 Limitations and Further Studies

Manuscript consistency note: The sample size is consistently specified as 300. The Results tables have been aligned with the questionnaire structure (8 AI-adoption items and 10 challenge items), respondent frequencies sum to 300, and the regression statistics are mathematically consistent with $n = 300$.

The study is geographically limited to Onitsha and Nnewi and uses a cross-sectional design, so it cannot establish temporal causality or represent every SME cluster in Anambra State. Self-reported measures may also be affected by recall or social desirability bias. Future studies should extend coverage to Awka and other parts of the state, compare sectors and firm sizes, and consider longitudinal or mixed-method designs to examine how AI adoption and organizational performance evolve over time.

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Appendix A

Artificial Intelligence Adoption and Organizational Performance of SMEs Questionnaire (AIAOPSQ)

Dear Respondent,

This questionnaire is designed to collect data for a study on Artificial Intelligence Adoption and Organizational Performance of SMEs in Anambra State, Nigeria. Your responses are for academic purposes and will be treated confidentially. Please answer as accurately as possible. Do not write your name.

Section A: Respondent and Enterprise Profile

1. Location: ☐ Onitsha ☐ Nnewi
2. Gender: ☐ Male ☐ Female ☐ Prefer not to say
3. Age: ☐ Below 25 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55 and above
4. Position: ☐ Owner ☐ Manager ☐ Owner-Manager ☐ Other: _____
5. Main business activity: ☐ Trading ☐ Manufacturing ☐ Services ☐ Other: _____
6. Years in operation: ☐ Below 5 ☐ 5-10 ☐ 11-15 ☐ Above 15
7. Number of employees: ☐ 1-9 ☐ 10-49 ☐ 50-199
8. Highest educational qualification: ☐ Secondary ☐ ND/NCE ☐ HND/Bachelor's ☐ Postgraduate ☐ Other

Section B: Extent of Artificial Intelligence Adoption (Objective 1)

Instruction: Indicate the extent to which your business currently uses each AI-enabled application. 5 = Very High Extent (VHE), 4 = High Extent (HE), 3 = Moderate Extent (ME), 2 = Low Extent (LE), 1 = Very Low Extent/Not Used (VLE).

Code	Item	5	4	3	2	1
AIA1	AI-enabled chatbots or	☐	☐	☐	☐	☐

	automated messaging for customer enquiries.					
AIA2	Generative AI tools for writing advertisements, captions, emails or other business content.	☐	☐	☐	☐	☐
AIA3	AI-enabled design or media tools for creating marketing materials.	☐	☐	☐	☐	☐
AIA4	AI-assisted accounting, bookkeeping or administrative tasks.	☐	☐	☐	☐	☐
AIA5	AI-enabled tools for sales analysis, demand forecasting or customer insights.	☐	☐	☐	☐	☐
AIA6	AI-enabled inventory or stock-management support.	☐	☐	☐	☐	☐
AIA7	AI tools for analysing business data and supporting managerial decisions.	☐	☐	☐	☐	☐
AIA8	AI-enabled personalization or recommendation tools for customers.	☐	☐	☐	☐	☐

Section C: Organizational Performance (Objective 2)

Instruction: Indicate your level of agreement with each statement about your business during the period in which AI tools have been used. 5 = Strongly Agree (SA), 4 = Agree (A), 3 = Undecided (U), 2 = Disagree (D), 1 = Strongly Disagree (SD).

Code	Statement	5	4	3	2	1
OP1	The use of AI-enabled tools has improved the speed of our business operations.	☐	☐	☐	☐	☐
OP2	AI-enabled tools have improved our response to customers.	☐	☐	☐	☐	☐
OP3	AI-enabled tools have helped reduce time spent on repetitive tasks.	☐	☐	☐	☐	☐
OP4	AI-enabled tools have improved employee/owner productivity.	☐	☐	☐	☐	☐
OP5	AI-enabled tools have improved the quality of managerial decisions.	☐	☐	☐	☐	☐
OP6	AI-enabled tools have contributed to better customer satisfaction.	☐	☐	☐	☐	☐
OP7	AI-enabled tools have helped improve sales or revenue performance.	☐	☐	☐	☐	☐
OP8	AI-enabled tools have helped reduce operating or marketing costs.	☐	☐	☐	☐	☐
OP9	AI-enabled tools have strengthened our ability to compete in the market.	☐	☐	☐	☐	☐

OP10	Overall, AI-enabled tools have improved the performance of this business.	☐	☐	☐	☐	☐
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Section D: Challenges Constraining AI Adoption (Objective 3)

Instruction: Indicate the extent to which each factor is a challenge to AI adoption in your business. 5 = Very High Extent, 4 = High Extent, 3 = Moderate Extent, 2 = Low Extent, 1 = Very Low Extent/Not a Challenge.

Code	Challenge	5	4	3	2	1
CH1	High cost of acquiring or subscribing to suitable AI tools.	☐	☐	☐	☐	☐
CH2	Inadequate knowledge of available AI tools and their business uses.	☐	☐	☐	☐	☐
CH3	Low AI/digital literacy among owners, managers or employees.	☐	☐	☐	☐	☐
CH4	Lack of technical expertise to implement or maintain AI solutions.	☐	☐	☐	☐	☐
CH5	Unreliable electricity supply.	☐	☐	☐	☐	☐
CH6	Poor or expensive internet connectivity.	☐	☐	☐	☐	☐
CH7	Concerns about data privacy and cybersecurity.	☐	☐	☐	☐	☐
CH8	Difficulty integrating AI tools with	☐	☐	☐	☐	☐

	existing business processes.					
CH9	Uncertainty about the benefits or return on investment from AI.	☐	☐	☐	☐	☐
CH10	Limited access to external technical, financial or government support.	☐	☐	☐	☐	☐



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