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THE ROLE OF ARTIFICIAL INTELLIGENCE IN ADVANCING SUSTAINABLE BANKING AND SERVICE EFFICIENCY IN NIGERIAN FINANCIAL INSTITUTIONS: AN ASSESSMENT OF SELECTED QUOTED BANKS

Abiodun Thomas Ogundele*, Olusola Anthony Ibitoye**, Oluwatoyin Olusola Akinterinwa***, Adeniran Abraham****, Felix Olusegun Ibukun***** and Apata Temitope Gift******

ABSTRACT

The rapid growth of human reasoning impacts the sustainability and efficiency of the banking industry globally, including in Nigeria. Many banks have used technology and creativity to improve service efficiency and revenue sustainability due to worries about the detrimental effects of human intelligence. Our research analyses how AI integration influences sustainable banking and service efficiency in selected Nigerian listed banks. Natural language processing, machine learning, and predictive analytics are revolutionising banking. In addition, risk management, fraud detection, customer service, and operational automation applications create data privacy, ethical, and regulatory compliance issues, though they are efficient and cost-effective. According to a cross-sectional study of clients from five Nigerian deposit money banks: Access Bank Plc, Fidelity Bank Plc, First Bank Plc, Guarantee Trust Bank Plc, and Zenith Bank Plc, 384 individuals completed the self-administered questionnaire SAQ. In this study, the following methods were used: mean, standard deviation, skewness, kurtosis, Jarque Bera, correlational analysis, and OLS regression. The researchers observed that AI awareness, application, and effectiveness have an impact on the service efficiency of a subset of Nigerian quoted deposit money banks. Finance firms in Nigeria use AI to improve productivity and client happiness as one suggestion was to automate tedious tasks for bank services. However, government regulations restrict Nigerian banks' AI usage. To bridge these gaps, the paper recommends banking AI regulations, infrastructural development, education, training, and monitoring. The paper also recommends that Nigerian officials automate identity verification and risk assessment to speed up procedures. Overall, there should be strong sustainability, security, and privacy laws to promote economic and social objectives.

Keywords: artificial intelligence, financial technology, Nigerian banking sector, sustainable service efficiency, operational performance.

1. INTRODUCTION

Recent global emphasis has focused on the detrimental effects of human intelligence on financial sustainability and service efficiency[1]. The main concern is human intelligence's threat to bank income. Some banks have promoted technical and creative improvements to maintain income via service efficiency for growth and development. Due to public concern about bank sustainability and service efficiency, AI has advanced into many critical areas of bank operations[2].

Specifically, AI has transformed banking. To compete in the digital age, banks need AI. Therefore, Nigeria's banking system must increase efficiency and sustainability to survive the digital age. Global banking is increasingly utilising AI to address many issues of operational concerns[3]. However, the Nigerian banking industry offers distinct opportunities and difficulties as AI

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1 Begoña TO, Saiz MC, and Sergio SA, 'Sustainable Banking, Market Power, and Efficiency: Effects on Banks' Profitability and Risk' (2021) 13 Sustainability https://doi.org/10.3390/su13031298

2 Gallego-Gomez C and De-Pablos-Heredero C, 'Artificial Intelligence as an Enabling Tool for the Development of Dynamic Capabilities in the Banking Industry' (2020) 16(3) International Journal of Enterprise Information Systems (IJEIS) 20 https://doi.org/10.4018/ijeis.2020070102

3 Rahman M, Ming TH, Baigh TA, and Sarker M, 'Adoption of artificial intelligence in banking services: an empirical analysis' (2023) 18(10) International Journal of Emerging Markets 4270.

improves banking and service efficiency. Though machine learning, NLP, and predictive analytics may enhance banking procedures, customer experiences, and efficiency, banks employ AI for risk management, fraud detection, customer service, and automation. Technology is efficient and cost-effective, but it creates ethical, legal, and data privacy concerns.

To reassure stakeholders amid rising fear, financial institutions have offered incentives for resolving challenges and upgrading banking products. Thus, artificial intelligence research has grown rapidly. According to Akpanbong and Essien the study suggest that while banks consider corporate entities' interests when fulfilling fiduciary duties, artificial intelligence may not always benefit them[4]. Most research has disregarded customer happiness, despite an increasing emphasis on service efficiency. Few studies have evaluated Nigerian banks' service efficiency, AI adoption, implementation, acceptance, concerns and obstacles, cost-benefit analysis, efficacy, and other features. AI impacts service effectiveness: thus, long-term company goals need service efficiency. As stated by Mohammed, Issah and Maah in their study opine that service efficiency projects match shareholder expectations for long-term corporate objectives. To enhance financial services, one must comprehend AI and world events[5].

Banking AI has improved regulatory compliance, client satisfaction, and efficiency worldwide. Chatbots for customer care, predictive analytics for risk management, and tailored financial solutions are banking AI tools for efficient service delivery. AI may lower bank operating expenses by 25%, boost customer happiness, and detect fraud[6]. AI in banking has witnessed

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[4] Akparbong P and Essien NP, 'Enhancing Customer Experience in Banking Using Artificial Intelligence' (2022) 44 International Journal of Information Management 76-86.

[5] Mohammad SA, Issah A, and Maah HM, 'Evaluating the Role of Artificial Intelligence in the Automation of the Banking Services Industry: Evidence from Jordan' (2022) 10(3) Humanities and Social Sciences Letters 383-393 https://doi.org/10.18488/73.10i3.3090

[6] Hassan M, Aziz LAR, and Andriansyah Y, 'The role of artificial intelligence in modern banking: an exploration of AI-driven approaches for enhanced fraud prevention, risk management, and regulatory compliance' (2023) 6(1) Reviews of Contemporary Business Analytics 110.

expansion in Nigeria with Zenith Bank, Guarantee Trust Bank, and Access Bank improving their operations and services[7].

Emerging countries dominate AI and service efficiency research due to increased demand. In developing nations like Nigeria, most studies have concentrated on AI rather than how it affects service quality. Moreso, the effects of AI on service efficiency have been studied in developed and developing nations, with mixed results[8].

Most Nigerian research has not examined AI awareness, application, and impact in banking, which are important in both developed and developing nations[9]. AI research's discrepancies have created a gap. This study explores how AI improves a chosen Nigerian listed deposit money bank's service quality. For this, the study limits AI to awareness, application, and effectiveness, while customer happiness indicates service effectiveness.

Many factors make this topic significant. First, sustainable banking is essential for banks and the economy. Banks may satisfy national and global sustainability goals by reducing environmental and social impacts. Second, AI may boost efficiency and democratise financial services for the underbanked and rural people, thereby encouraging economic inclusion. Moreso, recent events underscore the value of this research. Since the COVID-19 pandemic, AI has helped banks adjust to client behaviour and operational difficulties[10] Nigeria's SDGs focus encourages sustainable management in all areas, including finance.

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7 Lottu OA, Abdul AA, Daraojimba DO, Alabi AM, John-Ladega AA, and Daraojimba C, 'Digital transformation in banking: a review of Nigeria's journey to economic prosperity' (2023) 5(8) International Journal of Advanced Economics 215.

8 Omoge AP, Gala P, and Horky A, 'Disruptive technology and AI in the banking industry of an emerging market' (2022) 40(6) International Journal of Bank Marketing 1217.

9 Agarwal P, Swami S, and Malhotra SK, 'Artificial intelligence adoption in the post COVID-19 new-normal and role of smart technologies in transforming business: a review' (2024) 15(3) Journal of Science and Technology Policy Management 506.

10 Aderibigbe AO, Ohenhen PE, Nwaobia NK, Gidiagba JO, and Ani EC, 'Artificial intelligence in developing countries: bridging the gap between potential and implementation' (2023) 4(3) Computer Science & IT Research Journal 185.

AI has several banking benefits, but its impact on Nigerian sustainability is unclear[11]. Technology and service delivery dominate AI research, not sustainable financing. This study examines how AI improves Nigerian bank sustainability and efficiency to fill this gap. AI may improve financial institution governance, social justice, and environmental effect, according to available data. Based on the mentioned banks' experiences, this study provides invaluable advice to the government, policy maker, banking executives, and technology vendors. The study exposes how AI can make Nigeria's financial sector more sustainable and efficient, and supporting economic and social goals.

2. SUSTAINABLE BANKING AND THE GROWING RELEVANCE OF AI: A LITERATURE REVIEW

This section's main components include conceptual, theoretical, and empirical reviews of artificial intelligence and service efficiency.

2.1 Artificial Intelligence and Service Efficiency

There are mounting concerns about global technological change and artificial intelligence's rising effect on Nigeria's economy. The prioritisation of AI algorithms, AI-powered chatbots, AI automation, AI-driven robots, AI-driven voice, and speech recognition systems can improve stakeholders' perception and impact on banking service efficiency[12]. So, AI activity awareness, application, and effectiveness may increase service efficiency in the banking industry. Thus, banks' knowledge, acceptance, usage, and usefulness of AI operations are part of a bigger digital transformation trend that helps them compete, improve efficiency, and provide better services. According to studies, artificial intelligence is a machine's ability to see, reason, learn, grasp language, and interact with the environment. AI is "a branch of computer science that focuses on creating intelligent machines capable of performing

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[11] Agarwal P, Swami S, and Malhotra SK, 'Artificial intelligence adoption in the post COVID-19 new-normal and role of smart technologies in transforming business: a review' (2024) 15(3) Journal of Science and Technology Policy Management 506.

[12] Tatikonda, V., Venigandla, K., & Vemuri, N. (2022). Transforming customer banking experiences: ai-driven rpa for customized service delivery. International Journal of Development Research, 12, 60674-60677.

tasks that typically require human intelligence"[13]. AI impacts service efficiency and adversely impacts stakeholder sustainability. On its part, service efficiency is how successfully a bank offers products and services while minimising costs and maximising customer satisfaction. Nigerian deposit money banks need efficiency for several reasons. Firstly, good banking services help individuals and companies in trade, and lead to increased and improved economic outputs. Secondly, customer loyalty, client acquisition, and bank earnings may grow with better services. Lastly, efficient banking eliminates transaction delays and errors, thereby stabilising the financial system.

2.2 Theoretical Framework

This study appropriates resource-based viewpoint, innovation diffusion, and digital transformation theories as its theoretical paradigm.

2.2.1 Digital Transformation Theory

In the late 20th century, digital transformation theory emerged and has evolved. As firms realised how digital technology affected operations, strategies, and business models in the early 21st century, the notion of digital transformation gained attention. In response to the rapid use of digital technology across businesses, digital transformation theory has grown without a single proponent. In the view of Rahman, Choudhury, and Singh the study attribute the shaping of this idea to business, technological, and management executives, consultants, and researchers[14]. Digital transformation describes how firms utilise digital technology to fundamentally change their value propositions, consumer relationships, and operations. The digital transformation paradigm promotes innovation and productivity across an organisation's lifecycle by using digital tools and technologies like artificial intelligence, cloud computing, data analytics, and the internet of things[15]. As mentioned by Noonpakdre's study finds that digital transformation theory is applicable in modern business, particularly since firms across sectors implement digital transformations to remain competitive. The hypothesis suggests that firms adapt to rapid technological change, shifting client expectations, and a changing digital environment. Digital technology helps

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13 Ertel W, Introduction to Artificial Intelligence (Springer 2018)

14 Rahman S, Choudhury B, and Singh S, 'Role of Artificial Intelligence in Banking Sector: A Comprehensive Review' (2022) 18 Materials Today: Proceedings 1198-1204

15 Mohammad S, Issah A, and Maah H (n.5)

banks and financial institutions simplify operations, enhance client experiences, and adapt to a changing financial environment[16].

2.2.2 Innovation Diffusion Theory

In 1962, social scientist Everett Rogers developed the Innovation Diffusion Theory. Rogers' book, "Diffusion of Innovations," shows how new ideas, technologies, and innovations spread. The theory has changed several times since 1962 as the notion was modified and extended by Rogers and used in numerous fields. The theory explains why individuals, corporations, and society adopt innovations. Invention stages and adoption characteristics are described[17] and this concept is used in marketing, sociology, communication studies, and management to study innovation adoption. Fast-paced technology and business make the notion relevant today. It reveals innovation adoption patterns to assist banks and financial organisations develop and promote new technology. The adoption steps of the theory include knowledge, persuasion, decision-making, execution, and confirmation. Understanding these stages helps financial institutions implement new technologies[18].

2.2.3 Resource-Based View Theory

Jay Barney created the "Resource-Based View (RBV) Theory" in the 1980s and refined it in the 1990s. In 1991, he authored "Firm Resources and Sustained Competitive Advantage," which helped pioneer RBV. The argument posits that a firm's competitive edge stems from its unique and valued resources. RBV is used to manage corporate strategy as this paradigm allows for the assessment of a company's competitive assets and capabilities. Business and management researchers utilise this theory to explore how organisations can stay competitive. Business strategy conversations still reference RBV. Leveraging and developing resources for a long-term

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16 Noonpakdee W, 'The Adoption of Artificial Intelligence for Financial Investment Service' (2020) International Conference on Advanced Communication Technology (ICACT), Pyeongchang, Republic of Korea, 16(19), 396–400.

17 Iranmanesh SH, Hamid M, Bastan M, Hamed-Shakouri G, and Nasiri MM, 'Customer churn prediction using artificial neural network: An analytical CRM application' (2019) 3(5) International Conference on Industrial Engineering and Operations Management 23.

18 Inegbedion H, Inegbedion EE, Osifo SJ, Eze SC, Ayeni A, and Akintimehin O, 'Exposure to and usage of e-banking channels: Implications for bank customers' awareness and attitude to e-banking in Nigeria' (2020) 11 Journal of Science and Technology Policy Management 133.

competitive advantage is critical for firms in complex and changing situations. RBV may help banks discover and capitalise on intellectual capital, technology infrastructure, and customer connections. RBV emphasises that a firm's competitive advantage depends on its unique and valuable resources, which are difficult to copy, according to (Rahman S, Choudhury B, and Singh S. n. 3) These resources include a powerful brand, superior technological platforms, exclusive data analytics, and exclusive collaborations in banking. It also requires risk management, product innovation, customer service, and regulatory agility.

2.2.4 Theoretical Justification

This study analyses a few Nigerian deposit money banks' artificial intelligence and service efficacy through different theoretical frameworks. Three ideas in particular have shaped service efficiency debates. These theories include: digital transformation, innovation dissemination, and resource-based vision. The resource-based perspective idea is strongest in artificial intelligence research. Resource-based perspective theory also manages company-customer interests. Resource-based view theory helps decision-makers choose AI that best serves stakeholders. Service efficiency is used to monitor AI implementation in the resource-based view theory. In light of this study, the resource-based viewpoint hypothesis supports the study of how artificial intelligence influences Nigerian service efficiency.

2.3 Empirical Review

Four groups – artificial intelligence awareness, application, effectiveness, sustainable banking, service efficiency, and the role of AI – pools prior research on how AI influences service efficiency. We present these investigations in sequence to track the rise and development of the literature.

2.3.1 AI Awareness and Service Efficiency

Growing awareness of AI technology drives its use across industries, including banking. As they learn more, banks are under pressure to adopt AI technology to satisfy consumer expectations. Chatbots and virtual assistants for client service, and customer interactions powered by AI give real-time support and boost operational efficiency. Invariably, AI awareness increases demand for efficient, technology-driven services.

In this study, artificial intelligence awareness is an unimportant explanatory variable; however, in prior research, it was substantial but negatively correlated with service efficiency. According to Alzyoud, Al-Naimi and Al-

Gasaymeh conclude that service efficacy and AI awareness are unrelated[19], while Kelly and Rajasekaran[20], Break, Chalmeta, and Grangel[21] project a strong negative link between AI awareness and service efficiency in their research. Thus, it is concluded that AI awareness affects service efficacy.

2.3.2 Applying AI for Service Efficiency

AI applications are essential to the banking industry, offering much improved service efficiency. Wang and Smith[22] believe AI applications improve financial services efficiency. This empirical literature review synthesises studies on AI technology's influence on service efficiency in banking, healthcare, and customer service. Healthcare research by Du, Huang and and Liu[23] find that AI-assisted solutions enhance diagnosis accuracy. AI in medical diagnostics speeds up and improves patient care. Chen studied financial institution risk management using AI. AI-based risk models beat conventional techniques, reducing financial risks and improving service efficiency. Cohen's extensive algorithmic trading system examination demonstrated their effectiveness in executing complex trading strategies and maximising investment returns. The results of the study showed a favourable correlation. Patel and Wang[24] studied how AI-driven chatbots affect e-commerce customer service efficiency. AI applications improve service efficiency by reducing response

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19 Alzyoud S, Al-Naimi AA, and Al-Gasaymeh AS, 'The impact of artificial intelligence on the efficiency of banking service: Evidence from Jordanian commercial banks' (2022) 5(6) Journal of Southwest Jiaotong University 700.

20 Kelly R and Rajasekaran D, 'Artificial Intelligence in Banking Sector: Opportunities and Challenges' (2020) 7(5) Journal of Critical Reviews 381.

21 Break R, Chalmeta R, and Grangel R, 'Artificial intelligence in banking: A research agenda' (2019) 146 Technological Forecasting and Social Change 931.
Brown A and Miller B, 'The impact of AI on customer service' (2018) 22(4) Journal of Banking Technology 123.

22 Wang Q and Smith A, 'Transforming customer service: The role of AI-driven chatbots' (2020) 18(3) Journal of Financial Technology 112

23 Du J, Huang M, and Liu L, 'AI-Aided Disease Prediction in Visualized Medicine' in Visualized Medicine: Emerging Techniques and Developing Frontiers (Springer Nature Singapore 2023) 107.

24 Patel R and Wang Q, 'AI-driven chatbots in e-commerce: An empirical analysis of customer service efficiency' (2021) 14(2) Journal of Customer Experience Management 78.

time and increasing customer satisfaction. Wu and others[25], Huange and Rust[26] discovered no correlation between AI and service efficiency.

2.3.3 Optimising AI Performance and Service Efficiency

AI has attracted attention for its potential to improve service efficiency across sectors. This empirical literature review synthesises works on AI applications' effectiveness and service efficiency. Mäkinen [27] studied AI-driven chatbots' customer service efficacy. Chatbot usage's favourable link with customer happiness demonstrated AI's efficient and responsive customer care. Accordingly Sharma studied AI's potential in medical diagnosis. The study showed that AI-powered diagnostic tools were more accurate in detecting medical disorders than conventional approaches, suggesting that AI might improve healthcare service efficiency[28]. Marcello and Matteo investigated the scientific efficacy of financial robot-advisors[29]. The research showed that AI-driven robot advisors maintained competitive investment portfolios, demonstrating AI's efficiency in financial advice services[30]. Wang and Zhang studied retail AI-powered tailored suggestions. By adapting products to consumer preferences, AI-driven recommendation engines enhance sales and service efficiency, according to studies. Others find no association between AI efficacy and service efficiency using regression analysis. However, we tested the following hypothesis based on the influence of AI effectiveness on service efficiency[31].

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[25] Wu L, Lee Y, Wang D, Li Y, and Liu T, 'AI-driven inventory optimization in supply chains: An empirical analysis' (2021) 41(5) International Journal of Operations and Production Management 601.

[26] Huange M and Rust R, 'Artificial intelligence in service' (2020) 2(2) Journal of Service Research 155 doi:10.177/10946705217752459

[27] Mäkinen J, Consumer Perceptions of AI-driven Chatbots in Digital Platforms: Factors Affecting Service Quality and Satisfaction (2024).

[28] Sharma M, 'A Study: How AI is incorporated in the middle east banking' (2023) 2(3) Journal for Research in Applied Sciences and Biotechnology 202 doi:10.55544/jrasb.2.3.27

[29] Marcello MM and Matteo B, 'Artificial intelligence in service industries: customers' assessment of service production and resilient service operations' (2023) International Journal of Production Research <doi: 10.1080/00207543.2022.2160027>

[30] ibid

[31] Wang L and Zhang H, 'The effectiveness of AI-enhanced personalized recommendations in retail' (2019) 44(1) Journal of Retailing 89.

2.3.4 AI's Role in Sustainable Banking and Service Efficiency

Kaya examined how artificial intelligence boosts banking profitability and efficiency, especially how artificial intelligence might automate banking processes to improve service, save costs, and boost efficiency[32]. AI might change banking operations by streamlining procedures and decreasing human labour, according to the study.

Konigstorfer and Thalmann use behavioural finance to study commercial banks' AI implementation[33]. The study emphasised the use of AI to improve service efficiency and promote green banking. It examined how machine learning and predictive analytics may enhance banking decision-making and customer service. Jadhav, He, and Jenkins' study discussed the use of AI and data mining in finance. AI has improved service efficiency and consumer happiness[34]. The study covered AI-driven data mining methods. These methods let banks analyse massive volumes of data to get insights, predict trends, and enhance service.

Krüger examined how institutional investors handle climate risks using AI. It showed how AI may improve banking sustainability by improving risk assessment and management. AI can improve sustainable funding by providing more accurate and up-to-date climate-related hazard data, according to the research[35].

Gupta (2020) tested how artificial intelligence may improve financial services and operations. It emphasised AI's ability to automate customer service, build connections, and simplify banking[36]. Artificial intelligence improves

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[32] Kaya O, Schildbach J, AG DB, and Schneider S, Artificial intelligence in banking (2019) Artificial intelligence

[33] Königstorfer F and Thalmann S, 'Applications of Artificial Intelligence in commercial banks–A research agenda for behavioral finance' (2020) 27 Journal of behavioral and experimental finance 100352.

[34] Jadhav S, He H, and Jenkins KW, 'An academic review: applications of data mining techniques in finance industry' (2017).

[35] Krueger P, Sautner Z, and Starks LT, 'The Importance of Climate Risks for Institutional Investors' (2020) 33(3) The Review of Financial Studies 1067 https://doi.org/10.1093/rfs/hhz137

[36] Gupta J, 'The influence of artificial intelligence on the banking industry' (2020) Wire19.

customer pleasure and personalises banking experiences, according to the study.

According to Mhlanga, artificial intelligence (AI) has broader implications for the banking business, particularly for sustainable development objectives. The study examined how AI may improve service delivery, promote sustainability, and boost economic development in developing nations[37]. The study emphasised the need to integrate AI into sustainability initiatives to achieve long-term banking goals.

These studies show how artificial intelligence has revolutionised service efficiency, sustainable banking, and banking sector issues.

2.4 Conceptual Model

We offer a schematic model to bridge the gaps and accomplish the study's objectives.

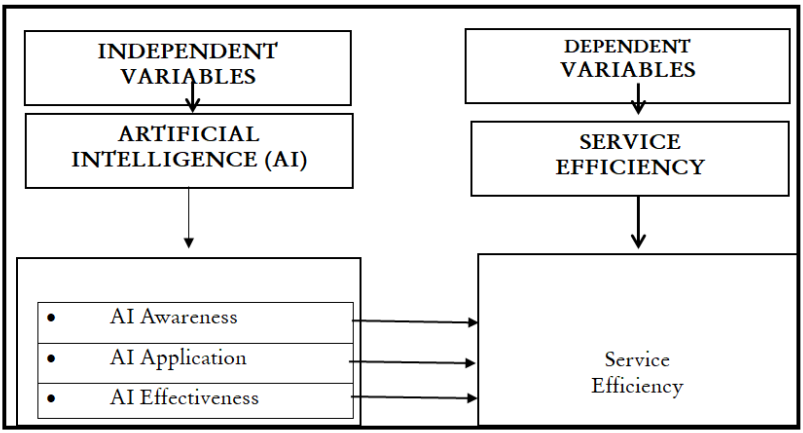

Figure 1: Conceptual Model

i. **AI Awareness:** Knowledge of AI skills, relevance, and drawbacks. It examines how banks use AI and involves AI workflow integration,

[37] Mhlanga D, 'Artificial intelligence in Industry 4.0, and its impact on poverty, innovation, infrastructure development, and the sustainable development goals: Lesson from emerging economies' (2021) 13(11) Sustainability 5788

ii. **AI Effectiveness**: refers to how well AI systems achieve goals and meet client needs.
iii. **Service efficiency:** is the ability of an organisation to use resources effectively to deliver excellent services on schedule.

2.4.1 Discussion in the Conceptual Framework

The conceptual framework demonstrates how raising awareness of AI capabilities among staff and customers can increase acceptance and deployment of AI solutions, thereby improving service efficiency. AI can improve banking operations and automate boring jobs in ways that increase service efficiency. Integrating AI into bank procedures may boost service efficiency.

3. METHODOLOGY

The study was conducted using cross-sectional surveys. We restricted the independent variable by using a cross-sectional survey. This approach leads to the collection of the ideas, attitudes, and feelings of demographically sampled groups via fieldwork. We collected primary data from Nigerian deposit money bank clients via questionnaires. A descriptive study examined changes in independent variables that affect the dependent variable. The study focused on Nigerian deposit money facility customers from Access Bank Plc, Fidelity Bank Plc, First Bank Plc, Guarantee Trust Bank Plc, and Zenith Bank Plc. We employed purposive and simple random sampling methods and utilised Cochran's (1963)[38] method for determining the sample size, which helped the sample to reflect the population without bias. The same method was usd in Mishra and others to confirm the authenticity of the formulae in getting the sample size[39] This sampling strategy benefits large populations with unknown respondent numbers. This is the 1963 Cochran formula for a vague population:

$$“n_0 = \frac{z^2 pq}{e^2}$$

[38] Cochran WG, Sampling Techniques, 2nd edn (John Wiley and Sons 1963).
[39] Mishra M, Kushwaha R, Gupta N, Sinha A, Dwivedi H, 'Survey data to evaluate consumer behaviour and consumption pattern of sustainable apparel: A study on consumer awareness level' (2023) 49 Data in Brief 109350 https://doi.org/10.1016/j.dib.2023.109350 accessed 12 July 2024.

where z is the value in the table, e is the intended degree of accuracy (with a 95% confidence level margin of error of 0.05), p is the expected percentage of the population that possesses the relevant trait, and q is equal to 1-p.

Thus, it suggests that no = $\frac{z^2 \text{ x } p\ (1\ -p)}{e^2} = \frac{1.96^2\ (0.5)\ (1-0.5)}{0.05^2} = 384.02 \simeq 384$

The 95% confidence level Z value at 5%+ or - is 1.96. A designed questionnaire tested AI awareness, applicability, effectiveness, and service efficiency. The questionnaire employed a Likert-scale rating method from strongly agreed (4 points) to strongly disagreed (1 point). The researchers may assign numerical values to Likert-scale responses, making quantitative analysis easier. Two components comprise the survey: biographical information, including bank name, gender, year of transaction, degree of education, and IT skill, was asked in section "A"; the study's goals were asked in section "B". Twenty research objectives and five biodata questions were asked. Questionnaires were delivered at the state capital and a few metropolitan centre branches of the selected banks in South West Nigeria. 384 bank deposit money customers participated. To ensure data quality and reliability, the study used many tests. To determine how artificial intelligence affects the service efficiency of a few Nigerian listed deposit money banks, descriptive statistics, regression analysis, Pearson correlation matrix, and Cronbach's Alpha were used in E-view 10. Table 1 shows the survey response rate.

Table 1: The response rate of questionnaires

Name of Bank	Response Received	Response Rate (%)
Access Bank Plc.	60	15.63
Fidelity Bank Plc.	73	19.01
First Bank Plc.	76	19.79
Guarantee Trust Bank Plc.	80	20.83
Zenith Bank Plc.	95	24.74
Total	384	100

2.5.1 Model Specification and Estimation

In the study's model, the independent variables were separated into AIAW, AIAP, and AIEF. We assume that AIAW, AIAP, and AIEF affect service efficiency in the following model:

SEFF = f (AI)

Equations 1 and 2 provide a straightforward expression for this.

SEFF = f (AIAW, AIAP, AIEF) .....Eq. (1)

Equation (1) is stated clearly as follows:

SEFF= β0it + β1AIAWi+ β2 AIAPi + β3AIEFi + μi……Eq. (2)

Where: SEFF= Service Efficiency; β 0= The regression line's intercept; 1-3 = Slope of the independent variables or the regression line; AIAW = Artificial intelligence awareness; AIAP= Artificial intelligence application; AIEF= Artificial intelligence effectiveness; μ = Error term denoting additional independent variables that impact the model but are not included in the analysis; i,= banks.

Based on a priori assumptions, we anticipate β0, β1 > 0, β2 > 0, β2 > 0, and β3 > 0, implying a positive correlation between both independent and dependent variables.

4. APPLICATION OF ARTIFICIAL INTELLIGENCE IN NIGERIAN BANKS: RESULT AND DISCUSSION

Access Bank, Fidelity Bank, First Bank, Guarantee Trust Bank, and Zenith Bank were investigated as Nigerian deposit money banks. These institutions responded 384 times. Three aspects relate to the independent variables and one to the dependent variables. For the study, multiple regression, correlation, and descriptive analysis were used.

4.1 Reliability Analysis

Each questionnaire item's reliability is assessed using Cronbach's Alpha. A variable with a Cronbach's Alpha value above 0.6 is dependable and should be studied. Each variable's dependability is in Table 2. Cronbach's alpha values, which range from 0.870 to 0.937, are higher than the cutoff line, indicating great reliability and generalisability of the data and parametres used to draw conclusions.

Table 2: Cronbach's alpha coefficient values of the variables

Variables	Acronym	Type of variables	Number of items	Reliability Cronbach Alpha	Comments
AI Awareness	AIAW	Independent	4	.895	Accepted
AI Application	AIAP	Independent	4	.903	Accepted
AI Effectiveness	AIEF	Independent	4	.937	Accepted
Service Efficiency	SEFF	Dependent	4	.870	Accepted

(Researchers Compilation, 2024)

4.2 Demographics Respondent Analysis

Bank name, gender, transaction year, educational level, and IT competence level classify this study's sample group. The demographics of respondents are in Table 3.

Table 3: Respondent Demographic Profile

Demographics	Categories	Frequency	Percent
Customer Bank	Access Bank	60	15.63
	Fidelity Bank	73	19.01
	First Bank	76	19.79
	Guarantee Trust Bank	80	20.83
	Zenith Bank	95	24.74
Gender	Male	204	53.13
	Female	180	46.88
Banking Experience	0-5	145	37.76
	6-10	104	27.08
	11-15	85	22.14
	16 and above	50	13.02
Educational level	Basic	45	11.72
	Secondary	67	17.45
	OND/NCE	80	20.83
	BSc/HND	124	32.29

	Postgraduate	68	17.71
IT Proficiency	Poor	50	13.02
	Fair	109	28.39
	Good	77	20.05
	Very good	105	27.34
	Excellent	43	11.2

(Researchers Compilation, 2024)

60 respondents from Access Bank, 73 respondents from Fidelity Bank, 76 respondents from First Bank, 80 respondents from Guarantee Trust Bank, and 95 respondents from Zenith Bank answered, totaling 384. Response patterns may be rational. A specific customer segment or targeted marketing strategies were suggested by 60 Access Bank respondents. Response count may reflect consumer loyalty owing to favourable feedback about the bank's products, services, or customer service. Excellent marketing and promotions may explain Fidelity Bank's 73 out of 384 response rate. Also, positive reviews and word-of-mouth may have boosted response rates. First Bank's lengthy history and outstanding reputation may explain its 76 out of 384 regular clients. Due to its broad appeal, First Bank's products and services may affect response distribution. Guarantee Trust Bank's 80 out of 384 response rate may be attributable to its innovative offers and strong digital presence, which attract tech-savvy clients. People or sectors may respond better to targeted marketing. Zenith Bank's 95 out of 384 replies may be attributed to its excellent customer loyalty programme or survey incentives. These findings suggest that each bank's strategies, reputation, and product offerings may affect survey answers, revealing customer participation and satisfaction across financial organisations. Table 3 shows 53.1% male and 46.9% female responders, with a somewhat higher male representation. These data aid gender-specific marketing and analysis. The bank was used by 37.8%, 27.1%, 22.1%, and 13.0% of respondents aged 0-5 to 16+. Most (37.8%) are new customers, having been consumers for 0-5 years, which may reflect bank client gain or turnover. Participants with basic, secondary, OND/NCE, BSc/HND, and postgraduate education are 11.7%, 17.4%, 20.8%, 32.3%, and 17.7% respectively. The most common level, 32.3%, is BSc/HND, which demonstrates diversity and the provision of educationally oriented communication and services. 13.0%, 28.4%, 20.1%, 27.3%, and 11.2% have

poor, fair, good, very good, and excellent IT proficiency respectively. Technical preparation varies, but most are fair or exceptional. When creating or promoting digital services, this breakdown may help the banks to make informed decisions and tailor marketing to local preferences.

4.3 Descriptive Analysis

Table 4: Descriptive Statistics

	SEFF	AIAW	AIAP	AIEF
Mean	2.699479	2.721354	2.705208	2.668229
Median	3.000000	3.000000	3.000000	3.000000
Maximum	4.000000	4.000000	4.000000	4.000000
Minimum	1.000000	1.000000	1.000000	1.000000
Std. Dev.	1.063714	1.061042	1.058189	1.053172
Skewness	-0.244336	-0.306741	-0.250646	-0.202203
Kurtosis	1.735028	1.774620	1.764998	1.740826
Jarque-Bera	29.42324	30.04663	28.42437	27.98502
Probability	0.164350	0.451962	0.687701	0.767321
Sum	1036.600	1045.000	1038.800	1024.600
Sum Sq. Dev.	433.3599	431.1849	428.8696	424.8124
Observations	384	384	384	384

Source: Author's Computation (2024). Note(s): AIAW-artificial intelligence awareness, AIAP-AIEF, SEFF, AI application, service efficiency.

Table 4 covers descriptive information for SEFF, AIAW, AIAP, and AIEF. Seff, AIAW, AIAP, and AIEF mean 2.699479, 2.721354, 2.705208, and 2.668229. The distribution of all variables is balanced as shown by the mean. The medians for SEFF, AIAW, AIAP, and AIEF are 3.000000. The dataset's median (middle value) confirms that distributions are not severely skewed, retaining varying homogeneity. Each variable has a common upper limit of 4.000000 and a lower limit of 1.000000. The standard deviations for SEFF, AIAW, AIAP, and AIEF are 1.063714, 1.061042, 1.058189, and 1.053172. Due to low standard deviations, data points are densely packed around the mean. As all variables have negative skewness values, they have longer left tails and may have outliers at the lower end of the distribution. For kurtosis, positive values for all variables indicate heavier tails than a normal distribution. SEFF, AIAW, AIAP, and AIEF Jarque-Bera tests provide 29.42324, 30.04663, 28.42437, and 27.98502. High p-values imply that the data may not substantially depart from a normal distribution. The 384 data

per variable and unified descriptive statistics reveal SEFF, AIAW, AIAP, and AIEF's distributional properties and core trends.

4.4 Correlation Analysis

Table 5: Correlation Matrix

	SEFF	AIAW	AIAP	AIEF
SEFF	1.000000			
AIAW	0.795589	1.000000		
AIAP	0.797569	0.795981	1.000000	
AIEF	0.792749	0.790733	0.793270	1.000000

Source: Author's Computation (2024)

Table 5 shows SEFF, AIAW, AIAP, and AIEF pairwise correlation coefficients. With a correlation coefficient of 1, a perfect positive linear connection exists, as -1 shows a perfect negative linear relationship, and 0 indicates no linear relationship. In particular, SEFF and AIAW have a strong positive connection (connection: 0.795589), indicating that SEFF increases AIAW and vice versa. A linear connection characterises this interaction. Similar to SEFF-AIAW, SEFF and AIAP (association: 0.797569) have a significant positive association. In this case, SEFF increases AIAP and vice versa. The SEFF-AIEF correlation (Correlation: 0.792749) shows a strong positive correlation, indicating that SEFF changes are strongly related to AIEF changes. Positive associations go both ways as there is a strong positive connection between AIAW and AIAP (connection: 0.795981), which suggests that AIAW changes correlate with AIAP changes. When one variable rises, the other rises also. The correlation between AIAW and AIEF (0.790733) is also good, since AIAW increases, AIEF presumably increases, and vice versa. The pattern matches past associations as AIAP and AIEF have a substantial positive association (association: 0.793270), indicating coordinated movement, while AIEF rises with AIAP and vice versa. According to the total correlation matrix, all pairs of variables exhibit strong positive linear correlations which may indicate linkages between variable changes. Correlation does not imply causality; thus, further study is needed to understand these correlations.

4.5 Regression Analysis

Table 6: Least Squares

Dependent Variable: SEFF
Method: Least Squares
Date: 01/15/24 Time: 08:59
Sample: 1 384
Included observations: 384

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AIAW	0.232477	0.037427	6.211538	0.0000
AIAP	0.654819	0.044009	14.87924	0.0000
AIEF	0.117132	0.029159	4.016978	0.0001
C	-0.017131	0.009697	-1.766533	0.0781

R-squared	0.895835	Mean dependent var	2.699479
Adjusted R-squared	0.895802	S.D. dependent var	1.063714
S.E. of regression	0.068921	Akaike info criterion	-2.501353
Sum squared resid	1.805034	Schwarz criterion	-2.460200
Log-likelihood	484.2597	Hannan-Quinn criter.	-2.485030
F-statistic	30283.98	Durbin-Watson stat	2.334804
Prob(F-statistic)	0.000000		

Source: Author's Computation (2024)

Table 6 shows regression. With all variables unchanged, a one-unit increase in AIAW should raise the dependent variable by 0.232477 units. Coefficient AIAP (0.654819): holding other variables equal, the dependent variable should climb 0.654819 units for every unit increase in AIAP. 0.117132 AIEF: a one-unit increase in AIEF is expected to raise the dependent variable by 0.117132 units, holding other variables constant. When all independent variables are zero, C (Constant) Coefficient (-0.017131) predicts the dependent variable's value. A 0.017131-unit decline in the dependent variable raises the constant by one unit. Use t-statistics and p-values for each

coefficient to test the null hypothesis, which states that the actual coefficient is zero. AIAW, AIAP, and AIEF coefficients have exceptionally low p-values, suggesting they are statistically significant in all cases. Model fit implies that independent factors explain the dependent variable's volatility to the degree that R-squared is 0.895835. Independent variables explain 89.58% of the dependent variable's variance. Adjusted R-squared (0.895802) is similar to R-squared but accounts for model predictors. Extra variables are penalised. The F-statistic (30283.98) assesses regression model relevance. The model has a 0.000000 p-value, indicating significance. Autocorrelation in residuals is determined by the Durbin-Watson statistic, 2.334804. It should be between 1.5 and 2.5; however, this result is 2.33, indicating little autocorrelation.

5. DISCUSSION OF FINDINGS

This study examines how artificial intelligence affects Nigerian deposit money banks' service efficacy. The research finds that artificial intelligence awareness, application, and effectiveness (AIAW, AIAP, and AIEF) considerably affect the service efficiency (SEFF) of a few quoted deposit money banks in Nigeria. Artificial Intelligence Awareness (AIAW) favourably correlates with Service Efficiency (SEFF) of Nigerian deposit money institutions as expected. The T-statistic (6.211) and P-values (0.000) are below 5%. which supports rejecting the null hypothesis over the alternative. Artificial intelligence awareness (AIAW) increases service efficiency by 23.25 in a subset of Nigeria's listed deposit money banks. Kelly and Rajasekaran[40], Hoyer et al. (2020), Aksaya, Simeon and Salma[41]., Mobayo, Aribisala and Belgore[42], Quadri[43], Jones, Reem and Henry[44]., and

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40 Ibid (n.20)

41 Aksaya T, Simeon B, and Salma E, 'An exploratory study on the effect of artificial intelligence enabled technology on customer experiences in the banking sector' (2021) 1(1) Journal of Technological Advancements 1.

42 Mobayo JO, Aribisala AF, and Belgore U, 'Artificial intelligence: Awareness and adoption for effective facilities management in energy sector' (2021) 2(2) Journal of Digital Food, Energy & Water System 1.

43 Quadri R, 'Awareness and adoption of artificial intelligence for effective library service delivery in academic libraries in federal polytechnics in South Western Nigeria' (2023) 8(5) International Journal of Novel Research and Development 893.

Kim[45]contradict the experiments. Hypothesis two shows a favourable link between Service Efficiency (SEFF) and Artificial Intelligence Application (AIAP) of several Nigerian quoted deposit money banks. The results show T-statistic (14.879) and P-values (0.000) below 5%. Contrary to the null hypothesis, the result supports the alternative hypothesis. In several Nigerian listed deposit money banks, AI adoption and application increase service efficiency (65.48). The findings match Wang and Smith[46], Cohen, Amorim and Reis[47], and Li, Du and Chen[48]. However, the findings contradict Patel and Wang[49] and Lins and others[50], which find no link between AI and service effectiveness.

A statistically significant positive association between Service Efficiency (SEFF) and Artificial Intelligence Effectiveness (AIEF) of a group of Nigerian listed deposit money banks supports hypothesis three. The results show T-statistic (4.017) and P-values (0.000) < 5% and support the alternative hypothesis and reject the null hypothesis. This shows that a subset of Nigeria's listed deposit money banks may enhance service efficiency by (11.76) as artificial intelligence efficacy increases. Marcello and Matto[51] Sharma, and Adam establish a high positive association between AI effectiveness and service efficiency. The result contradicts Lee and Kim[52], Wang and Zhag[53], and Chen and Liu[54], which showed that service efficiency inversely correlates with AI effectiveness.

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44 Jones P, Reem O, and Henry O, 'Public awareness and perception of artificial intelligence: A survey studies' (2020) 25(1) Journal of Information Technology 89.

45 Kim M, 'Connecting artificial intelligence to value creation in services: mechanism and implications' (2023) 17 Service Business 851 <doi.org/10.1007/s11628-023-00547-7>

46 Ibid (n.22)

47 Cohen Y, Amorim M, and Reis J, 'Artificial intelligence trends and applications in service systems' (2022) 12 Applied Sciences <doi.org/10.3390/app122413032>

48 Li L, Du Y, and Chen D, 'How does artificial intelligence impact bank performance? A literature review and future research agenda' (2021) 318 Journal of Cleaner Production 128456

49 Ibid (in 21)

50 Lins S, Pandl KD, Teigeler H, Thiebes S, Bayer C, and Sunyae A, 'Artificial intelligence as a service classification and research directions' (2021) 63(4) Business Information Systems Engineering 441.

51 Ibid (n. 29)

52 Lee H and Kim Y, 'The effectiveness of robo-advisors in enhancing investment performance' (2018) 15(3) Journal of Financial Technology 145.

53 Ibid (n. 31

5.1 Policy and regulatory gaps hinder AI implementation in Nigerian banks

1. Technology Gaps: Nigerian banks lack the technology to apply AI. Hardware and software are needed for strong AI systems. AI cannot be implemented into financial processes without the right technology. Thus, AI deployment, scalability, and reliability are hampered by this gap.
2. No Confidentiality and Reliability Regulations: AI deployment in banking requires data confidentiality and reliability regulations. In Nigeria, data protection regulations are lax. This exposes sensitive client data to system vulnerabilities. AI apps must be regulated to safeguard data privacy and prevent breaches so banks and consumers can trust them.
3. Lack of Monitoring Capacity: AI in banking needs continual monitoring and assessment. However, regulatory organisations lack the competence to regulate AI adoption and usage. This gap implies AI concerns like compliance with standards, efficacy of AI solutions, and risk mitigation are not adequately managed, which might lead to inefficiencies and failures.
4. Ethics and Fairness Issues: AI systems might unintentionally perpetuate biases in their training data, resulting in unjust banking results. Loan approvals by biased AI systems may discriminate against specific populations. Current rules fail to address these ethical problems, preventing AI decision-making responsibility for justice. Thus, AI apps must have clear ethical norms and fairness audits to treat consumers fairly.
5. Lack of Infrastructure and Investment: High-speed internet, modern computer resources, and stable power supply are needed to adopt AI. AI research and development are underfunded. Building infrastructure and investing in AI technology need more government and private sector funding to close this gap.
6. Talent and Skill Shortages: Banking AI adoption needs AI and data science experts. Nigeria is weak on this ability. Banks struggle

[54] Chen Q and Liu B, 'The effectiveness of AI-driven chatbots in enhancing customer satisfaction' (2020) 24(2) Journal of Customer Service Research 112.

to create, install, and manage AI systems due to this talent mismatch. Education and training should be prioritised to produce a skilled workforce with AI-related certifications, professional training, and educational partnerships. These legislative and regulatory shortcomings must be addressed for Nigerian banks to use AI effectively. Nigeria can use AI to improve banking service efficiency and sustainability by improving technological infrastructure, data privacy regulations, monitoring capacity, ethical AI use, investment, and AI talent. AI awareness, application, and effectiveness positively correlate with service efficiency, highlighting the need to close these gaps to fully exploit AI's advantages.

5.2 The Need for New Law

A new comprehensive legislation or policy to incorporate and govern AI in banking is proposed. This legislation should cover:

i. Privacy and Data Protection: Implement tight data privacy rules that mandate contemporary encryption, safe storage, and effective data breach protections. Set explicit data use and sharing rules, particularly for AI-handled customer data.
ii. Ethical AI Use: Establish AI ethics for justice, openness, and accountability. Regularly check AI algorithms for biases.
iii. Regulatory Supervision: Develop a banking AI monitoring and assessment system. Regulatory AI monitoring committees may enforce standards and handle issues.
iv. Infrastructure Investment: Increase governmental and private sector investment in high-speed internet, fast processors, and stable electricity to enable AI technology.
v. Development of the Workforce: Develop AI and data science training courses with banks, universities, and government organisations. Develop AI and associated professional certifications. At the moment, money deposit bank employees' AI training is poor; only the wealthy can do such projects.
vi. Innovation and Research: Increase public-private AI R & D collaboration. Fund and support innovation and best practices.
vii. Encourage Institutions' Formation: The National AI Council coordinates AI policy, research, and applications across several industries, including

banking. Standards, best practices, and national AI strategy may be set by the council.

viii. AI Ethics Board Oversees AI Ethics: This board would oversee fair AI usage and combat systemic prejudice.

ix. Data Protection Agency: Enforcement agency for data privacy laws. Data privacy and breaches would be its responsibility.

x. AI Research and Innovation Centres: Establish AI research and innovation centres with universities and businesses. These centres will create Nigerian banking-specific AI solutions.

Besides passing a policy-enabling statute, the government should examine budgetary provisions for financial allocation. AI's economic influence on banking services and economic development need more funding for monitoring and deployment. The following are examples:

i. Increase funding for regulatory bodies to monitor and enforce AI-related rules.

ii. Infrastructure Investment: Boost technology spending to promote AI adoption.
Provide funding for AI and data science education and training to develop a skilled workforce

iii. Expand AI research and development funding via grants, tax incentives, and public-private partnerships.

These ideas will help Nigeria build a solid base for AI adoption in banking by ethically and effectively using AI technology to increase service efficiency and financial system sustainability.

6. BRIDGING THE GAPS

6.1 Conclusion

This study compares the service efficacy of many Nigerian listed deposit money banks to AI. It also analyses whether AI knowledge, utilisation, and effectiveness affect service efficiency. The study evaluates AI and service efficiency using three assumptions. In each hypothesis, service efficiency is the dependent variable. Artificial intelligence awareness, application, and effectiveness are separate factors.

Our test shows a high positive association between AI awareness, application, effectiveness, and service efficiency. The selected deposit money banks have a very high service efficiency of 2.70, indicating that artificial intelligence has affected service efficiency.

6.2 Recommendations

The study recommends that deposit money institutions should prioritise workforce education and training to ensure workers can work with AI technology. Banks must also establish robust monitoring and evaluation systems to identify how AI may impact customer service. Banks must also prioritise ethical AI practices. Finally, deposit money banks should engage the regulatory bodies to create an AI-friendly regulatory environment. Given the limitations of this study, the findings should be interpreted with caution, since they may lead to future research in this area. Thus, the sample size and selected banks limit the investigation. The study's period may not convey AI's long-term implications. Only primary data from a structured questionnaire were used for the study. Data quality and availability also restrict the study. Thus, future research might include a bigger and more diversified sample of Nigerian deposit money banks and a longer observation period to better understand how AI affects service efficiency over time. Future research should seek more precise data to better understand the link between AI and service efficiency. Longitudinal studies can show how AI affects service efficiency. Qualitative research methods like focus groups and interviews may augment quantitative results to gather specific input from stakeholders, customers, and bank staff.

Finally, there is the need to educate workers in AI collaboration and establish robust monitoring and evaluation mechanisms to evaluate AI's influence on customer service. Develop ethical AI protocols to guarantee fairness and transparency, and engage with authorities to develop an AI-friendly regulatory environment.

Future research should address limitations such as small sample size and reliance on structured questionnaires by increasing diversity, extending observation periods, accessing more precise data, and using longitudinal research and qualitative methods like focus groups and interviews. These recommendations may help Nigeria establish a stable banking AI platform for service efficiency and ethical AI usage for financial system sustainability.