Evaluating The Impact of Technological Innovations on Customer Satisfaction in Nigerian Electricity Distribution Companies

AKINDELE TAIWO RICHARD[1], FOLARORI TITILAYO SHAKIRAT[2]
[1, 2]*Bells University of Technology Ota, Nigeria*

Abstract- ***This study evaluates the impact of technological innovations on customer satisfaction within Nigerian electricity distribution companies (EDCs). Specifically, it examines how smart meters, digital outage reporting, and online support platforms influence key aspects of customer satisfaction: billing accuracy, service reliability, and complaint resolution. Using a quantitative research design and regression analysis, the study reveals significant positive relationships between each technology and the respective customer satisfaction dimensions. Findings suggest that technological advancements are critical to enhancing customer experiences in Nigeria's electricity sector, despite existing infrastructural and digital literacy challenges. Recommendations include expanding digital access, investing in customer training, and fostering regulatory collaboration to sustain these technological benefits. This research contributes valuable insights to the discourse on technology-driven service improvements in emerging markets, emphasizing the potential for digital transformation to bridge service gaps in essential utilities.***

Indexed Terms- ***Technological innovations, Customer satisfaction, Electricity distribution, Nigeria, Utility services***

I. INTRODUCTION

In the increasingly globalized and technologically advanced landscape, businesses are under continuous pressure to adopt innovative solutions to remain competitive and improve service delivery. Technological innovation, particularly in the utility sector, has revolutionized the way companies operate, offering enhanced efficiency, reduced operational costs, and, crucially, improved customer satisfaction (Bolla et al., 2022; Rahman & Saha, 2023). In the electricity distribution industry, technological advancements such as automated billing systems, mobile applications for customer support, and digital metering are pivotal in delivering more accurate, reliable, and transparent services (Okoro & Okorie, 2023). These developments are critical in emerging markets like Nigeria, where the power sector has historically struggled with inefficiencies, customer dissatisfaction, and an unreliable supply (Ahmed et al., 2022).

Despite substantial government and private sector investments in the Nigerian electricity sector, the industry continues to experience operational inefficiencies, high technical and commercial losses, and low customer satisfaction levels. According to recent reports, Nigeria loses an estimated $29 billion annually due to energy inefficiencies, underscoring the urgent need for innovative technological interventions to reduce such losses and improve service quality (Babatunde & Akinola, 2022). Customer satisfaction in this sector hinges on variables such as service reliability, prompt response to complaints, billing accuracy, and ease of payment, each of which can potentially be addressed through targeted technological innovations (Eze & Ndukwe, 2023).

However, the Nigerian electricity sector faces barriers that limit the success of these digital initiatives, such as poor infrastructure, a lack of technical expertise, and a limited understanding of customer needs. These issues have led to high rates of service complaints, increased operational costs due to inefficiencies, and reduced public trust in the utility sector. While global research has shown mixed results regarding the relationship between technological innovations and customer satisfaction, the Nigerian context presents unique infrastructural challenges that may impact the

effectiveness of technological interventions (Garcia et al., 2022; Khan et al., 2023).

Thus, understanding how specific technological innovations impact customer satisfaction could provide actionable insights for electricity distribution companies (EDCs) in Nigeria, assisting them in aligning their technological initiatives with the needs and expectations of their customers. This study investigates the impact of technological innovations on customer satisfaction within Nigerian electricity distribution companies. By examining key technological interventions like smart metering, automated customer service platforms, and mobile payment systems, this research aims to shed light on the correlation between technological advances and perceived customer satisfaction.

Three specific hypotheses have been formulated to guide this research:
1. $H0_1$: The adoption of smart metering technology has no significant impact on customer satisfaction in Nigerian electricity distribution companies.
2. $H0_2$: The implementation of automated customer service platforms has no significant effect on the resolution time and customer satisfaction in Nigerian electricity distribution companies.
3. $H0_3$: Mobile payment solutions have no significant influence on customer satisfaction in Nigerian electricity distribution companies.
Through these hypotheses, this research aims to contribute to the existing literature on technological innovations and customer satisfaction within the power sector, with a specific focus on the Nigerian context.

II. LITERATURE REVIEW

Technological innovations have become central to the operations of electricity distribution companies (EDCs) worldwide, driven by the need to enhance operational efficiency, reduce costs, and improve customer satisfaction. The adoption of innovations such as smart metering, mobile applications, and automated customer service systems has been examined across various sectors, yet their effects on customer satisfaction within Nigerian EDCs are not extensively studied. This literature review examines relevant concepts, theoretical frameworks, and empirical studies on the relationship between technological innovations and customer satisfaction, focusing on corroborative and contrasting perspectives.

- Conceptual Overview of Technological Innovations in Utility Services

Technological innovation in the utility sector refers to the introduction of new technologies or the improvement of existing ones aimed at enhancing service delivery and operational efficiency (Chen, Yang, & Wang, 2022). Common innovations in electricity distribution include smart metering, customer management systems, and digital payment solutions, which facilitate accurate billing, real-time monitoring, and customer engagement (Glover & Achebe, 2023). Research suggests that these technologies can directly influence customer satisfaction by addressing key pain points such as billing discrepancies, long wait times, and service unreliability (Abubakar et al., 2023).

In Nigeria, these innovations are seen as solutions to systemic issues plaguing the electricity sector, including energy theft, non-payment, and inadequate customer service (Okoro & Okorie, 2023). Studies show that technological interventions could enhance transparency and trust in EDCs, as they provide customers with more control over their electricity usage and billing (Eze & Ndukwe, 2023). However, other studies caution that without adequate infrastructure and customer education, the benefits of these innovations may not be fully realized (Rahman & Saha, 2023).

- Theoretical Framework: The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by Davis (1989), offers a widely recognized framework for evaluating user acceptance of new technologies. TAM posits that perceived usefulness and perceived ease of use are key factors that determine whether individuals adopt new technologies (Lee et al., 2023). In the context of electricity distribution, TAM suggests that customer acceptance of technologies such as mobile payment apps or smart meters would depend on whether customers find these innovations beneficial and easy to use.

Recent studies have applied TAM to the adoption of utility services in emerging markets, affirming that technological adoption is strongly influenced by user expectations of convenience and perceived reliability (Ali et al., 2022). For instance, a study by Glover and Achebe (2023) found that Nigerian EDC customers who believed in the usefulness of digital billing were more likely to engage with online services and experience greater satisfaction. This aligns with the findings of Chen, Yang, and Wang (2022), who reported that in the Chinese power sector, customer satisfaction increased with the adoption of technologies perceived as reliable and user-friendly. However, Ayinde and Onakoya (2022) argue that TAM's focus on individual perception may not fully capture challenges in Nigerian EDCs, where infrastructural deficiencies and economic constraints influence technological adoption.

- Empirical Evidence on Technological Innovations and Customer Satisfaction

The impact of technological innovations on customer satisfaction has been widely examined, with several studies reporting a positive relationship between the two. For example, Garcia et al. (2022) found that automated customer service platforms significantly reduced customer complaint resolution times, thereby increasing customer satisfaction. Similarly, Khan et al. (2023) highlighted the role of mobile payment solutions in facilitating quicker transactions, which improved customers' experience with utility services in South Asia. These findings suggest that technological innovation, when effectively implemented, can improve service delivery and customer satisfaction by increasing operational efficiency and minimizing service disruptions.

In the Nigerian context, Abubakar et al. (2023) revealed that EDCs' adoption of smart metering technology led to higher billing accuracy and a reduction in billing disputes. The study found that customers appreciated the transparency and control offered by smart meters, which translated to a significant improvement in their satisfaction levels. Eze and Ndukwe (2023) further corroborated these findings, noting that automated billing systems in Nigerian EDCs reduced the frequency of customer complaints about estimated billing, a common issue in the sector.

While these studies highlight the positive outcomes of technological innovation, others present a more cautious view. Rahman and Saha (2023) argue that technological adoption alone is insufficient to resolve deep-seated issues in public utilities. Their study, which focused on EDCs in Bangladesh, found that the positive impacts of technology on customer satisfaction were limited when underlying operational challenges, such as power shortages and inadequate infrastructure, persisted. This perspective aligns with Babatunde and Akinola (2022), who maintain that without addressing infrastructural and economic limitations, technology alone cannot sustain customer satisfaction in Nigerian EDCs.

- Contrasting Views on Technological Innovation and Customer Experience

Contrary to the studies affirming a direct link between technological innovations and improved customer satisfaction, some scholars argue that technology may not yield the expected benefits in certain contexts. Ayinde and Onakoya (2022) contend that, in Nigeria, infrastructural challenges and inconsistent power supply limit the effectiveness of technologies like digital billing and mobile apps. They found that customers remained dissatisfied despite technological advancements due to frequent power outages, underscoring that technology must be accompanied by improvements in service reliability. This view contrasts with the findings of Ali et al. (2022), who posit that even incremental technological improvements can positively impact customer satisfaction if they address specific service gaps.

III. SUMMARY

The literature indicates a general consensus on the potential of technological innovations to improve customer satisfaction in the electricity distribution sector. Studies by Garcia et al. (2022) and Glover and Achebe (2023) affirm that technologies such as smart meters and mobile payment platforms have enhanced transparency and convenience for customers, leading to increased satisfaction. However, there is an opposing view that emphasizes the limitations of technology in the face of infrastructural deficits, as seen in the works of Babatunde and Akinola (2022) and Rahman and Saha (2023). These contrasting perspectives underscore the need for a balanced

approach to technological adoption in Nigerian EDCs, combining innovation with infrastructure improvements to achieve sustainable customer satisfaction.

IV. METHODOLOGY

This section outlines the research methodology used to evaluate the impact of technological innovations on customer satisfaction in Nigerian electricity distribution companies (EDCs). It includes details on the study area, study population, sampling technique, data collection instrument, and methods used to ensure validity and reliability.

V. STUDY AREA

This study focuses on major electricity distribution companies in Nigeria, with a particular emphasis on Ikeja Electric (IE), one of the country's largest and most technologically advanced electricity distribution companies, headquartered in Lagos. Lagos is not only Nigeria's economic hub but also its most densely populated city, making it an ideal location for evaluating the impact of technological innovations on a large and diverse customer base. Ikeja Electric, with its extensive infrastructure and recent implementation of smart meters, online billing systems, and customer support mobile applications, represents a prime example of technological advancements in the Nigerian electricity distribution sector.

In addition to Ikeja Electric, the study includes Eko Electricity Distribution Company (EKEDC), also based in Lagos, and Abuja Electricity Distribution Company (AEDC), based in the nation's capital. The selection of both Lagos and Abuja offers a scientifically valid approach to examining customer satisfaction across different demographic and economic groups. Lagos serves as a commercial and residential powerhouse, while Abuja represents a significant semi-urban and governmental concentration, allowing the study to capture data across diverse socio-economic and geographic settings.

- Study Population and Sample Size Determination

The study population consists of residential and commercial customers of Ikeja Electric, Eko Electricity Distribution Company, and Abuja Electricity Distribution Company. These customers interact with a variety of technological innovations introduced by these companies, making them suitable respondents for assessing the impact of these technologies on customer satisfaction.

To ensure robust and generalizable findings, a sample size was determined using Cochran's formula for calculating sample size in large populations, which accounts for a 95% confidence level and a 5% margin of error. This calculation allows for a statistically significant representation of customers' responses across the selected regions. Anticipating response variability, approximately 400 respondents was targeted, distributed proportionately across the three companies based on their customer density.

- Sampling Technique

A multistage sampling technique was employed. First, stratified sampling was used to categorize respondents from each electricity distribution company—specifically Ikeja Electric, Eko Electricity Distribution Company, and Abuja Electricity Distribution Company. Within these strata, systematic random sampling was applied to select respondents, ensuring each customer has an equal chance of participating. This approach minimizes sampling bias and maximizes representativeness across diverse customer demographics.

- Data Collection Instrument

Data was collected using a structured questionnaire designed to assess customer perceptions of specific technological innovations, including smart metering, automated billing, mobile payment options, and online customer service platforms. The questionnaire included both closed and open-ended questions to capture quantitative and qualitative data on customers' experiences, satisfaction levels, and perceived challenges or improvements resulting from these innovations.

- Validity and Reliability

To establish content validity, the questionnaire underwent expert review by professionals in the power and technology sectors to ensure it adequately covers the relevant variables. Construct validity was

addressed by aligning the questionnaire items with the research objectives and hypotheses. To ensure reliability, a pilot test was conducted with a small sample from each selected distribution company to refine the questionnaire items. Cronbach's alpha was used to measure the internal consistency of the questionnaire items, with a threshold of 0.7 indicating acceptable reliability.

- Data Collection Procedure

The data collection process was carried out over a four-week period. Questionnaires was distributed electronically to customers via email and, where necessary, paper-based copies were administered in person at customer service centers of each electricity distribution company to enhance response rates. Participants were informed of the research purpose and assured of confidentiality to encourage honest responses. Trained research assistants were available at each distribution point to assist respondents and clarify any concerns related to the questionnaire items.

- Data Analysis

The collected data were analyzed using descriptive and inferential statistics. Descriptive statistics, such as means and frequencies, provide a preliminary understanding of customers' satisfaction levels across the selected companies. Inferential statistics, including regression analysis, were used to test the hypotheses and determine the relationship between technological innovations and customer satisfaction. Statistical analysis were conducted using SPSS software to ensure accuracy, and the results are thus presented in tables and graphs for clear interpretation.

VI. RESULTS AND DISCUSSION

This section presents and interprets findings from the data analysis conducted on customer responses. Each hypothesis was tested to determine the significance and direction of the relationship between technological innovations and customer satisfaction in Nigerian electricity distribution companies (EDCs).

Hypothesis Testing

Hypothesis 1 : Technological innovations have no significant impact on customer satisfaction in terms of billing accuracy.

Table 1: Regression Analysis for Billing Accuracy and Technology Adoption (Hypothesis 1)

Predictor Variable	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t	Sig. (p-value)
Technology Adoption (Smart Meters)	0.52	0.52	4.76	<0.01
R	0.52			
R^2	0.27			
F	22.68			<0.01

Interpretation: This table shows a significant positive relationship between the use of smart meters (technology adoption) and billing accuracy, with an R^2 of 0.27, meaning that 27% of the variation in billing accuracy is explained by technology adoption.

To assess $H0_1$, a regression analysis was conducted using billing accuracy as the dependent variable and technology adoption as the independent variable. The analysis revealed a statistically significant positive relationship between technology adoption (specifically, smart metering systems) and billing accuracy ($\beta = 0.52$, $p < 0.01$). This indicates that customers who reported higher usage of smart meters were more satisfied with the accuracy of their bills. Thus, $H0_1$ was rejected, suggesting that smart metering contributes significantly to customer satisfaction by improving billing precision. These findings align with the works of Garcia, Kim, & Shimizu (2022), who also found that smart systems enhance billing transparency.

Hypothesis 2 : Technological innovations have no significant impact on customer satisfaction regarding service reliability.

Table 2: ANOVA for Service Reliability and Use of Digital Reporting (Hypothesis 2)

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	14.32	1	14.32	4.85	<0.05
Within Groups	92.76	104	0.89		
Total	107.08	105			

Interpretation: The ANOVA test shows a significant effect of digital reporting and outage management on service reliability satisfaction ($p < 0.05$), supporting the rejection of the null hypothesis.

For $H0_1$, service reliability was tested as a function of digital reporting and outage management technologies. The ANOVA results showed significant differences in customer satisfaction with service reliability across different levels of technology use ($F = 4.85$, $p < 0.05$). Customers who used mobile apps for service notifications and outage reporting expressed higher satisfaction with service reliability compared to those who did not. Therefore, $H0_2$ was rejected. These results are consistent with recent findings by Odeyemi & Musa (2023), who noted that real-time outage reporting enhances customer perception of reliability.
Hypothesis 3 ($H0_3$): Technological innovations have no significant impact on customer satisfaction in complaint resolution.

Table 3: Regression Analysis for Complaint Resolution Satisfaction and Online Support Platforms (Hypothesis 3)

Predictor Variable	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t	Sig. (p-value)
Online Support Platform Usage	0.38	0.38	3.09	<0.05
R	0.38			
R^2	0.14			
F	9.54		<0.05	

Interpretation: This table presents the regression analysis results for the impact of online support platforms on complaint resolution satisfaction. The findings indicate a significant positive effect, with an R^2 value of 0.14, meaning that 14% of the variance in satisfaction with complaint resolution is explained by online support usage. Regression analysis was conducted with complaint resolution satisfaction as the dependent variable and usage of online support platforms as the independent variable. The findings showed a positive, significant effect ($\beta = 0.38$, $p < 0.05$). Customers who engaged with EDCs' online support and complaint channels reported higher satisfaction in resolution timeliness and effectiveness. Consequently, H03_{03}03 was rejected, supporting the idea that accessible online platforms contribute to effective complaint handling. Similar research by Adebayo & Okafor (2023) corroborates this, highlighting how digital service channels promote efficiency in customer service processes.

VII. DISCUSSION

The results underscore the substantial role of technological innovations in enhancing customer satisfaction across various aspects of service quality in Nigerian EDCs. Specifically, smart meters improve billing transparency, digital outage reporting bolsters perceived reliability, and online support systems expedite complaint resolution. These findings echo a growing body of research that advocates for technological integration in utility services to meet modern consumer expectations (Garcia et al., 2022; Odeyemi & Musa, 2023). However, while technology adoption shows promise, successful implementation also hinges on customer digital literacy and infrastructure stability, both of which pose challenges in emerging markets like Nigeria. Further studies could explore how EDCs might support customer adoption and expand these technologies to underserved areas.

V. SUMMARY, CONCLUSION, RECOMMENDATION AND CONTRIBUTION TO KNOWLEDGE

- Summary

This study aimed to evaluate the impact of technological innovations on customer satisfaction within Nigerian electricity distribution companies (EDCs). Focusing on three primary areas—billing accuracy, service reliability, and complaint resolution—the research explored whether specific technological advancements positively influenced customer perceptions. The analysis showed that the adoption of smart meters improved billing accuracy, digital outage reporting enhanced service reliability, and online support platforms significantly facilitated complaint resolution, leading to higher customer satisfaction. These findings align with recent studies that underscore technology's critical role in modernizing customer service in utility sectors (Adebayo & Okafor, 2023; Odeyemi & Musa, 2023).

- Conclusion

The evidence from this study suggests that technological innovations are instrumental in enhancing customer satisfaction in the Nigerian electricity sector. The rejection of all three null hypotheses confirmed that billing accuracy, service reliability, and complaint resolution are significantly improved through targeted technological solutions. This emphasizes the need for Nigerian EDCs to continue investing in digital technologies to meet evolving customer expectations. The results corroborate previous research by Garcia et al. (2022), who found similar benefits of smart systems in enhancing utility services. However, implementing these technologies requires overcoming infrastructural and digital literacy challenges prevalent in Nigeria (Musa et al., 2022).

- Recommendations

1. Invest in Customer Training and Support: Since the effectiveness of these technologies relies partly on customer engagement, Nigerian EDCs should conduct customer education programs to ensure users can efficiently use digital platforms and smart meters.
2. Expand Digital Access Across Service Areas: To maximize customer satisfaction, it is crucial to bridge the digital divide by deploying these technological innovations across both urban and rural areas, ensuring equitable access to reliable services.
3. Continuous System Improvement and Feedback Integration: Companies should establish feedback mechanisms to continuously monitor customer satisfaction and make data-driven improvements to the technologies implemented, further fostering trust and satisfaction among users.
4. Collaborate with Regulators: Collaborating with regulatory bodies can facilitate better infrastructure, funding, and policies supporting sustainable technological advancements in Nigeria’s electricity sector.

- Contribution to Knowledge

This study contributes to the body of knowledge on the nexus between technological innovation and customer satisfaction in utility services, particularly in emerging markets like Nigeria. While much of the literature addresses general technology adoption, this research provides targeted insights into how billing, reliability, and complaint resolution technologies uniquely contribute to customer satisfaction. Additionally, this research bridges a gap by offering empirical evidence from a Nigerian context, where infrastructural challenges and digital literacy play significant roles. These findings offer valuable guidance for both practitioners and policymakers on the potential of technology to reshape customer experiences in sectors critical to national development, such as electricity distribution (Garcia et al., 2022; Adebayo & Okafor, 2023).

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