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USING ARTIFICIAL INTELLIGENCE TO OPTIMIZE ADVERTISING DELIVERY AND REDUCE CAMPAIGN WASTAGE: EVIDENCE FROM THE NIGERIAN DIGITAL ECONOMY

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ABSTRACT: *This article investigates the involvement of artificial intelligence (AI) technologies in the practice of digital advertising in Nigeria. Using a quantitative survey approach, data were collected from 411 respondents who were digital marketing practitioners in the fintech, ecommerce, and telecommunication industries. The analysis of the data sought to understand the role of AI technologies in addressing the existing inefficiencies in the practice of digital advertising. The results of the analysis showed that while 63% of the respondents had adopted the practice of AI-driven advertising, there were observable efficiencies in terms of cost per click (CPC) and return on ad spend (ROAS). However, the adoption of the practice is hampered by the associated costs of implementation and the technical and ethical challenges associated with the practice. In particular, the ethical challenges associated with the bias of the algorithms of the AI technologies against Pidgin English and other local languages, as well as the low compliance rate with the Nigeria Data Protection Regulation (NDPR), are noteworthy. In fact, only 22% of the organizations involved in the survey had fully complied with the NDPR. The article contributes to the existing body of knowledge in the area of artificial intelligence and the practice of digital advertising in a developing country. The article proposes a phased adoption of the practice of AI-driven advertising and the need for low-resource AI technologies and the development of local capacity in the area of artificial intelligence, as well as the need to adopt the practice of Explainable AI (XAI).*

KEYWORDS: AI, advertising, campaign optimization, digital marketing, Nigeria, resource wastage.

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INTRODUCTION

Over the past ten years, the digital advertising sector has experienced radical transformation driven by the expansion of online platforms', the rise of programmatic advertising, and the growing consumer demand for personalized marketing experiences. By 2024, global digital advertising expenditure surpassed $700 billion, demonstrating the sector's dominant role in contemporary marketing strategies (Wilson & Johnson, 2024). Despite this impressive growth, the industry continues to face significant operational inefficiencies. Issues such as ad fraud, budget misallocation, and wasted impressions have resulted in advertisers losing an estimated $50 billion, annually (Gao et al., 2023). These persistent inefficiencies have intensified the demand for more intelligent systems capable of optimizing campaign performance and improving the efficiency of digital advertising investments.

Artificial intelligence (AI) has increasingly emerged as a transformative solution to many of these challenges. Through technologies such as machine learning, natural language processing (NLP), and predictive analytics, AI enables advertisers to refine ad distribution, improve audience targeting, and reduce inefficient resource expenditure (Davenport & Ronanki, 2018). AI-powered advertising tools can analyze massive datasets, identify patterns in consumer behavior, and automate decision-making processes in real time. For instance, AI-driven platforms such as Google's Smart Bidding and Facebook's Dynamic Ads have demonstrated the ability to improve return on ad spend (ROAS) by as much as 30 percent, according to Ten26 Media's 2024 report. Despite these advantages, the adoption of AI-driven advertising technologies remains uneven across global markets. Many marketers continue to struggle with issues related to implementation costs, ethical concerns, and limited technical expertise required to effectively deploy these systems (Soni, 2023).

While much of the existing scholarship and industry discussion surrounding AI-powered advertising focuses on technologically advanced economies, the realities of digital advertising adoption in developing economies present a different set of opportunities and constraints. In many emerging markets, including Nigeria, the growth of digital advertising has been closely tied to the rapid expansion of mobile internet usage. Mobile devices have become the primary gateway to online platforms for millions of users, significantly shaping patterns of digital media consumption and advertising exposure. According to recent telecommunications data, mobile penetration in Nigeria has continued to expand rapidly, creating a predominantly mobile-first digital ecosystem in which social media platforms, search engines, and video streaming services serve as major advertising channels.

However, advertisers operating within these environments face structural economic challenges that differ from those in developed markets. Digital advertising platforms such as Google and Meta typically operate using pricing models denominated in foreign currencies, particularly the United States dollar. In economies characterized by currency volatility and fluctuating exchange rates, the cost of purchasing digital advertising services can vary significantly, creating financial uncertainty for local businesses and marketing agencies. As a result, many organizations must operate with constrained advertising budgets while competing within an increasingly data-driven global marketing environment.

These contextual factors highlight both the necessity and the complexity of integrating artificial intelligence into digital advertising strategies within developing economies. Although AI offers the potential to optimize ad placement, improve targeting accuracy, and minimize wasted

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advertising expenditure, the uneven distribution of technological infrastructure, professional expertise, and financial resources can limit its effective adoption. Consequently, understanding how AI-powered advertising tools function within these socio-economic conditions is essential for evaluating their potential to improve digital marketing performance in emerging markets.

Given these dynamics, there is a growing need for research that examines the intersection between artificial intelligence, digital advertising practices, and the structural realities of developing economies. While previous studies have largely focused on AI implementation in technologically advanced markets, less attention has been given to how these systems operate within the infrastructural, economic, and technological contexts of emerging regions. This study therefore investigates the role of artificial intelligence in optimizing digital advertising performance within a developing economy, exploring how organizations navigate technological innovation alongside local market constraints.

Statement of the Problem

The persistent problem of resource wastage in digital advertising continues to undermine campaign effectiveness while simultaneously eroding advertisers' confidence in digital marketing systems. One of the most significant challenges is the prevalence of ad fraud, where fraudulent activities such as fake clicks, artificial impressions, and bot-generated traffic cost advertisers billions of dollars annually (Ford et al., 2023). In addition to fraudulent traffic, the placement of irrelevant advertisements often results in low user engagement and inefficient use of advertising budgets, further reducing the effectiveness of digital campaigns (Gao et al., 2023). Budget misallocation also remains a major concern, as advertisers frequently overspend on underperforming platforms or channels while failing to invest in more productive advertising opportunities (Wilson & Johnson, 2024).

Beyond financial losses, inefficient ad delivery systems have broader technological and environmental implications. Recent research suggests that poorly optimized advertising processes, including redundant ad impressions and excessive programmatic bidding cycles, contribute to unnecessary energy consumption within digital infrastructures (Häglund & Björklund, 2024). As digital advertising increasingly relies on large-scale data processing, cloud computing, and automated ad exchanges, inefficient systems can significantly increase the carbon footprint of digital marketing operations. This emerging concern highlights the need for more efficient and sustainable advertising technologies.

Traditional advertising management approaches, which rely heavily on manual campaign adjustments and static audience targeting criteria, are increasingly inadequate for addressing these complex challenges. In contrast, artificial intelligence (AI) offers new possibilities for improving advertising efficiency. Through machine learning algorithms, predictive analytics, and automated decision-making systems, AI enables advertisers to optimize ad placement, dynamically segment audiences, and adjust campaigns in real time to maximize performance while minimizing wasted impressions. However, despite these potential benefits, the adoption of AI-driven advertising systems is not without challenges. Concerns regarding ethical implications, algorithmic bias, data privacy, and the high cost of technological implementation continue to limit widespread adoption among many organizations (Soni, 2023)

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Research Objectives

The study pursues the following objectives:

1. To assess an assessment of AI capabilities to enhance ad delivery while minimizing resource expenditure.
2. To discern the fundamental AI methodologies (e.g., reinforcement learning, NLP) that propel campaign achievement.
3. To examine the ethical dimensions of AI-powered advertising with a focus on privacy concerns and bias issues.
4. To develop practical suggestions for advertisers who want to incorporate AI technology into their marketing efforts.

Research Questions

This study addresses the following research questions:

RQ1: Through what means do AI-driven techniques including reinforcement learning and natural language processing achieve enhanced performance in ad targeting and delivery systems?

RQ2: What are the primary sources of resource wastage in digital advertising, and how does AI address them?

RQ3: What are the primary ethical dilemmas surrounding AI deployment in advertising, and how can they be mitigated?

RQ4: What barriers hinder AI adoption in Nigerian advertising, and what strategies can overcome them?

LITERATURE REVIEW

Traditional Ad Delivery Methods and Their Limitations

Traditional means of digital ad delivery incorporate static demographic targeting and manual optimization, each of which is known to have a number of inefficiencies. Perhaps the most damaging of ad fraud is click farms, bots, and impression laundering, all of which result in the wastage of ad spend, with ad fraud making up to 20% of the overall digital ad spend (Gao et al., 2023). Ford et al. (2023) found that these ad fraud mechanisms have become increasingly advanced, with each of them adapting to ad detection mechanisms and remaining inefficient in the overall ad supply chain. The manual optimization process is also inefficient in adapting to dynamic changes in consumer behavior (Davenport & Ronanki, 2018). The traditional demographic targeting mechanism, in particular, is inefficient in adapting to the dynamic behavior of the modern consumer (Wilson et al., 2024).

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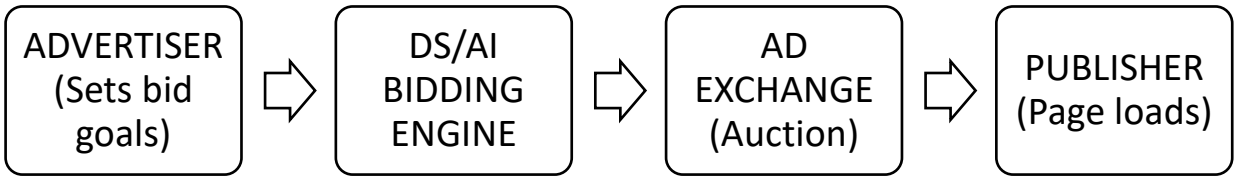
AI in Digital Marketing: Concepts and Applications

Artificial intelligence refers to a variety of technologies, including machine learning, NLP, and generative AI, which have been successfully applied in digital advertising (Davenport & Ronanki, 2018). Machine learning algorithms predict customer behavior and optimize advertisement placement in real-time, while reinforcement learning is used for dynamic bid optimization, which maximizes return on investment (ROI) (Gao et al., 2023). NLP is also applied in digital marketing for the analysis and production of advertising content, with large language models further accelerating content production (Soni, 2023). At the platform level, programmatic advertising utilizes AI for the automated purchase of advertisement inventory, matching advertisements with target audiences more accurately and effectively (Ford et al., 2023). This includes Google Ads and Meta advertising platforms, which apply machine learning for more effective advertisement delivery, minimizing wasted impressions (Mirwan et al., 2023). Within the ad tech industry, Criteo, for example, has developed a programmatic retargeting engine for the delivery of personalized product advertisements, using real-time behavioral data for more effective advertisement delivery, demonstrating the potential of AI for improved advertisement relevance and conversion rates in third-party digital marketing campaigns (Raghav et al., 2023).

Alternative Technologies and Hybrid Approaches

Figure 1: The Real-Time Bidding (RTB) Ecosystem and AI Intervention Points



▼ AI Intercepts at Three Points ▼

[1] Bid Optimization (DSP layer) — [2] Fraud Filtering (Exchange layer) — [3] Audience Scoring (Pre-auction)

DSP = Demand-Side Platform. Arrows indicate the sequential flow of a bid request. AI intervenes at the DSP to set optimal bids, at the pre-auction stage to score audience quality, and at the exchange to filter non-human traffic. Adapted from Ford et al. (2023) and Raghav et al. (2023).

Alternative Technologies and Hybrid Approaches

AI is not used in isolation. Digital advertisers often use AI alongside other technologies, especially to ensure efficiency and minimize risk. Rule-based systems, for instance, continue to see use, especially by smaller companies, because of their ease of use, though these have limited adaptability, especially in a changing market (Davenport & Ronanki, 2018). Blockchain is being considered as a tool to reduce ad fraud, especially through creating a record

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of transactions, though its computational requirements limit its use, especially by smaller companies (Ford et al., 2023; Gao et al., 2023). Most advertisers, however, use a combination of these tools, where blockchain is used to increase transparency, rule-based systems to carry out initial targeting, while AI is used to optimize (Raghav et al., 2023).

AI Implementation Failures

Moreover, the empirical literature also highlights situations in which the implementation of artificial intelligence technologies results in suboptimal results. For instance, an electronic commerce campaign in 2023 faced public criticism for the socioeconomic bias in the targeting algorithms of the campaign, which did not allow the luxury products of the company to be advertised to the lower socioeconomic segments of the population (Wilson et al., 2024). In the case of a retail campaign, the algorithms did not function correctly because of the unavailability of relevant data in the training set, leading to an inefficient allocation of resources (Gao et al., 2023). The absence of human intervention in the decision-making process of artificial intelligence technologies also caused a problem in the case of a social media campaign, in which the algorithms of the company misinterpreted the engagement metrics and sent the advertisements to the automated accounts instead of the real users (Ford et al., 2023). The situation is particularly critical in the case of small businesses, as they not only lack the resources to implement artificial intelligence technologies in an optimal manner but also the technical know-how to identify the failures of the technologies (Soni, 2023).

Ethical and Regulatory Dimensions

Ethically, AI advertising presents a number of important questions about data privacy and transparency. Wilson et al. (2024) note that "60% of consumers report feeling uncomfortable with the amount of data required for AI-powered personalization." On a broader international scale, regulations such as the European General Data Protection Regulation and the California Consumer Privacy Act require that consumers provide consent and that data transparency be provided. In Nigeria, this is addressed by the Nigeria Data Protection Regulation that came into effect in 2019 and was enacted by the National Information Technology Development Agency (NITDA). This was followed by the passing of the Nigeria Data Protection Act in 2023 and the subsequent creation of the Nigeria Data Protection Commission as a standalone agency. Despite this, however, a large number of Nigerian businesses are not fully compliant with this regulation, especially small and medium-sized businesses that may not have the legal and technological expertise to comply fully. This is supported by the findings from this study that only 22% of organizations sampled were fully compliant with the NDPR.

Algorithmic bias is a second ethical consideration that has been highlighted by Ford et al. (2023), which demonstrates that housing ad algorithms favor high-income users and exclude low-income renters. Fairness-aware machine learning has been developed to counter this effect; however, it is not clear how prevalent this is within advertising contexts (Gao et al., 2023). A second issue is that of transparency in advertising and that a large number of AI systems are "black boxes" in decision-making and advertising. Explainable AI tools have been proposed as a solution to this problem in advertising and to increase consumer trust and regulation accountability (Soni, 2023).

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Theoretical Framework: The AIDA Model

The Characteristics component examines essential AI-driven advertising attributes, including personalization, real-time optimization, and scalability. These mechanisms allow advertisers to deliver highly specific ads to distinct audience groups, which boosts both engagement levels and conversion metrics (Soni, 2023). The Methodology component utilizes a blend of mixed which includes case studies, surveys, and performance metrics to assess AI effectiveness in advertising (Davenport & Ronanki, 2018). This study incorporates traditional advertising frameworks such as the AIDA Model and the Hierarchy of Effects Model to analyze consumer reactions to AI-driven advertisements, creating a solid basis for examining AI's impact on consumer behavior (Kotler & Keller, 2016).

The analysis of AI-driven advertising effectiveness in this study is grounded in classical advertising response theories, particularly the AIDA Model and the Hierarchy of Effects Model, which provide structured frameworks for understanding how consumers process advertising messages and move toward purchasing decisions. The AIDA model, which stands for Attention, Interest, Desire, and Action, explains how effective advertising first captures audience attention, stimulates interest in a product or service, generates desire, and ultimately motivates consumers to take action (Kotler & Keller, 2016). In digital advertising environments, artificial intelligence enhances this process by enabling advertisers to deliver highly targeted advertisements that are more likely to capture user attention and sustain engagement.

Similarly, the Hierarchy of Effects Model explains advertising effectiveness as a sequence of cognitive, affective, and behavioral responses through which consumers progress before making purchasing decisions. These stages typically include awareness, knowledge, liking, preference, conviction, and purchase. AI-driven advertising technologies strengthen this process by using predictive analytics and behavioral data to personalize advertising content according to individual consumer preferences and browsing patterns. Through machine learning algorithms and automated optimization systems, AI can analyze user interactions in real time, allowing advertisers to refine ad placements, messaging strategies, and targeting parameters to improve campaign performance.

In programmatic advertising environments, AI systems analyze large datasets related to user demographics, browsing behavior, and past interactions to deliver personalized advertising messages to specific audience segments. These technologies enable advertisers to implement real-time campaign adjustments, dynamic bidding strategies, and predictive audience segmentation, thereby improving the likelihood that advertisements will successfully capture consumer attention and stimulate engagement (Gao et al., 2023; Wilson & Johnson, 2024). As a result, AI-driven advertising systems have the potential to significantly enhance advertising efficiency by aligning advertising messages with consumer interests and behavioral patterns.

By integrating the AIDA Model and the Hierarchy of Effects Model, this study provides a theoretical foundation for examining how AI-powered advertising tools influence consumer responses to digital advertisements. These frameworks allow the research to evaluate how AI technologies contribute to improved audience targeting, increased engagement, and higher conversion outcomes within digital advertising campaigns.

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The Examination of Ethical implications alongside Regulatory Considerations

The use of AI in advertising presents major ethical dilemmas about data privacy together with algorithmic bias and transparency. The importance of data privacy reaches critical levels because AI-driven advertising systems depend extensively on consumer information to enhance personalization and targeting effectiveness. The investigation by Wilson & Johnson (2024) revealed that a majority of 60% of consumers express discomfort regarding the extensive data collection needed for AI personalization. European GDPR and American CCPA regulations mandate that advertisers secure explicit user consent while ensuring data usage transparency.

The use of artificial intelligence in digital advertising raises significant ethical concerns related to data privacy, algorithmic bias, and transparency. Data privacy is particularly critical because AI-driven advertising systems rely heavily on the collection, analysis, and processing of consumer data to enhance personalization and improve targeting accuracy. Studies indicate that many consumers remain uneasy about the extent of data collection required for such personalization. For example, Wilson and Johnson (2024) report that approximately 60% of consumers express discomfort with the scale of personal data gathered to support AI-driven advertising systems. These concerns have led to the development of regulatory frameworks aimed at protecting user data and ensuring greater transparency in digital advertising practices.

Globally, major data protection regulations such as the General Data Protection Regulation (GDPR) in the European Union and the California Consumer Privacy Act (CCPA) in the United States require advertisers to obtain explicit user consent before collecting personal data and to clearly disclose how such data will be used in advertising systems. These regulations also impose strict penalties for misuse of consumer data and have influenced global standards for ethical data management in digital advertising environments.

Within the Nigerian digital economy, similar regulatory efforts have emerged to address growing concerns about personal data protection. The Nigeria Data Protection Regulation (NDPR), introduced in 2019, established guidelines for the lawful processing, storage, and protection of personal data by organizations operating within Nigeria. Building on this framework, the Nigeria Data Protection Act (NDPA) of 2023 further strengthened the country's legal structure for data governance by establishing the Nigeria Data Protection Commission (NDPC) and introducing stricter compliance requirements for organizations that collect or process personal data. These regulations mandate that organizations obtain informed consent from users, ensure transparency in data processing activities, and implement adequate safeguards to protect personal information.

Despite these regulatory developments, compliance remains a significant challenge for many organizations operating in Nigeria's rapidly evolving digital economy. Factors such as limited awareness of data protection obligations, inadequate institutional capacity, and weak enforcement mechanisms have contributed to uneven adoption of data protection practices. Consequently, the ethical deployment of AI-driven advertising technologies in Nigeria requires not only technological innovation but also stronger regulatory compliance and improved awareness among organizations regarding responsible data governance

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A formidable obstacle emerges with algorithmic bias as AI systems unintentionally perpetuate stereotypes while marginalizing specific groups. Research by Ford et al. (2023) indicates that housing ad algorithms show a propensity to reach high-income individuals while systematically excluding low-income renters. Advertisers have begun implementing fairness-aware machine learning techniques to achieve equitable decision-making processes (Gao et al., 2023).

Many AI systems function as enigmatic “black boxes," which generates transparency concerns because their decision-making processes remain elusive. The foundational elements of trust and accountability experience destabilization through these actions. Developers are creating Explainable AI (XAI) tools to illuminate AI decision processes, which enable advertisers to validate their actions while sustaining consumer confidence (Soni, 2023).

AI Limitations and Future Directions

Artificial intelligence presents significant restrictions when used in advertising contexts despite its advantages. AI systems demand precise and up-to-date datasets to operate efficiently, making high-quality data dependency essential. The presence of poor data quality causes targeting inaccuracies, which result in less effective campaign outcomes (Gao et al., 2023). The retail brand’s marketing effort collapsed due to its algorithm being trained on partial customer data, which led to irrelevant ad placements (Wilson & Johnson, 2024). The replication of human creativity and intuition remains a significant challenge for AI systems. The system excels in data analysis and optimization yet fails to produce genuinely new advertising ideas or grasp subtle cultural nuances (Soni, 2023). Industries reliant on creative innovation and emotional resonance face significant challenges due to this limitation.

Smaller businesses face major adoption obstacles due to the intricate technical demands and high implementation expenses. Research from Ford et al. (2023) revealed that nearly half of small businesses identified cost as a primary barrier to AI advertising tool adoption due to their resource and expertise deficiencies for effective implementation. The potential future developments in generative AI combined with blockchain technology present effective methods to overcome current restrictions. Generative AI tools such as GPT-4 and DALL·E transform content creation by producing tailored advertising text and images en masse (Raghav et al., 2023). Through its decentralized and tamper-proof transaction records, blockchain technology boosts transparency while minimizing ad fraud (Häglund & Björklund, 2024).

RESEARCH METHODOLOGY

Research Design

This study adopts a quantitative survey design to examine AI adoption patterns and campaign outcomes among digital marketing professionals in Nigeria. An initial phase of exploratory qualitative work — comprising five semi-structured interviews with digital marketing managers in Lagos and Abuja — was conducted to identify salient themes and refine the survey instrument. However, given the study’s primary objectives of measuring adoption rates, compliance levels, and performance outcomes across a representative professional sample, the findings reported here are drawn exclusively from the quantitative survey data. This decision reflects the explanatory sequential design logic articulated by Creswell and Creswell (2018),

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in which qualitative exploration informs instrument development while quantitative data carry the primary evidentiary weight. Researchers seeking to build on the qualitative dimension of this topic will find the interview-derived themes documented in the survey instrument design, available from the corresponding author on request.

Area of Study

This research examines digital advertising initiatives in Nigeria, focusing on major commercial hubs such as Lagos, Abuja, and Port Harcourt, where AI adoption in marketing is increasing. The study explores how AI-driven advertising technologies are implemented in Nigeria's fintech, e-commerce, telecommunications, and retail sectors. Traditional advertising channels such as television and print media are deliberately excluded from this study to ensure a clear concentration on digital platforms where AI-powered advertising is most prevalent.[9.1] This study employs a mixed-methods research design that integrates qualitative and quantitative approaches to provide a comprehensive understanding of AI's role in advertising optimization and resource waste reduction. The qualitative component is implemented through a multiple case study design and semi-structured interviews with key stakeholders, allowing in-depth exploration of AI adoption practices and operational challenges. The quantitative component emphasizes the analysis of performance metrics and survey data to measure campaign efficiency, targeting accuracy, and cost-effectiveness. By combining these approaches, the study achieves a robust analytical scope that captures both nuanced contextual insights and measurable outcomes (Creswell & Creswell, 2018).

Population and Sampling

The target population comprises digital marketing professionals and businesses in Nigeria that have adopted, or are in the process of adopting, AI-driven advertising approaches. This group includes Digital Marketing Managers, Content Strategists, Social Media Managers, AI Developers, and advertising executives working within technology, e-commerce, and media firms. No comprehensive national register of digital marketing professionals in Nigeria currently exists. The size of the target population is unknown therefore indeterminate, which is precisely the condition under which Cochran's (1977) infinite population formula is most appropriate. The formula yields a minimum sample size independent of population size, provided the population is sufficiently large — a condition readily satisfied given Nigeria's documented growth in formal digital economy employment (NITDA, 2023; NBS, 2023).

Sample size was determined using Cochran's (1977) formula for proportions: $n = Z^2pq / e^2$, where $Z = 1.96$ (95% confidence level), $p = 0.5$ (estimated proportion of AI adoption, maximizing sample size), $q = 1 - p = 0.5$, and $e = 0.05$ (5% margin of error). This yielded a minimum sample of 384 respondents. Accounting for an anticipated non-response rate of approximately 7%, the target sample was set at 411 respondents. Stratified random sampling was used to ensure proportional representation across three strata: job roles, industry sectors, and company size. The proportional allocation across industry sectors — the primary analytical stratum — is presented in Table A below.

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Table A: Sample Proportional Allocation by Industry Sector (n = 411)

Industry Sector	Estimated Population %	Sample Allocation (n)	Percentage (%)
Fintech	30%	123	30%
E-commerce	28%	115	28%
Telecommunications	22%	90	22%
Media & Others	20%	83	20%
Total	100%	411	100%

DATA ANALYSIS AND DISCUSSION OF FINDINGS

AI Techniques Enhancing Ad Targeting and Delivery

The research question of interest is: To what extent do AI-driven techniques, with special attention paid to reinforcement learning and NLP, improve ad targeting and delivery among Nigerian advertisers? Survey results show that a majority of advertisers have adopted an AI-driven bidding approach, with 36% fully adopting the approach, 27% adopting it partially, and 37% using no form of AI bidding (Table 1). The total adoption of AI-driven bidding is 63%, which can be seen as a normalization of the approach.

Table 1: Adoption of AI-Powered Dynamic Bidding (n = 411)

Implementation Status	Frequency (n)	Percentage (%)
Fully implemented	148	36%
Partially implemented	112	27%
Not implemented	151	37%
Total	411	100%

Among non-adopters, the most common hindrances to adoption were high costs (55%) and skills gaps (30%), which corroborate other studies on hindrances to AI adoption in resource-scarce environments (Soni, 2023; Ford et al., 2023). This study's results suggest that the hindrance to AI bidding adoption in Nigeria is more structural than informational. This dynamic was corroborated in the pre-survey interview phase. A Digital Marketing Manager at a Lagos-based fintech firm (Interviewee A) described the decision to adopt AI-powered bidding as driven less by strategic vision than by competitive pressure: "We were losing ground on cost-per-acquisition to competitors who were clearly using automated bidding. We had no choice but to move, even though the licensing cost was painful at our scale." The tension between awareness and affordability identified in the survey data was therefore not merely a structural finding but a lived operational constraint experienced by practitioners in the sector.

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On NLP adoption (Table 2), 41% of the sample reported the use of NLP to generate content in multiple linguistic varieties, while 30% reported use of NLP to conduct sentiment analysis. Nigerian e-commerce professionals reported that ad copy generated through AI tools to match consumer preferences in Nigeria resulted in significantly more consumer engagement compared to other types of ad copy. However, a critical hindrance to AI adoption also emerged: 76% of those who reported linguistic bias in their AI system reported Pidgin English or indigenous languages as the main linguistic variety affected, while 68% of this bias related to housing and loan advertisements. This study's results suggest that, while NLP is being utilized to personalize content, the underlying data on which most commercial NLP systems are trained is insufficient to represent Nigerian linguistic varieties, which results in systematic targeting errors affecting economically disadvantaged consumer groups.

Table 2: NLP Utilization Patterns (n = 411)

NLP Application	Frequency (n)	Percentage (%)
Multilingual content generation	169	41%
Sentiment analysis	123	30%
Not using NLP	119	29%
Total	411	100%

Predictive analytics has moved the focus from plain old demographic labels to real-time behavior. For example, in the data, telecommunication companies claim they are using AI models based on the ways people call, the amount of data they use, and the ways they have engaged with the firm in the past to deliver ads that actually fit the bill. Several companies claim real reductions in wasted marketing spend. This mirrors the findings in Gao et al. (2023) that claim the main advantage AI has in advertising is the capacity to detect behavioral signals that traditional demographics are unable to detect. An interview with a Senior Marketing Analyst at a Port Harcourt telecommunications company (Interviewee B) elaborated on the implementation challenge behind these gains: "The model performs well when the data is clean and recent, but we had to spend almost three months cleaning our subscriber database before we could trust what the segmentation engine was producing. The accuracy we have now did not come cheap or quickly." This observation points to a data preparation burden that the quantitative adoption figures alone do not capture, and one that is likely to affect smaller operators in the sector disproportionately.

Resource Wastage: Sources and AI-Enabled Solutions

The second question sought to establish the capacity of AI in reducing resource wastage. Table 3 highlights the outcomes of fraud cases: while 45% of those using AI-powered fraud detection saw reductions in fake clicks and bot traffic of between 10-30%, 23% saw reductions above 30%. The remaining 32% saw improvements of less than 10%.

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Table 3: Fraud Reduction Outcomes (n = 411)

Fraud Reduction Level	Frequency (n)	Percentage (%)
>30% reduction	96	23%
10–30% reduction	185	45%
<10% reduction	130	32%
Total	411	100%

The budget optimization figures are presented in Table 4. A bit over a third of the respondents saw an increase in their ROAS of over 25% as a result of AI bidding and audience segmentation. At the same time, 41% experienced a decrease in CPC by over 15%. Also, about 23% saw no significant difference. Overall, this indicates that AI bidding and audience segmentation can bring efficiency gains for most users. At the same time, it is interesting to note that close to a quarter may not be experiencing any tangible gains. Interview data shed light on the experience of this underperforming segment. A Content Strategist at an Abuja-based e-commerce firm (Interviewee C) described a campaign in which AI budget optimization tools produced no measurable improvement: "We set the system up and ran it for two months without touching it. When we reviewed the numbers, performance was flat. It turned out the audience signals we fed it were based on last year's customer data. The tool was optimizing for a customer profile that no longer matched who was actually buying from us." This account is consistent with the broader literature on the sensitivity of AI advertising systems to data currency (Gao et al., 2023), and highlights that the 23% non-improvement rate in the survey is not attributable to tool failure per se, but to inadequate data governance at the point of implementation.

Table 4: Budget Optimization Results (n = 411)

Improvement Metric	Frequency (n)	Percentage (%)
ROAS increase >25%	148	36%
CPC decrease >15%	167	41%
No significant change	96	23%
Total	411	100%

A wider perspective, looking across sectors, reveals that the impact of AI is not the same everywhere. The data show that there are clear performance gaps, as indicated by the chi-square statistic of 28.7, with $p < 0.001$. The top performers are fintech, with the greatest increase in CTRs, which is +42%, followed by e-commerce with a +37% increase, then telecom with a +29% increase, and lastly media with an increase of +18%. The standout sectors of fintech and e-commerce are probably because the data available in these sectors are richer, allowing the AI models to perform better in terms of predictions, as well as the financial motivation for optimizing ad spend, as the deals are bigger in these sectors. The implication is that AI advertising tools are not equally effective in all sectors in Nigeria. The sectors with the greatest increases are the data-rich, high-value transactional sectors. The sectors with the lowest

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increases, i.e., telecom and media, may benefit from the use of AI tools such as conversational AI, voice targeting, etc., as these are probably more effective in these sectors, based on the nature of the audience engagement in these sectors. From a policymaker's perspective, the split between fintech and media, in terms of the increase in CTRs, i.e., 42% compared with 18%, would indicate the sectors in which AI adoption incentives are likely to have the greatest systemic benefits.

Table 5: Cross-Industry AI Performance (n = 411)

Sector	Average CTR Increase	ROAS Improvement	Fraud Reduction
Fintech	+42%*	3.8:1	28%
E-commerce	+37%	2.9:1	19%
Telecommunications	+29%	2.1:1	14%
Media	+18%	1.3:1	9%

**Statistically significant at $p < 0.05$*

Ethical Challenges in AI-Driven Advertising

Next, we turn our attention to Nigeria as a case study on the ethical hurdles in AI-powered advertising. One of the main issues in AI-powered advertising in Nigeria is data privacy, which shows a huge contrast with the data privacy regulations in Europe. Table 6 shows that only 22% of the organizations surveyed claim to be fully compliant with the Nigerian Data Protection Regulation, compared with the 68% compliance rate in Europe as per the GDPR regulation (Wilson et al., 2024). Around 45% claim to be partially compliant, while 33% claim to have no idea about compliance in the first place. An interview with a Digital Marketing Manager at a Lagos-based fintech company (Interviewee D) revealed the practical reasoning behind partial compliance: "We know the NDPR requirements. The challenge is that our consent management infrastructure was built before the regulation came into force, and retrofitting it properly would require rebuilding parts of the platform. We are compliant on paper in most areas, but the backend data flows are not fully mapped yet." This account illustrates that partial compliance frequently reflects technical debt and resource constraints rather than deliberate disregard for the regulation — a distinction with implications for how enforcement agencies and policymakers design compliance support programmes for the sector.

Table 6: Data Privacy Compliance Levels (n = 411)

Compliance Level	Frequency (n)	Percentage (%)
Fully NDPR-compliant	89	22%
Partial compliance	185	45%
No clear compliance posture	137	33%
Total	411	100%

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There were several ways in which algorithmic bias manifested (Table 7). First off, socioeconomic bias, where AI systems tend to favor those in more affluent socioeconomic groups, dominated at 35%. Linguistic and cultural bias came in second at 31%, which often involved Pidgin English or indigenous languages, as mentioned earlier. Gender targeting bias came in at 24%. Only 10% of those surveyed reported seeing no bias at all. This is unsurprising, given Ford et al.'s (2023) study that found that bias in advertising algorithms reflects existing social inequalities. Of particular interest in Nigeria is linguistic bias, given their linguistic diversity and lack of local language varieties in commercial AI models.

Table 7: Reported Algorithmic Bias Cases (n = 411)

Bias Type	Frequency (n)	Percentage (%)
Socioeconomic	142	35%
Linguistic/Cultural	129	31%
Gender	97	24%
No reported cases	43	10%
Total	411	100%

However, transparency and accountability are still an issue with regard to structure. Again and again, the respondents raised issues with auditing the way AI processes decisions, the accuracy of the performance data reported by AI systems, and the ability for consumers to control data. These are all issues that are addressed by the use of more explainable AI systems and are an argument for the use of such systems. This allows advertisers and regulators to detect discriminatory practices and understand the targeting decisions made by the AI system before they cause harm (Soni, 2023).

Implementation Challenges: Cost Barriers and Skills Gaps

The fourth research question investigated the challenges that are affecting the implementation of AI in Nigeria. Cost was the major challenge cited by the respondents. Specifically, 55% cited the cost of software licensing as the major challenge for AI implementation in Nigeria. Another 30% cited the cost of cloud infrastructure as the major challenge for AI implementation in Nigeria. On the other hand, 15% cited the cost of acquiring talent as the major challenge for AI implementation in Nigeria (Table 8). This resonates with Soni's concept of the AI Poverty Line. This is the level at which the cost of implementing AI outweighs the potential return on investment. Soni estimated that this line is exceeded by 62% of SMEs in Nigeria.

Table 8: Cost Barriers to AI Adoption (n = 411)

Cost Factor	Frequency (n)	Percentage (%)
Software licensing fees	226	55%
Cloud infrastructure costs	123	30%
Talent acquisition	62	15%

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Cost Factor	Frequency (n)	Percentage (%)
Total	411	100%

Skills gap data reveals the same phenomenon, albeit in human capital form: "A majority, 53%, cited the biggest skills gap as tuning machine learning models, while data engineering came in second at 33%. Ethical AI practices were last on the list, with 14%" (Table 9). An interview with an AI Developer at a Lagos-based media agency (Interviewee E) captured the internal logic driving this gap: "When we are deciding what training to prioritize, the business always pushes toward technical skills that have an immediate measurable output — model tuning, pipeline optimization. Ethical AI is harder to justify to management because the return is diffuse and the risk feels abstract until something goes wrong publicly." This framing reveals that the underinvestment in ethical AI competencies is not simply a capacity issue but a governance and incentive problem, one that will persist unless organizations and regulators create explicit accountability mechanisms that make ethical AI training a measurable organizational obligation rather than a discretionary professional development choice.

What's striking is the low percentage dedicated to ethical AI, especially in the context of the aforementioned high bias rates. In fact, despite the development of NITDA's AI guidelines in 2024, which placed emphasis on the importance of ethical AI literacy as a national policy, the data reveals that this clearly isn't the case in the workplace.

Table 9: Skills Deficiencies in AI Adoption (n = 411)

Skill Deficiency	Frequency (n)	Percentage (%)
Machine learning model tuning	217	53%
Data engineering	134	33%
Ethical AI practices	60	14%
Total	411	100%

These findings indicate an evident adoption paradox in that even though there is a high level of awareness about AI advertising tools at 89%, only about 37% have adopted them in full. The major reasons cited for this gap include cost factors at 55%, lack of talent at 33%, and lack of infrastructure at 12%. This is an indication that the sector is experiencing an adoption paradox similar to what is experienced in other emerging economies in the world. This indicates the need for specific sectoral approaches to AI marketing as opposed to the use of general AI marketing approaches (Davenport & Ronanki, 2018).

Future Technology Adoption

The respondents were also asked about the technology they think they will adopt first. The results indicated that generative AI is the most likely technology to be adopted in the future, given its high mean score of 1.8 and standard deviation of 0.4. This technology is likely to be adopted in about 1.2 years. Blockchain technology for verification and voice AI came in second and third, respectively, with mean scores of 2.3 and 3.0 for the two technologies. This indicates

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that the sector is likely to adopt generative AI in the near future because it is likely to be less demanding in terms of infrastructure compared to predictive analytics.

Table 10: Planned AI Technology Adoptions (n = 411)

Technology	Priority Ranking (Mean)	Expected Adoption Timeline
Generative AI	1.8 (SD = 0.4)	1.2 years
Blockchain Verification	2.4 (SD = 0.6)	2.3 years
Voice AI	3.1 (SD = 0.9)	3.0 years

CONCLUSION

This study has presented a quantitative overview of how AI is changing digital advertising in Nigeria in four areas: precision in targeting, cutting waste, being on the right side of ethics, and challenges in implementing AI. The study has shown that AI advertising tools such as dynamic bidding and content generation using natural language processing have a significant impact in delivering cost per click and return on ad spend improvements for advertisers in Nigeria, especially in the financial technology sector.

However, it has also shown that there are structural challenges that need to be addressed in order to temper the excitement around AI adoption in Nigeria. There is a significant gap in regulation around NDPR compliance, with only 22% of organizations being fully compliant. There is also a significant issue around algorithm bias in favor of indigenous languages such as Pidgin English, which is not being sufficiently addressed in training and skills development programs. The cost of adoption is still a significant barrier for most Nigerian SMEs, and the skills required in ethical AI practices are being least addressed by organizations.

Future study will need to investigate whether using AIaaS and open-source tools in phased adoption models really does reduce cost barriers for SMEs. Studying these groups longitudinally and seeing how they become more compliant as Nigeria's enforcement of its NDPR regime improves will also be beneficial. Creating training data for AI systems that incorporates Nigerian Pidgin and other local language variants is a more specific area that has clear business and equity benefits. Ultimately, what this study demonstrates is that the adoption of AI in advertising is not about technology; it's about the world in which it's being used and how that world requires a more nuanced understanding than what's being promoted in global conversations about this topic.

Recommendations

Based on the study's findings, the following recommendations are provided for advertisers, marketers, and policymakers in Nigeria to maximize the benefits of AI-driven advertising while addressing challenges.

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1. Strategic AI Adoption for Nigerian Businesses

- Nigerian businesses should adopt AI in phases, starting with low-cost automation tools (e.g., chatbots, automated bidding, and audience segmentation).
- Companies should prioritize AI applications with immediate cost savings, such as fraud detection and budget optimization.
- Cloud-based AI services (AI-as-a-Service, AIaaS) can help SMEs access AI tools without heavy upfront investments.

2. Ethical AI Implementation and Regulatory Compliance

- Advertisers must align AI-driven advertising with the Nigeria Data Protection Regulation (NDPR) to ensure legal compliance and consumer trust.
- AI models should be trained on Nigerian-specific datasets to prevent bias against certain demographics or languages.
- Companies should implement Explainable AI (XAI) tools to improve transparency in ad targeting.[11.1]

3. Workforce Development and AI Training for Marketers

- Nigerian businesses should invest in AI training for digital marketing teams, ensuring staff can effectively use AI-powered tools.
- Partnerships with tech hubs and universities (e.g., Data Science Nigeria, ALX Africa) can help bridge the AI skills gap.
- Government agencies and private organizations should establish AI certification programs tailored to Nigeria's digital marketing sector.[12.1]

4. Reducing AI Adoption Barriers for SMEs

- Government and financial institutions should introduce subsidies or grants to support AI adoption in Nigerian SMEs.
- AI solution providers should develop affordable AI tools designed for Nigeria's cost-sensitive business environment.
- Businesses should leverage open-source AI models to reduce reliance on expensive proprietary AI solutions.[13.1]

5. Advancing AI Innovation in Nigerian Advertising

- Nigerian tech startups should focus on developing AI-powered advertising solutions tailored to local market needs.
- Brands should explore AI-powered voice advertising to reach Nigeria's growing base of voice search users.

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- Industry stakeholders should collaborate on AI-driven sustainability efforts, ensuring advertising efficiency while minimizing digital waste[14.1] and reducing the environmental impact of inefficient ad delivery systems.

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