ISA Journal of Business, Economics and Management (ISAJBEM)

Homepage: https://isapublisher.com/isajbem/

Volume 3, Issue 1, Jan-Feb, 2026 ISSN: 3049-1835

Application of Queuing Theory to Optimize Customer Service Efficiency of Deposit Money Banks in Nigeria: A Desk Review Approach

OKAH Friday Peter & AJIBADE Ayodeji Temitope

Department of Accounting, Babcock University, Ilishan Remo, Ogun State, Nigeria

Received: 10.12.2025 | **Accepted:** 23.12.2025 | **Published:** 01.01.2026

***Corresponding Author:** OKAH Friday Peter

DOI: *10.5281/zenodo.18110988*

Abstract **Review Article**

This study investigates the application of queuing theory to enhance customer service efficiency in Nigerian deposit money banks using a desk review approach. The objectives were to synthesize existing empirical evidence on queuing models, evaluate their effectiveness in managing waiting times, and identify research gaps for developing a conceptual framework for queue management. Secondary data were collected from peer-reviewed journals, conference proceedings, and industry reports published between 2010 and 2024 through platforms such as Elsevier, ScienceDirect, and ResearchGate. Findings reveal that inefficient queue management remains a major challenge, causing long waiting times and reduced customer satisfaction. Multi-server models, simulation-based approaches, and predictive analytics were effective in optimizing teller allocation and improving service delivery, though adoption of advanced technology-driven solutions in Nigerian banks is limited. The study concludes that integrating queuing theory with technology and effective staff scheduling can significantly enhance operational efficiency. Recommendations include adopting multi-server and simulation models, leveraging AI-driven queue management, and establishing regulatory benchmarks for service efficiency.

Keywords: Queuing Theory, Customer Service Efficiency, Deposit Money Banks, Nigeria, Desk Review, Service Optimization.

INTRODUCTION

1.0 Background to the Study

Banking institutions are the backbone of modern economies, serving as key intermediaries that mobilize deposits, extend credit, and facilitate financial transactions. Their effectiveness in performing these roles depends not only on financial soundness but also on the quality and efficiency of customer service delivery (Agboola & Oyedele, 2020). In Nigeria, despite sustained banking reforms and digital innovation, the issue of operational inefficiency persists within physical banking environments. Long queues, excessive waiting times, and poor service coordination remain common experiences for many customers visiting bank branches. These inefficiencies not only diminish customer satisfaction but also affect the overall

productivity and competitiveness of Deposit Money Banks (DMBs).

Customer service efficiency has therefore become a major determinant of competitiveness and trust in the Nigerian banking sector. With the evolution of technology and the emergence of alternative banking channels such as mobile and internet banking, customers now expect faster, more personalized, and reliable service experiences (Adebayo, 2021). However, while digital transformation has improved service delivery in remote channels, physical branches where a significant proportion of customers still transact continue to face challenges of overcrowding, slow service processes, and uneven resource allocation (Eze & Nwakoby, 2022). These challenges are particularly evident during peak hours when the influx of customers overwhelms available service staff and facilities. As a result, long queues have become a visible symptom of deeper operational inefficiencies in many Nigerian banks.

The persistence of these queues suggests that traditional management approaches, which rely on intuition rather than analytical modeling, are no longer sufficient. This is where queuing theory becomes highly relevant. Queuing theory provides a mathematical and conceptual framework for analyzing service systems where customer arrivals and service times vary (Bhat, 2015). By applying this theory, managers can determine optimal staffing levels, estimate expected waiting times, and design systems that minimize congestion while maintaining cost efficiency. In essence, queuing theory transforms what appears to be a routine operational issue, waiting lines into a quantifiable and optimizable aspect of service management (Okon & Hassan, 2023).

The growing body of research in operations management shows that queuing theory has been effectively applied across various sectors, including healthcare, transportation, manufacturing, and telecommunications (Saha & Ray, 2021; Kumar et al., 2022). These applications have demonstrated its potential to enhance productivity, allocate resources efficiently, and improve customer satisfaction. Yet, its systematic application within the Nigerian banking industry remains limited (Olawale & Nwachukwu, 2024). Many bank managers still make staffing and scheduling decisions without empirical models that reflect real-time customer flow and service variability. Consequently, physical branches experience under- or over-utilization of staff, resulting in either idle time or excessive congestion.

The problem therefore lies in the absence of analytical and predictive systems to manage customer queues effectively in Nigerian banking halls. Despite heavy investments in automation and customer relationship management systems, service delivery remains largely reactionary. Customers continue to face long waits for simple transactions, and banks lose valuable goodwill as a result (Aremu & Ayodele, 2023). These inefficiencies also increase operational costs and stress among frontline employees, further reducing service quality. Thus, the challenge is not merely technological but managerial and the need to apply systematic, data-driven tools like queuing models to balance service capacity and fluctuating demand.

This study aims to apply a desk review approach to synthesize existing global and local research on the use of queuing theory to optimize customer service efficiency in banking institutions. A desk review is particularly suitable for this study because it enables the researcher to collate and analyze evidence from previous empirical studies, identify trends, and adapt best practices to the Nigerian context (Mohammed & Udo, 2022). Through this approach, the paper examines how various queuing models such as M/M/1, M/M/c, and M/D/1 have been used to predict customer waiting times, optimize teller allocation, and improve throughput in banking and related service environments.

1.2 Statement of the Problem

Despite notable technological advancements such as internet banking, mobile applications, and the deployment of automated teller machines (ATMs), customer queuing remains a persistent operational challenge in Nigerian banking halls. During peak periods, customers still spend between 20 and 45 minutes waiting to be served, resulting in frustration, declining satisfaction, and in some cases, customer attrition (Eze & Nwakoby, 2022). This recurring scenario highlights that technological innovations

alone have not translated into corresponding improvements in customer service efficiency. The problem appears to stem from a mismatch between digital interventions and the actual management of in-branch service flow.

The persistence of long queues points to deeper operational inefficiencies beyond the visible front-end technologies. Many banks continue to rely on intuition-based or experience-driven decision-making rather than data-oriented models for managing customer arrivals and service delivery. The absence of real-time queue monitoring, predictive analytics, and structured queue models contributes to poor resource allocation, especially during high-demand hours. Consequently, the operational performance of banking halls becomes inconsistent, with some service points overloaded while others remain underutilized.

Furthermore, weak queue management practices exacerbate congestion and prolong service delays, creating a ripple effect on both customers and staff. Extended waiting times not only erode customer trust and satisfaction but also increase the workload and stress levels among frontline employees. This, in turn, reduces productivity and raises the risk of service errors, ultimately affecting the overall performance and competitiveness of deposit money banks. The challenge, therefore, transcends physical queues, it involves the ability of banks to model, predict, and manage customer flow using analytical and scientific tools such as queuing theory.

Given these challenges, there is an urgent need for a comprehensive desk review to assess the current state of research and practice on queuing theory application in Nigeria's banking sector. Existing studies have produced fragmented insights, often emphasizing customer satisfaction without addressing the stochastic nature of service demand and arrival patterns. A systematic synthesis of previous empirical works is essential to identify what has been studied, where gaps exist, and how global best practices can be adapted to Nigeria's context. Such a review will not only consolidate the evidence base but also provide a foundation for developing a more data-driven, theory-based approach to optimizing customer service efficiency in deposit money banks.

1.3 The Objective of the Study

The main objective of this study is to examine how the application of queuing theory can optimize customer service efficiency in deposit money banks in Nigeria through a comprehensive desk review of existing empirical and theoretical literature. The specific objectives are:

i. To review and synthesize existing empirical studies on the application of queuing theory in improving customer service efficiency within Nigerian deposit money banks.

ii. To examine the different queuing models and analytical frameworks that have been employed in Nigerian banking operations and evaluate their reported effectiveness in managing customer waiting times and enhancing service delivery.

iii. To identify research gaps, methodological limitations, and policy implications from previous studies and develop a conceptual framework for optimizing queue management in Nigerian banks.

1.4 Justification for the Study

Although several studies have examined service quality and operational performance in Nigerian banks, few have quantitatively or empirically applied queuing models to actual customer flow data (Adebayo, 2021; Eze & Nwakoby, 2022). Most prior research has focused on customer perceptions of service quality rather than the stochastic behavior of customer arrivals and service times that drive operational efficiency (Agboola & Oyedele, 2020). While evidence from advanced economies highlights the effectiveness of AI-driven and predictive queue management systems (Zhang & Li, 2022), such technological applications remain limited in Nigeria.

This study bridges that gap through a comprehensive desk review of existing empirical and theoretical literature on the application of queuing theory in banking operations. By systematically synthesizing findings across global and local contexts, the review

identifies dominant trends, methodological gaps, and best practices that can inform the adaptation of queuing models to Nigeria's banking environment for improved service efficiency. The desk review approach is particularly justified as it allows for the integration of diverse data sources and empirical results without the constraints of field-based research, making it a cost-effective and evidence-rich method for developing new insights.

The study is significant in three dimensions. Theoretically, it extends the application of queuing theory to the Nigerian financial service landscape, contributing to the operational research literature of developing economies. Practically, it provides managers with a framework for optimizing teller performance and reducing customer waiting time. From a policy perspective, the synthesized findings can guide the Central Bank of Nigeria (CBN) in establishing service efficiency benchmarks that promote customer protection and sustainable banking operations.

LITERATURE REVIEW

2.0 Conceptual Review

Queuing theory provides a structured framework for analyzing waiting lines and understanding how organizations can allocate their resources efficiently to handle varying customer demand. It rests on key parameters such as the arrival rate, the service rate, and the number of servers, which together determine how well a service system performs. In Nigerian Deposit Money Banks, these parameters are especially relevant because customers arrive at unpredictable times and service durations differ depending on the nature of transactions, staff competence, and system reliability. When the rate at which customers arrive exceeds the rate at which they are served, long queues form, leading to delays, customer frustration, and pressure on staff. As Eze and Nwakoby (2022) observed, such inefficiencies remain common in many Nigerian banks despite technological improvements. Queuing theory therefore provides a scientific and data-driven way to predict waiting times, allocate resources, and improve overall customer flow rather than relying on guesswork or experience alone.

The major constructs of queuing theory include the arrival rate, service rate, number of servers, queue discipline, and system utilization rate. The relationship among these constructs determines the efficiency of service delivery. When the arrival rate is consistently higher than the service rate, queues become congested and waiting times increase, but when the service capacity exceeds customer inflow, resources remain underused, increasing operational costs. Queue discipline, which refers to the order in which customers are served, also plays an important role in how customers perceive fairness and professionalism in service delivery. In Nigerian banking halls, especially during peak hours, perceived disorder or favoritism in queue handling often leads to dissatisfaction and loss of confidence in the system (Agboola & Oyedele, 2020). Therefore, managing queues effectively requires both mathematical precision and sensitivity to the human side of customer service.

Beyond the operational dimension, queuing outcomes have strong behavioral and psychological implications. Customer satisfaction, patience, and perceived waiting time are important factors that determine how people evaluate their service experience. Empirical evidence suggests that customers' perceptions of how long they wait are often influenced by comfort, communication, and the level of attention received, rather than by the actual duration of the wait (Agboola & Oyedele, 2020; Eze & Nwakoby, 2022). The SERVQUAL (Service Quality) model developed by Parasuraman, Zeithaml, and Berry (1988) connects queuing outcomes to the wider dimensions of service quality such as responsiveness, empathy, reliability, and physical environment. SERVQUAL identifies five key dimensions that influence how customers perceive service, namely: tangibles, reliability, responsiveness, assurance and empathy. When queues are short, organized, and transparent, customers perceive the bank as efficient and dependable, which in turn enhances satisfaction and loyalty. Queuing theory therefore extends beyond operational management to include the emotional and perceptual aspects of service delivery that shape customer experiences.

Technology has introduced a new dimension to how queues are managed in modern financial institutions. The use of digital queue management systems, predictive analytics, and artificial intelligence enables banks to forecast customer arrivals and adjust teller allocation in real time (Zhang & Li, 2022). However, many Nigerian banks still depend on manual or experience-based methods to control queues, which often leads to inefficiencies and wasted time (Adebayo, 2021). Integrating technology with queuing principles allows for better staff scheduling, improved customer throughput, and reduced idle time. According to Ogunleye and Musa (2023), banks that adopt predictive models can manage peak periods more effectively, thereby improving both customer satisfaction and staff productivity. This technological integration transforms queuing management from a routine operational task into a strategic tool for enhancing competitiveness and service quality.

The regulatory and policy environment also shapes how banks apply queuing theory in practice. The Central Bank of Nigeria has continued to emphasize the importance of consumer protection and service efficiency, yet there are still no clear benchmarks for acceptable waiting times in banking halls (CBN, 2023). Establishing uniform standards across the industry would promote accountability and provide a consistent basis for evaluating service performance. In addition, performance benchmarking across branches has been shown to promote organizational learning and reveal areas where service can be improved. When supported by appropriate policies, queuing models can serve as useful tools for ensuring not only operational efficiency but also regulatory compliance and customer well-being.

Taken together, the interplay of arrival rate, service rate, number of servers, technology adoption, and customer behavior determines the overall level of service efficiency in Deposit Money Banks. The desk review approach is particularly relevant for this study because it allows the synthesis of existing research findings, the identification of knowledge gaps, and the assessment of how queuing models have been applied in different Nigerian banking contexts. By drawing from global and local studies, this review will highlight how queuing theory can be adapted to improve customer service efficiency, reduce operational bottlenecks, and strengthen institutional performance. In doing so, it positions queuing theory as both a scientific framework and a practical strategy for enhancing service delivery and sustaining customer satisfaction in Nigeria's financial sector (Eze & Nwakoby, 2022; Ogunleye & Musa, 2023).

All the constructs discussed ultimately influence customer service efficiency, which reflects how effectively a bank converts its resources into timely, satisfactory service experiences. In queuing theory, this is measured through metrics such as average waiting time, time in the system, and server utilization, while from a managerial perspective it also includes staff productivity, cost efficiency, and customer satisfaction. Operational design variables such as arrival rate, service rate, number of servers, and queue discipline act as independent factors, whereas management practices like staff scheduling, technology adoption, and process design serve as mediators shaping customer outcomes such as satisfaction, loyalty, and perceived fairness. The overall service efficiency of a bank depends on how well these interrelated constructs are balanced, making the system responsive, efficient, and capable of reducing queues, increasing throughput, and enhancing profitability and brand image (Eze & Nwakoby, 2022).

2.1 Empirical Review

Research on the application of queuing theory in banking systems has gained prominence both in Nigeria and globally due to the persistent challenge of long waiting times and service inefficiencies.

In Nigeria, multiple studies have focused on the operational performance of deposit money banks. Farayibi and Oladapo (2016) applied multi-server queuing models to GTBank and Ecobank branches in Lagos, demonstrating that optimizing the number of servers and service rates significantly reduces waiting times and operational costs. Similarly, Daramola (2024) assessed Access Bank Plc in Anyigba, Kogi State, using multiple-server queuing models and highlighted the importance of structured resource allocation in minimizing customer wait times and enhancing service efficiency.

Aronu (2021) evaluated the United Bank for Africa (UBA) branch in Agbor, Delta State, and reported that careful analysis of service characteristics and operating costs improves both efficiency and customer satisfaction. Bassey (2025) studied selected banks in Ogoja and found that effective waiting line management directly influences customer satisfaction, showing that operational interventions can yield tangible improvements in service experience. Observational studies such as those by Odirichukwu and Lekara (2022) and Ugwa et al. (2015) also reinforce the critical role of queuing models in reducing delays and improving staff productivity, while Shaba (2019) demonstrated that reduced waiting times in First Bank Ltd at Kaura Namoda Branch directly increased customer loyalty.

Beyond Nigeria, the application of queuing theory in other African countries underscores its broader relevance. In Cameroon, Nguimkeu and Tchouassi (2022) employed an M/M/1 (Markovian (Poisson) arrival process, Markovian (Exponential) service process, Single server) queuing model to analyze ATM service efficiency at Credit Communautaire D'Afrique, Bamenda. Their study revealed that increasing the number of ATMs and optimizing customer flow can substantially reduce waiting times and improve satisfaction levels. In Ethiopia, Yifter (2023) applied simulation-based queuing models at the Commercial Bank of Ethiopia to predict and manage customer arrivals, demonstrating that predictive modeling enhances perceived service quality. These studies indicate that structured queuing systems, including single-server and multi-server models, can be successfully adapted to the operational contexts of African banks, yielding improved efficiency and customer satisfaction.

Globally, empirical evidence also validates the application of queuing theory in banking. In the Philippines, Sy et al. (2021) studied banks in Laguna and used queuing analysis to redesign waiting lines, significantly reducing delays and enhancing customer service. In Bangladesh, Shyfur et al. (2013) applied queuing theory to mitigate long waiting times during cash deposit transactions, demonstrating operational improvements. In the United States, Cowdrey et al. (2018) employed queuing analysis to optimize banking operations, highlighting its impact on overall customer experience. Sharma et al. (2013) in India utilized mathematical models to compare waiting times across two banks, confirming that queuing models improve service efficiency.

In China, Salami (2019) and Zhang and Li (2022) emphasized the value of predictive and AI-driven queuing systems, showing that technology integration can further enhance queue management, reduce customer wait times, and optimize service delivery.

Across these studies, common themes emerge. In all contexts, long waiting times and inefficient customer flow management negatively affect customer satisfaction and operational performance. Conversely, implementing queuing models whether single-server, multi-server, or simulation-based consistently improves efficiency, optimizes resource allocation, reduces idle time, and enhances customer experience.

Furthermore, integrating technological solutions such as predictive analytics and AI-driven queue management can amplify these benefits, particularly in high-traffic banking environments. Nigerian studies, in particular, reveal gaps in the adoption of technology-driven queuing interventions, indicating significant opportunities for operational improvements and research contributions (Eze & Nwakoby, 2022; Ogunleye & Musa, 2023).

2.3 Theoretical Framework

This study is anchored on queuing theory, which provides a systematic framework for analyzing waiting lines and service processes to optimize operational efficiency. Queuing theory examines how customers arrive at service points, how long they wait, and how resources such as tellers or service counters can be allocated to minimize delays (Gross & Harris, 1998; Bhat, 2015). Core constructs of the theory include arrival rate (λ), service rate (μ), number of servers (c), and queue discipline, which collectively determine the behavior of waiting lines and system performance.

In the context of Nigerian deposit money banks, queuing theory is directly applicable in understanding and improving customer flow.

Customers often arrive at irregular intervals, and transaction times vary depending on the service type. By modeling these processes mathematically, banks can determine the optimal number of tellers needed during peak and off-peak hours, allocate staff efficiently, and minimize both idle time and congestion (Eze & Nwakoby, 2022). For example, the M/M/1 model can be applied to single-teller service points, while the M/M/c model is suitable for branches with multiple tellers, enabling management to simulate different scenarios and predict waiting times under varying operational conditions.

The theory also provides a foundation for evaluating operational performance metrics, such as average waiting time, queue length, system utilization, and customer throughput. These metrics allow bank managers to monitor service efficiency, identify bottlenecks, and implement data-driven interventions. Moreover, queuing theory can guide the design of service processes and scheduling policies that reduce customer frustration and enhance overall efficiency.

By anchoring this study on queuing theory, it becomes possible to systematically analyze the relationship between customer arrivals, service capacity, and waiting times, offering a quantitative basis for improving service efficiency in Nigerian banks. The theory underpins both the empirical review and the conceptual framework, providing a robust foundation for practical recommendations on queue optimization and operational management.

METHODOLOGY

This study adopts a desk review approach to comprehensively examine the application of queuing theory in optimizing customer service efficiency in Nigerian deposit money banks. The approach involves a thorough review of secondary data sources, including peer-reviewed journal articles, conference proceedings, industry reports, and other scholarly publications. The sources were carefully selected based on their relevance to queuing models, service efficiency, operational performance, and technology integration in banking systems. To ensure the currency and applicability of the data, only publications between 2010 and 2024 were considered.

Data were retrieved from reputable academic databases and platforms such as Elsevier, ScienceDirect, ResearchGate, JSTOR, and Google Scholar, which provide access to high-quality studies conducted both within Nigeria and globally. The review focused on extracting empirical evidence, theoretical frameworks, and practical insights related to the management of waiting lines, the optimization of teller resources, and the adoption of technology-based queue management systems in banks.

A systematic content analysis was employed to synthesize the literature. This involved identifying recurring themes, trends, and patterns regarding queuing theory application, operational efficiency, and service delivery outcomes. The analysis also highlighted the relationship between queuing constructs such as arrival rate, service rate, number of servers, and queue discipline and managerial interventions like staff scheduling and technology adoption. By examining and comparing studies across different temporal and geographical contexts, the desk review approach provided a robust foundation for understanding the current state of research, identifying gaps in knowledge, and informing recommendations for Nigerian banks.

This methodology allows for a comprehensive, evidence-based understanding of how queuing theory has been applied in banking, the extent to which technological interventions have been integrated, and the measurable impact on service efficiency. It also offers a structured framework to critically evaluate prior studies, enabling the identification of best practices and areas where further research is needed.

FINDINGS AND DISCUSSIONS

The first objective of this study was to review and synthesize existing empirical studies on the application of queuing theory in improving customer service efficiency within Nigerian deposit money banks. The desk review revealed that inefficient queuing remains a persistent challenge in Nigerian banks, contributing to prolonged waiting times, customer dissatisfaction, and operational bottlenecks. Studies consistently show that both single-server (M/M/1) and multi-server (M/M/c) queuing models have been applied to optimize

resource allocation, improve teller performance, and enhance service delivery (Farayibi & Oladapo, 2016; Daramola, 2024; Aronu, 2021). These findings confirm that structured queue management is critical to improving customer service efficiency in Nigerian banking operations.

In line with the second objective, which sought to examine the different queuing models and analytical frameworks employed in Nigerian banking, the review identified the use of multi-server models, simulation-based queuing, and predictive analytics. Multi-server models were particularly effective in minimizing waiting times and improving teller utilization, while simulation-based approaches allowed banks to anticipate customer arrivals and optimize service processes (Yifter, 2023; Bassey, 2025). International studies further demonstrated the effectiveness of AI-driven and technology-enhanced queuing systems in improving service efficiency, emphasizing the importance of integrating operational models with technological solutions (Zhang & Li, 2022; Cowdrey et al., 2018).

The third objective aimed to identify research gaps, methodological limitations, and policy implications to develop a conceptual framework for optimizing queue management in Nigerian banks. The review revealed that most studies focus on single branches or limited datasets, with few longitudinal or multi-branch analyses. There is also limited adoption of advanced predictive or AI-driven queuing solutions in Nigerian banks, despite their proven benefits globally (Eze & Nwakoby, 2022; Ogunleye & Musa, 2023). These gaps underscore the need for a comprehensive framework that integrates queuing theory constructs such as arrival rates, service rates, number of servers, and queue discipline with managerial interventions like staff scheduling and technology adoption to optimize service efficiency.

Overall, the synthesis of Nigerian, African, and global studies confirms that applying queuing theory, supported by technology and effective operational management, significantly enhances customer service efficiency. These findings justify the desk review approach as a valuable method for consolidating knowledge, identifying gaps, and providing evidence-based recommendations for improving queue management and service delivery in Nigerian deposit money banks.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Summary

This study employed a desk review approach to critically examine existing literature on the application of queuing theory in Nigerian deposit money banks. Through systematic analysis of peer-reviewed journals, reports, and conference proceedings published between 2010 and 2024, the study synthesized empirical evidence on how queuing models influence customer service efficiency.

First, the review highlighted that inefficient queuing remains a pervasive challenge in Nigerian banks, leading to long waiting times, customer dissatisfaction, and operational bottlenecks. Empirical studies indicate that both single-server (M/M/1) and multi-server (M/M/c) queuing models have been employed to optimize resource allocation, manage teller workloads, and reduce congestion in banking halls. Multi-server models, in particular, showed a higher capacity to minimize customer waiting times and enhance service delivery (Daramola, 2024; Farayibi & Oladapo, 2016).

Second, the study examined literature various analytical frameworks used in banking operations, including simulation-based queuing, predictive modeling, and AI-enhanced queue management systems. Evidence from Nigeria, other African countries, and global contexts demonstrates that these frameworks improve operational efficiency, staff utilization, and customer satisfaction (Yifter, 2023; Zhang & Li, 2022). However, the review also revealed that many Nigerian banks have not fully integrated advanced predictive or technology-based models into routine operations, highlighting a critical area for improvement.

Finally, the desk review identified research gaps and methodological limitations in the literature. Most studies rely on limited empirical data, focus on single branches, or prioritize observational findings over longitudinal analysis. Furthermore, there is a lack of comprehensive frameworks that integrate

operational, technological, and managerial variables to optimize queuing and service efficiency in Nigerian banks. These insights informed the development of a conceptual framework for effective queue management, emphasizing the interrelationships between arrival rates, service rates, number of servers, technology adoption, and staff scheduling.

5.1 Conclusion

The study concludes that queuing theory is a vital tool for enhancing customer service efficiency in Nigerian deposit money banks. Proper application of queuing models particularly multi-server and simulation-based approaches can significantly reduce waiting times, optimize teller utilization, and improve overall customer satisfaction. While international and African studies show the benefits of predictive and technology-enhanced queue management, Nigerian banks have yet to fully capitalize on these innovations. Consequently, there is a need for a systematic, evidence-based approach to integrating queuing theory into operational decision-making.

Furthermore, the study concludes that optimizing service efficiency requires more than mathematical models; it necessitates alignment with staff scheduling, process design, and technology adoption. By addressing these interrelated factors, Nigerian banks can improve operational performance, enhance customer experiences, and strengthen competitive positioning within the financial services sector.

5.2 Recommendations

Based on the findings and conclusions, the study recommends the following:

1. **Implementation of Multi-Server and Simulation-Based Queuing Models**
   Banks should adopt multi-server and simulation-based models to optimize teller allocation, minimize waiting times, and enhance service delivery, particularly during peak banking hours.
2. **Integration of Technology and Predictive Analytics**
   Banks are encouraged to implement AI-driven or predictive queue management systems that can forecast customer arrivals, dynamically adjust resources, and streamline service processes.
3. **Staff Scheduling and Operational Alignment**
   Queuing models should be integrated with staff scheduling and process optimization to balance workloads, reduce idle time, and ensure that human resources are efficiently deployed.
4. **Continuous Monitoring and Evaluation**
   Banks should establish mechanisms to regularly monitor queue performance, customer waiting times, and service satisfaction, using data-driven insights to refine queue management strategies.
5. **Policy and Regulatory Support**
   The Central Bank of Nigeria and other regulatory bodies should develop guidelines or benchmarks for service efficiency in banks, encouraging the adoption of queuing models and technology-driven solutions to improve customer experience.

References

Alonge, T., Adeyemi, K., & Bello, O. (2025). Application of discrete event simulation and queuing models to optimize banking operations in Nigeria. *Journal of Banking and Finance Studies, 18*(2), 45–62.

Aronu, C. (2021). Analysis of queuing systems in United Bank for Africa: Implications for service efficiency. *International Journal of Management and Economics, 6*(1), 112–130.

Asogwa, L., Nwankwo, P., & Eze, T. (2018). Optimizing customer service delivery using queuing theory: Evidence from Zenith Bank Plc, Abakaliki branch. *African Journal of Business Management, 12*(3), 98–110.

Ayobami, A., Okonkwo, R., & Tunde, F. (2025). Comparing discrete event simulation and queuing models for optimizing customer flow in Nigerian

banks. *Operations Research Perspectives, 12*, 100–115.

Bassey, I. (2025). Managing waiting lines in Nigerian banks: An empirical study of selected branches in Ogoja. *Journal of Banking Operations, 7*(2), 56–70.

Bhat, U. N. (2015). *An introduction to queueing theory: Modeling and analysis in applications* (3rd ed.). Birkhäuser.

Cowdrey, J., Miller, S., & Anderson, P. (2018). Queuing analysis in U.S. banking firms: Optimizing customer experience. *Journal of Financial Services Research, 54*(1), 25–44.

Daramola, A. (2024). Application of multi-server queuing models to optimize service efficiency: Case study of Access Bank Plc, Anyigba, Kogi State. *International Journal of Operational Research, 15*(4), 210–230.

Eze, F., & Nwakoby, C. (2022). Queue management and customer satisfaction in Nigerian deposit money banks: A review of empirical studies. *African Journal of Banking and Finance, 14*(2), 77–95.

Farayibi, O. (2016). Optimizing service levels in Nigerian banks using queuing models: A case study of GTBank and Ecobank. *Journal of Financial Operations, 8*(1), 33–50.

Farayibi, O., & Oladapo, A. (2016). Multi-server queuing model analysis of customer service in Nigerian banks. *MPRA Paper No. 73614*. https://mpra.ub.uni-muenchen.de/73614

Nguimkeu, P., & Tchouassi, A. (2022). Application of M/M/1 queuing model in ATM service efficiency: Evidence from Cameroon. *African Journal of Management and Technology, 10*(3), 88–102.

Odirichukwu, C., & Lekara, I. (2022). Customer queuing and service delivery in Nigerian banks: Observational insights. *Journal of Banking Research, 11*(1), 40–55.

Ogunleye, O., & Musa, K. (2023). Technology-enhanced queuing systems in Nigerian deposit money banks: A desk review. *Journal of Operations Management in Emerging Economies, 9*(2), 101–120.

Salami, R. (2019). Queuing theory and service optimization in Chinese banks. *International Journal of Banking Studies, 7*(4), 55–68.

Shaba, H. (2019). Evaluating service efficiency at First Bank Ltd, Kaura Namoda branch using queuing models. *Nigerian Journal of Banking Operations, 5*(2), 66–78.

Sharma, S., Kumar, A., & Verma, P. (2013). Application of queuing theory in banking: A comparative study of two banks in India. *International Journal of Management Sciences, 3*(2), 12–25.

Shyfur, M., Rahman, S., & Hossain, T. (2013). Queuing theory application for reducing waiting times in Bangladeshi banks. *Asian Journal of Banking Operations, 5*(1), 44–58.

Sy, R., Santos, P., & Cruz, L. (2021). Queuing system analysis in Philippine banks: Reducing customer waiting times. *IEOM Society International Proceedings, 2021*, 456–467. https://ieomsociety.org/proceedings/2021monterrey/456.pdf

Ugwa, J., Chike, U., & Okeke, B. (2015). Applying queuing theory to optimize teller operations in Zenith Bank Plc, Enugu. *International Journal of Operational Management, 4*(3), 21–35.

Yifter, G. (2023). Simulation-based queuing model for enhancing service quality in Ethiopian banks. *Journal of African Financial Studies, 11*(2), 77–94.

Zhang, H., & Li, Q. (2022). AI-driven predictive queue management in banks: Lessons from global practices. *Journal of Financial Technology and Innovation, 8*(1), 101–118.