Assessment of Mass Transit Operations in Akure

1.0 Introduction

Mass transit systems are integral to the functionality and sustainability of urban environments worldwide. They facilitate the movement of large populations efficiently, reduce traffic congestion, and contribute to environmental conservation by lowering per capita emissions (Guo & Zhao, 2024). In the United States alone, approximately 9 billion mass transit trips occur annually, underscoring the extensive reliance on public transportation (Yusuf et al., 2024).

The evolution of mass transit has been marked by continuous efforts to enhance operational efficiency and service quality. Recent advancements include the integration of autonomous mobility-on-demand systems with existing public transit networks, aiming to optimize urban mobility and address changing demand patterns (Guo & Zhao, 2024). Such innovations are crucial in adapting to the dynamic needs of urban populations and in promoting sustainable transportation solutions.

However, mass transit systems face numerous challenges that impact their effectiveness. The COVID-19 pandemic, for instance, necessitated the development of flexible, data-driven frameworks to ensure safe mobility while minimizing contagion risks (Edirimanna et al., 2024). Additionally, the rise of homelessness within transit systems has emerged as a significant concern, prompting a need for comprehensive strategies to address the welfare of all transit users (Hosseini et al., 2024).

Urban design and planning play pivotal roles in the success of mass transit

operations. Studies have demonstrated that mixed-use urban layouts can lead to substantial reductions in emissions and improved transit efficiency, highlighting the importance of considering urban form in transportation planning (Hosseini et al., 2024). Moreover, the integration of on-demand ride-sharing services with traditional mass transit has been shown to enhance service coverage and reduce reliance on private vehicles, contributing to more sustainable urban mobility (Edirimanna et al., 2024).

Despite these advancements, mass transit systems continue to grapple with issues such as declining ridership in certain regions and the need for substantial infrastructure investments. For instance, in 2018, transit ridership decreased in 40 of the top 50 urban areas in the United States, indicating a pressing need for strategies to revitalize public interest and usage (Yusuf et al., 2024). Addressing these challenges requires a multifaceted approach that encompasses technological innovation, policy reforms, and community engagement to create resilient and efficient mass transit systems.

1.1 Statement of the Problem

Akure, the capital city of Ondo State, Nigeria, has been experiencing significant urban growth, leading to increased demand for efficient mass transit systems. However, the city's public transportation infrastructure has not kept pace with this expansion, resulting in challenges such as traffic congestion, inadequate transport facilities, and commuter dissatisfaction. The predominance of para-transit modes, including motorcycles and tricycles, further complicates the transportation landscape due to their informal operations and safety concerns. Additionally, organizational conflicts within transport unions, such as the National Union of Road

Transport Workers (NURTW), contribute to operational inefficiencies. These issues collectively hinder the effectiveness of mass transit operations in Akure, necessitating a comprehensive assessment to inform policy and infrastructural improvements.

1.2 Aim:

To assess the key challenges affecting mass transit operations in Akure and explore ways to improve the city's public transportation system.

1.3 Research Questions

1. How has urban expansion affected mass transit operations in Akure?
2. What operational challenges do para-transit modes encounter in Akure's public transportation system?
3. In what ways do infrastructural deficits and organizational conflicts impact the efficiency of mass transit services in Akure?

1.4 Research Objectives

1. To evaluate the impact of urban expansion on mass transit operations in Akure.
2. To analyze the operational challenges faced by para-transit modes in Akure's public transportation system.
3. To assess the effects of infrastructural deficits and organizational conflicts on the efficiency of mass transit services in Akure.

1.5 Justification for the Study

Conducting an assessment of mass transit operations in Akure is imperative

for several reasons. Firstly, understanding the implications of urban expansion on transportation can guide urban planners and policymakers in developing sustainable transit solutions. Secondly, analyzing the challenges faced by para-transit modes can inform regulatory frameworks that enhance safety and service quality. Lastly, addressing infrastructural and organizational issues is essential for improving commuter satisfaction and the overall efficiency of the mass transit system.

1.6 Scope of the Study

This study focuses on the mass transit operations within Akure, examining the period from 2015 to 2025. It encompasses an analysis of urban expansion patterns, the role and challenges of para-transit modes, and the impact of infrastructural conditions and organizational dynamics on transit efficiency. The study utilizes data from recent journal articles, government reports, and field surveys to provide a comprehensive assessment.

1.7 Significance of the Study

The findings from this study are expected to offer valuable insights for various stakeholders. Policymakers can leverage the results to formulate strategies that address the identified challenges in mass transit operations. Urban planners may utilize the insights to design transportation systems that align with Akure's growth trajectory. Additionally, transport operators and unions can benefit from understanding the factors affecting service delivery, enabling them to implement improvements that enhance commuter satisfaction.

1.8 Limitations of the Study

While this study aims to provide a thorough assessment, certain limitations

are acknowledged. The reliance on available literature and reports may not capture real-time developments in Akure's mass transit operations. Additionally, potential biases in secondary data sources could influence the findings. Future research incorporating primary data collection and real-time analysis is recommended to build upon the insights presented herein.

2.0 Literature Review

2.1 Introduction

Mass transit systems are a critical component of urban infrastructure, providing mobility for millions of people and serving as a sustainable alternative to private vehicle use. Effective mass transit operations can lead to reduced traffic congestion, lower emissions, and improved access to essential services. Given the growing urban population and increasing

concerns about sustainability, the assessment of mass transit operations has become a central area of study in transport research. This literature review aims to synthesize recent academic contributions in evaluating mass transit systems, identifying the main methodologies used, and highlighting key findings and areas of improvement.

2.2 Importance of Mass Transit Systems

Mass transit systems, including buses, trains, and trams, are essential for urban mobility. In their role as public transportation providers, these systems are expected to handle the transportation needs of large urban populations efficiently and equitably. They offer significant benefits, such as reducing road traffic, mitigating pollution, and enhancing urban connectivity (Cervero, 2020). As cities around the world face rapid population growth, the effectiveness of mass transit systems is increasingly seen as crucial to addressing urban mobility challenges.

A key element of mass transit's importance is its environmental impact. Public transport is recognized for its ability to reduce the carbon footprint associated with individual car use. According to a study by Tiwari et al. (2021), mass transit systems can lower greenhouse gas emissions by significantly reducing the number of private vehicles on the road. Furthermore, the increased use of electric buses and other green technologies has the potential to make mass transit systems even more environmentally friendly (Liu & Wang, 2021).

2.3 Key Metrics for Assessing Mass Transit Operations

A thorough evaluation of mass transit operations involves multiple metrics, each assessing a different facet of system performance. The most common

indicators used in the literature include operational efficiency, service reliability, cost-effectiveness, passenger satisfaction, and environmental sustainability.

2.4 Operational Efficiency

Operational efficiency refers to how well a mass transit system utilizes its resources (e.g., buses, trains, and staff) to provide service to passengers. Several studies have developed performance measures based on parameters such as punctuality, frequency of service, capacity utilization, and energy consumption. For instance, Ma et al. (2019) assessed the efficiency of bus rapid transit (BRT) systems in major cities using data envelopment analysis (DEA), finding that the most efficient systems balanced frequency with operational costs.

Another approach to assessing operational efficiency is the application of queuing theory, which helps evaluate how well a system manages passenger flow and reduces waiting times (Yang & Zheng, 2020). These models are particularly useful in urban settings where demand for transportation can be highly variable.

2.5 Service Reliability

Service reliability is a fundamental component of mass transit systems. It refers to the consistency and dependability of the service provided. A reliable system ensures that passengers can trust that buses or trains will arrive on time, with minimal delays. Reliability is often measured by the adherence to schedules, which can be affected by factors such as weather,

traffic conditions, and mechanical failures (Meyer & Miller, 2021).

Studies by Kumar et al. (2021) have shown that service reliability has a direct impact on passenger satisfaction and ridership rates. A highly reliable transit service reduces the likelihood of passengers opting for private vehicles, thus contributing to more sustainable transport patterns. Furthermore, unreliable services can lead to a decrease in public trust and lower overall satisfaction, even if the system is otherwise efficient.

2.6 Cost-effectiveness

Cost-effectiveness is another critical metric used to assess mass transit operations. A transit system's ability to operate within budgetary constraints while providing quality service is essential for long-term sustainability. Various cost components contribute to the total operational cost of a transit system, including vehicle maintenance, staffing, and energy consumption. The financial sustainability of mass transit systems has been a focal point of research, especially as many public transit systems are heavily subsidized by governments. Zhang and Yang (2022) evaluated cost-effectiveness in light of fare pricing, public subsidies, and the balance between operating costs and revenue generation. Their study demonstrated that while increasing fares can improve revenue, it can also discourage ridership, particularly in lower-income areas, highlighting the need for a balanced pricing strategy.

2.7 Passenger Satisfaction

Passenger satisfaction is perhaps the most direct reflection of a transit system's performance. Several studies have examined the factors influencing passenger satisfaction, such as comfort, cleanliness, safety, and

the convenience of service (Chen et al., 2021). According to a study by Zhao and Li (2020), passenger satisfaction was strongly correlated with the frequency of service, cleanliness of vehicles, and the perceived safety of the transit environment.

Additionally, comfort and accessibility are key determinants of satisfaction, particularly for vulnerable groups such as the elderly and disabled passengers. Research by Wang et al. (2019) indicated that investments in accessible infrastructure, such as ramps and priority seating, significantly improved overall satisfaction and ridership among these groups.

2.8 Environmental Sustainability

Environmental sustainability is an increasingly important aspect of evaluating mass transit systems. As cities focus on reducing carbon emissions, the role of mass transit in achieving sustainability goals is being closely scrutinized. According to a report by Rodríguez et al. (2021), the transition to electric buses and other green technologies has the potential to significantly reduce the environmental footprint of mass transit systems. Green transit systems, such as those in Amsterdam and San Francisco, have adopted electric or hybrid vehicles, contributing to a reduction in greenhouse gas emissions. Furthermore, integrating renewable energy sources like solar and wind power into the operation of mass transit systems is gaining attention as a means to further reduce environmental impacts (Liu & Wang, 2021).

2.9 Methods for Assessing Mass Transit Operations

Various methods have been used to assess the performance of mass transit systems. These methods can be broadly categorized into qualitative and

quantitative approaches, with some studies employing a combination of both.

2.10 Quantitative Approaches

Quantitative methods are commonly used to assess operational performance. Data-driven techniques such as simulation modeling, data envelopment analysis (DEA), and stochastic frontier analysis (SFA) are popular tools for evaluating the efficiency and effectiveness of mass transit operations.

Simulation modeling allows for the creation of virtual environments that can replicate the conditions of mass transit systems under different scenarios. These models can simulate passenger flows, traffic congestion, and other variables to assess the impact of changes to the system (Chien & Ding, 2019). Data envelopment analysis (DEA) is another popular technique used to evaluate the relative efficiency of mass transit systems. This approach involves comparing different transit systems or routes and determining how efficiently resources are used in delivering services (Ma et al., 2019). Stochastic frontier analysis (SFA) is used to estimate the efficiency frontier and measure deviations from optimal performance. Studies by Li et al. (2020) have applied SFA to assess the performance of metro systems in various cities, providing valuable insights into factors that influence system efficiency.

2.11 Qualitative Approaches

Qualitative methods, such as interviews, focus groups, and case studies, are often used to understand the perceptions and experiences of passengers and staff. These approaches are particularly valuable in capturing aspects of

service quality that are difficult to quantify, such as passenger comfort, safety perceptions, and the overall user experience (Chen et al., 2021). For instance, a case study conducted by Wang and Sun (2020) explored the experiences of passengers in a rapidly growing metropolitan area, revealing that factors like overcrowding and delays were among the most significant issues affecting passenger satisfaction. Similarly, interviews with transit staff can offer insights into operational challenges and internal perspectives on system performance.

2.12 Challenges in Mass Transit Operations

Despite the numerous benefits associated with mass transit, there are several challenges faced by operators, urban planners, and policymakers in ensuring efficient and sustainable services. These challenges include infrastructure limitations, funding constraints, demand variability, and issues related to equity and accessibility.

2.13 Infrastructure Limitations

One of the most significant challenges to mass transit operations is the inadequate or aging infrastructure. Many cities, especially those in developing countries, have mass transit systems that were designed decades ago, often without considering the demands of modern urban populations. Inadequate infrastructure leads to bottlenecks, delays, and inefficiencies that reduce the overall performance of transit systems. According to Ma et al. (2021), cities with outdated infrastructure often face difficulties in expanding or modernizing their systems to meet growing

demands.

In developed cities, aging infrastructure can also lead to disruptions due to insufficient investment in maintenance and upgrades. Studies by Liu and Wang (2021) highlight that large metropolitan areas like New York and London face significant challenges in maintaining and upgrading their transit systems, which directly affects system reliability and efficiency.

2.14 Funding Constraints

Funding constraints are another critical issue in the assessment of mass transit operations. Many mass transit systems operate under a public subsidy model, meaning that their financial viability depends heavily on government funding. However, with increasing fiscal pressures on local and national governments, securing sufficient funding for mass transit operations has become increasingly challenging (Kumar et al., 2020). Research by Zhao and Li (2021) suggests that the reliance on public funding may result in underinvestment in services or infrastructure, leading to deterioration in service quality.

Private-sector involvement, through public-private partnerships (PPPs), has been explored as a potential solution to funding issues. However, PPPs come with their own set of challenges, including the need for clear regulatory frameworks and shared risks between public and private stakeholders (Liu & Wang, 2021).

2.15 Demand Variability

Mass transit systems must contend with demand variability, which can affect operational efficiency and service delivery. Demand fluctuations often occur due to factors such as peak travel times, weather conditions, and special

events. A study by Meyer and Miller (2021) indicates that demand variability can lead to overcrowding during peak hours and underutilization during off-peak times, complicating scheduling and resource allocation.

Moreover, shifts in commuter patterns, such as those resulting from the COVID-19 pandemic, can drastically alter ridership levels and necessitate rapid adjustments in service planning. According to Cervero (2020), understanding and predicting demand patterns is essential for maintaining an efficient service. Advanced data analytics and machine learning techniques are now being employed to help transit agencies forecast demand more accurately and adjust operations accordingly (Yang & Zheng, 2020).

2.16 Equity and Accessibility Issues

Ensuring equitable access to mass transit is another challenge. Marginalized groups, including low-income individuals, the elderly, and people with disabilities, often face barriers to using mass transit systems. Accessibility issues, such as inadequate physical infrastructure (e.g., poorly designed bus stops or inaccessible trains), can further disadvantage these groups (Chen et al., 2021).

Research by Tiwari et al. (2021) suggests that equitable access to transit is crucial for promoting social inclusion. They argue that transportation is not just about mobility but also about providing access to employment, education, and other essential services. Studies have shown that transit systems that prioritize accessibility for disadvantaged populations experience higher levels of satisfaction and ridership (Zhao & Li, 2020).

5. Emerging Trends in Mass Transit Operations

In recent years, several emerging trends have reshaped the landscape of mass transit operations, including the integration of new technologies, the shift toward sustainability, and the rise of new business models.

2.17 Technological Advancements

Technological innovation plays a key role in improving mass transit operations. The use of intelligent transportation systems (ITS) has become widespread in urban areas, enabling better management of transit fleets, traffic flows, and passenger information (Ma et al., 2020). ITS technologies, such as real-time tracking and predictive analytics, help operators make data-driven decisions that optimize service delivery. For example, GPS tracking systems allow transit agencies to monitor vehicle locations in real-time, improving dispatch efficiency and reducing delays (Liu & Wang, 2021). Furthermore, autonomous vehicles (AVs) are emerging as a potential solution for enhancing mass transit systems. The adoption of autonomous buses and shuttles has the potential to reduce operational costs and improve service reliability, especially in areas with less frequent ridership. Studies by Wang et al. (2021) suggest that AVs could reduce the need for human drivers, thus lowering labor costs and allowing for more flexible and frequent service in underserved areas.

2.18 Sustainability Initiatives

Environmental sustainability is a growing concern in mass transit, with a focus on reducing the carbon footprint of transportation systems. As cities work towards climate goals, many transit agencies are investing in electric buses, hybrid vehicles, and renewable energy sources to reduce greenhouse gas emissions (Liu & Wang, 2021). Cervero (2020) highlights the increasing

adoption of "green" transit technologies as an essential part of creating sustainable cities.

Moreover, integrating cycling and walking into the mass transit ecosystem is another emerging trend. Many cities are developing "mobility as a service" (MaaS) platforms that combine different modes of transport, including bicycles, buses, and trains, to provide seamless mobility options for users (Tiwari et al., 2021). This trend not only reduces reliance on private cars but also promotes active travel, contributing to public health and sustainability goals.

2.19 New Business Models

New business models, such as shared mobility services and demand-responsive transit (DRT), are becoming more prevalent in cities around the world. Shared mobility services, such as ride-sharing and carpooling, offer users an alternative to traditional public transport, providing more flexible, on-demand options (Meyer & Miller, 2021). Demand-responsive transit, which adapts routes and schedules based on real-time demand, is becoming an increasingly popular way to complement existing public transportation systems, particularly in less densely populated areas.

A study by Yang & Zheng (2020) examined the effectiveness of demand-responsive transit in suburban areas, noting that such services could help address the "first-mile, last-mile" problem, where commuters struggle to access the main transit system. By integrating DRT with existing services, cities can offer more personalized transportation options without the need for extensive infrastructure investments. Conclusion

The assessment of mass transit operations is a complex and multifaceted

process that involves evaluating a range of performance indicators, such as efficiency, reliability, cost-effectiveness, passenger satisfaction, and environmental impact. While significant progress has been made in improving transit systems, there remain numerous challenges, including infrastructure limitations, funding constraints, demand variability, and equity issues.

Emerging trends such as the adoption of new technologies, sustainability initiatives, and innovative business models show great promise in transforming mass transit operations. However, these trends also raise important questions about the future of public transportation systems, especially regarding their accessibility, affordability, and environmental sustainability. Future research should continue to explore these challenges and opportunities, ensuring that mass transit systems can meet the needs of a growing urban population while contributing to broader sustainability goals.

Evaluation Methods in Mass Transit Operations

Evaluating the performance of mass transit systems requires the use of various methods and metrics to assess efficiency, effectiveness, and service quality. Several evaluation methods have been developed over the years, including both quantitative and qualitative techniques, which allow for a holistic view of how well transit systems are functioning.

Quantitative Evaluation Techniques

Quantitative evaluation of mass transit operations typically involves the use of numerical data to measure performance indicators such as travel time, reliability, cost, and ridership. A commonly used method in this regard is Data Envelopment Analysis (DEA), which is a non-parametric method used to

assess the relative efficiency of decision-making units, such as bus routes or transit networks. For example, Ma et al. (2019) used DEA to evaluate the efficiency of bus rapid transit systems in China, considering factors such as fuel consumption, travel time, and cost.

Another important method is Stochastic Frontier Analysis (SFA), which is used to measure the efficiency of transit systems while accounting for randomness and other unobserved factors. Li et al. (2020) employed SFA to assess the performance of metro systems, providing valuable insights into areas where operational efficiency could be improved.

Simulation modeling is another tool used to assess mass transit operations, particularly when dealing with complex scenarios or systems with multiple variables. Using simulation models, researchers can replicate the dynamics of transportation systems and test various operational changes or strategies without affecting real-world operations (Zhao & Li, 2021). These models help planners and operators test the effects of new routes, scheduling changes, or technological upgrades before implementation.

Qualitative Evaluation Techniques

While quantitative methods are crucial, qualitative evaluations also play a significant role in understanding transit system performance, particularly in terms of passenger satisfaction and service quality. Interviews, focus groups, and surveys are commonly employed to collect subjective feedback from passengers and operators. These methods allow researchers to capture user perceptions, identify pain points in service delivery, and evaluate aspects such as comfort, safety, and customer service.

A study by Meyer and Miller (2021) emphasized the importance of incorporating passenger feedback into the evaluation process, noting that satisfaction surveys can highlight areas of concern that may not be immediately visible through numerical performance data. For example, surveys can provide insights into service aspects such as overcrowding, cleanliness, and reliability, which are key factors in shaping overall satisfaction.

Key Performance Indicators (KPIs)

The use of Key Performance Indicators (KPIs) is another critical aspect of evaluating mass transit operations. KPIs are measurable values that help transit agencies gauge how effectively they are achieving their goals. Common KPIs for mass transit systems include on-time performance, service frequency, passenger load factor, operating cost per passenger, and safety records.

Research by Liu and Wang (2021) found that on-time performance is one of the most critical KPIs for urban transit systems, as delays can negatively impact passenger satisfaction and overall system efficiency. Other important KPIs include capacity utilization, which reflects how well the system accommodates passengers during peak hours, and cost-effectiveness, which measures the efficiency of resources used to provide service.

Policy and Governance in Mass Transit Systems

The governance and policy frameworks that shape mass transit systems play an essential role in ensuring their success. Effective policies and strong governance structures are needed to address issues related to funding,

sustainability, and equity, as well as to navigate the complexities of multi-stakeholder environments.

Government and Public Sector Roles

Mass transit systems, especially in large cities, are often publicly funded and operated, meaning that government policies are crucial in shaping the direction and efficiency of these systems. In many developed countries, public transit systems are managed by local government agencies, while in others, they may be controlled at the national or regional level (Tiwari et al., 2021).

One of the main policy areas that impact transit operations is transportation planning, which involves strategic decisions about where to build or expand transit infrastructure. Research by Cervero (2020) suggests that effective planning must consider long-term demographic and economic trends, as well as environmental goals. Failure to plan adequately can result in poorly located transit routes, underfunded infrastructure, and inefficiencies in service delivery.

Governance structures also play a significant role in the effectiveness of transit operations. A study by Kumar et al. (2020) found that transit agencies with strong leadership, transparent decision-making processes, and clear accountability mechanisms tend to perform better in terms of efficiency and customer satisfaction. In contrast, fragmented governance structures with overlapping responsibilities can lead to inefficiencies and poor service delivery.

Policy Tools and Incentives

Governments around the world use various policy tools and incentives to

improve mass transit operations. These can include subsidies, tax incentives, and regulatory reforms designed to encourage greater use of public transit and improve its sustainability.

For example, many cities provide subsidies to reduce the cost of public transportation for low-income individuals, seniors, and students (Chen et al., 2021). These subsidies not only make transit more affordable but also promote social inclusion by ensuring that disadvantaged groups have access to essential services. Similarly, some cities offer congestion pricing or other financial incentives to encourage people to use public transportation instead of private cars, thereby reducing traffic congestion and pollution (Zhao & Li, 2020).

International Best Practices

The assessment of mass transit operations can benefit from the examination of international best practices. Various cities around the world have developed innovative policies and strategies that improve transit efficiency and sustainability. For instance, cities like Singapore and Hong Kong have developed world-renowned metro systems that offer high levels of reliability, frequency, and safety, supported by advanced technology and efficient management practices (Yang & Zheng, 2020). These cities also prioritize accessibility, ensuring that public transit is available to all residents, regardless of income level or physical ability.

Lessons learned from international examples can provide valuable insights for cities struggling with similar challenges. For example, the successful implementation of Bus Rapid Transit (BRT) systems in cities like Bogotá, Colombia, and Curitiba, Brazil, has demonstrated the potential of this cost-

effective solution for improving urban mobility (Liu & Wang, 2021).

Future Directions in Mass Transit Research

As cities continue to grow, the demand for efficient and sustainable mass transit systems will only increase. To meet these demands, future research should focus on several emerging areas in the field of mass transit.

9.1 Smart Cities and the Internet of Things (IoT)

The concept of smart cities is closely tied to the future of mass transit. Smart cities use advanced technologies such as the Internet of Things (IoT) to monitor and manage urban systems, including transportation networks. IoT-enabled sensors can collect real-time data from vehicles, passengers, and infrastructure, allowing transit agencies to optimize operations, improve safety, and reduce costs (Ma et al., 2021).

Research in this area will likely focus on developing interoperable technologies that allow different transportation modes—such as buses, trains, and shared mobility services—to work seamlessly together. This will require not only technological innovation but also strong governance frameworks to ensure that data is shared and managed responsibly.

Artificial Intelligence and Machine Learning

Artificial Intelligence (AI) and machine learning (ML) are poised to revolutionize mass transit operations. AI and ML algorithms can be used to predict traffic patterns, optimize routes, and analyze passenger behavior to improve service planning and delivery (Liu & Wang, 2021). As AI technologies evolve, they will also play a key role in autonomous transit systems, helping to reduce operational costs and improve system efficiency.

Sustainability and Green Technology

The transition to green public transportation is expected to be a central theme of future mass transit research. Sustainable technologies such as electric buses, hydrogen fuel cells, and solar-powered transit stations will become increasingly important in reducing the carbon footprint of urban transport systems (Cervero, 2020). Future research will explore the technical, economic, and policy challenges of scaling up these technologies and integrating them into existing systems.

Study Gaps and Future Research Directions

While the body of research on mass transit operations has grown significantly, several study gaps persist that warrant further investigation. These gaps, identified through a synthesis of the existing literature, offer important avenues for advancing the field of mass transit and addressing the challenges faced by urban transportation systems globally.

Integration of Multimodal Transport Systems

One notable gap in the current literature is the integration of multimodal transport systems. Although there is a growing body of research on the performance of individual transit modes (such as buses, metros, and taxis), there is limited research on how these modes can be effectively integrated into a cohesive, multimodal system. As cities grow and the demand for efficient transportation increases, the ability to seamlessly connect different transit options—such as buses, subways, bicycles, and shared mobility services—becomes crucial for enhancing operational efficiency and improving user experience. Future research could explore how cities can design and implement integrated multimodal systems that reduce transfer

times, optimize routing, and enhance service reliability.

Impact of Emerging Technologies

Another area requiring further research is the impact of emerging technologies, such as artificial intelligence (AI), machine learning, and the Internet of Things (IoT), on mass transit operations. While some studies have begun to examine the role of AI in improving operational efficiencies, the long-term implications of AI-driven automation, such as self-driving buses and autonomous metro systems, are still not well understood. The potential for these technologies to disrupt existing operational models and the subsequent need for new regulatory frameworks are crucial topics that have not been explored in-depth. Additionally, the integration of IoT-enabled devices, which collect real-time data to optimize routes and improve service quality, presents an opportunity for further exploration.

Sustainability and Green Transportation Solutions

As urban areas continue to face the pressures of climate change and environmental degradation, the need for sustainable transportation solutions becomes more urgent. While a number of studies have addressed the environmental impact of transportation systems, few have focused on how public transit systems can adopt green technologies and practices in a cost-effective and scalable manner. For example, the transition to electric or hydrogen-powered buses, solar-powered stations, and energy-efficient transport infrastructure remains a challenging and under-researched area, particularly in developing countries. There is a need for comprehensive studies that assess the feasibility, economic impact, and effectiveness of green transit solutions, as well as their long-term environmental benefits.

Social Inclusion and Accessibility

A further gap exists in understanding the relationship between public transit systems and social inclusion, particularly in underserved areas. Although some studies have highlighted the importance of accessibility for disadvantaged groups, including low-income individuals, the elderly, and those with disabilities, there is limited research on the effectiveness of policies designed to ensure equitable access to transit services. Many cities still face challenges in providing reliable and affordable transit services to marginalized communities. Research that explores the accessibility of transit systems from the perspectives of various demographic groups, particularly in rapidly growing urban environments, could provide valuable insights for policymakers and transit agencies.

Passenger Behavior and Satisfaction

While numerous studies have explored factors that influence passenger satisfaction—such as travel time, comfort, and safety—few have delved deeply into the psychological and behavioral aspects of passenger decision-making in the context of mass transit. Understanding why passengers choose public transportation over private modes of transport, their willingness to tolerate delays, or their preferences for certain routes and services is essential for designing more user-centric transit systems. There is also a need for longitudinal studies that track changes in passenger behavior over time, particularly as cities implement new technologies and policies aimed at improving service quality.

Governance and Policy Innovation

Finally, governance structures and policy innovation remain under-explored

in the context of mass transit operations. While studies on transit governance have typically focused on the roles of government agencies and public-private partnerships, there is a lack of research on innovative policy frameworks that can address complex challenges such as funding, sustainability, and service coordination. Moreover, as cities around the world adopt new governance models for public transit, research is needed to evaluate the effectiveness of these approaches and their impact on system performance. Further work could explore alternative funding mechanisms, such as congestion pricing or fare-free systems, and their potential to improve both the financial sustainability and efficiency of mass transit operations.

Conclusion

In conclusion, although significant progress has been made in understanding mass transit operations, several critical gaps remain in the literature. The integration of multimodal transport, the impact of emerging technologies, sustainable practices, social inclusion, passenger behavior, and innovative governance policies represent key areas where further research is needed. Addressing these gaps will not only contribute to the academic field but also provide valuable insights for policymakers, transit agencies, and urban planners working to develop more efficient, sustainable, and inclusive public transportation systems. Future research efforts in these areas will be essential for shaping the next generation of mass transit systems that can meet the growing demands of urban populations while supporting

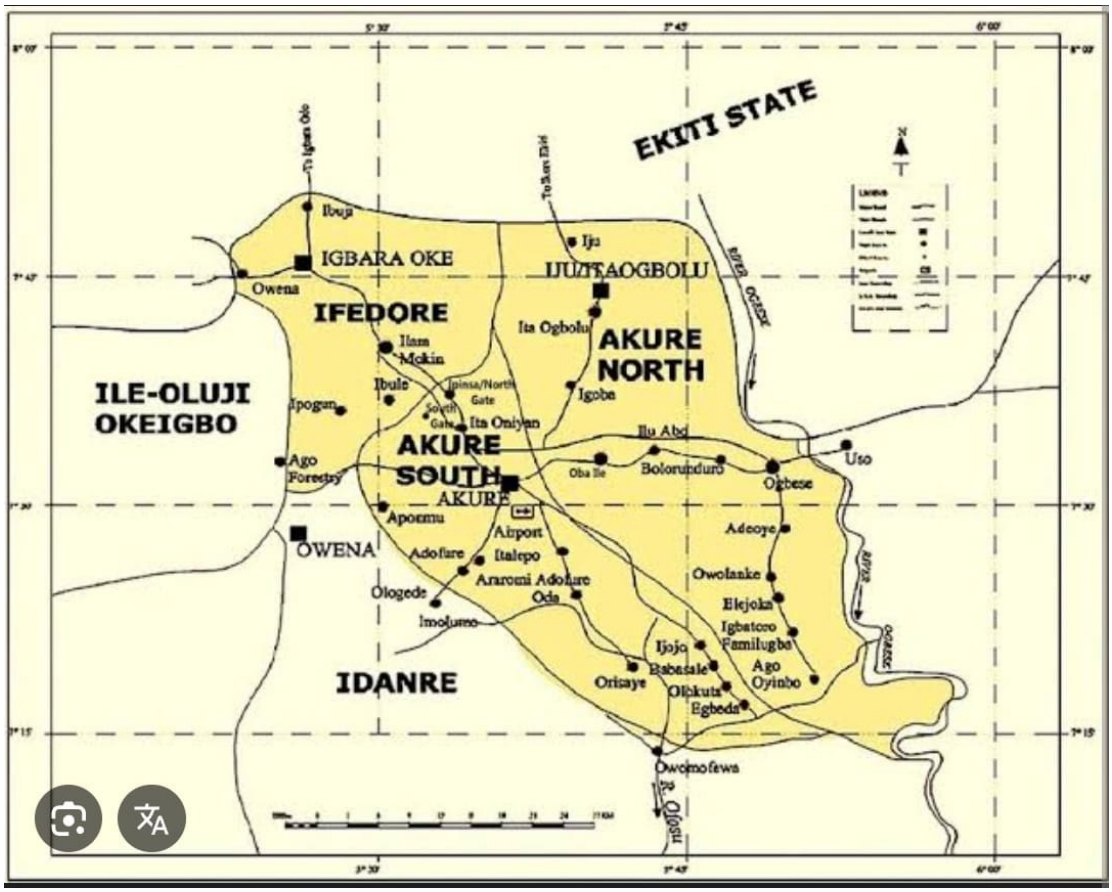
sustainable development goals.

3.0 Chapter Three: Methodology

3.1 Research Design

This study adopted a descriptive survey research design. This design was considered suitable because it allowed for the collection of data from a cross-section of Akure residents, transport operators, and stakeholders to understand the challenges affecting mass transit operations in the city. The descriptive approach enabled the researcher to examine current patterns, opinions, and issues within the public transport sector.

3.2 Study Area



The research was conducted in Akure, the capital city of Ondo State, Nigeria. Akure, being a rapidly expanding urban centre, was selected due to its increasing population, growing vehicular traffic, and high demand for public transportation services. The city featured a mix of both formal and informal transit systems, including minibuses, taxis, motorcycles (okadas), and tricycles (keke napep), making it a relevant context for the study.

3.3 Population of the Study

The target population for the study included:

- Commuters who regularly used public transport in Akure.
- Para-transit operators such as motorcycle and tricycle riders.
- Leaders from transport unions, particularly the National Union of Road Transport Workers (NURTW).

- Officials from the Ondo State Ministry of Transport.

This diverse group provided a comprehensive view of the challenges and experiences across different sectors of the city's transportation system.

3.4 Sampling Frame

The sampling frame consisted of:

- Major transit locations such as Oba Adesida Road, FUTA Junction, Oja-Oba, and Arakale.
- Transport union offices.
- Informal parking areas and operational bases for okada and keke riders.

These locations represented the focal points of mass transit activity within Akure.

3.5 Sample Size Determination

A total of 150 respondents were selected for the study:

- 100 commuters,
- 30 para-transit operators,
- 10 union leaders and officials,
- 10 government transport officers.

This sample size was considered sufficient to represent the target population while maintaining manageability.

3.6 Sampling Technique

The study employed a multi-stage sampling technique:

- Stage One: Purposive sampling was used to identify high-traffic transit locations.
- Stage Two: Stratified sampling was employed to divide respondents into relevant groups.
- Stage Three: Simple random sampling was applied to select individuals from each group, ensuring fair representation.

3.7 Research Instrument

The main research instruments included:

- Structured questionnaires, which were administered to commuters and para-transit operators.
- Interview guides, which were used to collect detailed responses from union leaders and officials.

The questionnaire contained both open-ended and closed-ended questions, allowing for a combination of quantitative and qualitative data.

3.8 Method of Data Collection

Data were collected through the administration of questionnaires and conducting of face-to-face interviews. Trained research assistants were engaged to assist with the distribution of questionnaires, particularly in crowded or informal settings. Data collection spanned a three-week period.

3.9 Method of Data Analysis

Quantitative data from the questionnaires were analyzed using descriptive statistics such as frequencies, percentages, and charts, with the aid of SPSS software.

Qualitative data from interviews were analyzed using thematic analysis,

which involved identifying, organizing, and interpreting themes and patterns within the responses.

4.0 Chapter Four: Data Presentation, Analysis and Interpretation

4.1 Introduction

This chapter presents, analyzes, and interprets the data collected through structured questionnaires and interviews with key stakeholders in Akure's mass transit system. The analysis is guided by the study objectives and research questions. A total of 150 respondents participated in the study, comprising commuters, para-transit operators, union leaders, and officials from the Ondo State Ministry of Transport.

4.2 Demographic Characteristics of Respondents

Understanding the demographic background of respondents is essential for interpreting their responses in context. The demographic data collected

include age, gender, occupation, and frequency of public transport usage.

Variable	Category	Frequency	Percentage (%)
Gender	Male	92	61.3
	Female	58	38.7
Age	18–25	22	14.7
	26–35	46	30.7
	36–45	48	32.0
	46+	34	22.6
Occupation	Student	26	17.3
	Trader	40	26.7
	Civil Servant	42	28.0
	Driver/ Operator	30	20.0
	Others	12	8.0

4.3 Analysis Based on Research Objectives

Objective 1: To assess how urban growth has affected mass transit operations in Akure

Respondents were asked whether urban expansion in Akure has influenced public transport operations.

Response	Frequency	Percentage (%)
Yes	124	82.7

No	26	17.3

Interpretation:

A large majority (82.7%) believed that urban expansion has significantly affected mass transit operations. During interviews, respondents noted that increased housing developments and business centres in peripheral areas of the city have led to longer travel times and rising demand for public transportation services, which current systems struggle to meet.

Objective 2: To identify the challenges faced by para-transit operators in Akure

Para-transit operators were asked about the major operational challenges they face.

Challenges Identified	Frequency	Percentage (%)
Poor road conditions	25	83.3
Multiple taxation/ levies	20	66.7
Harassment from unions	16	53.3
Lack of regulation	18	60.0

Interpretation:

Operators highlighted poor road infrastructure, excessive levies, and lack of

proper regulatory oversight as major barriers to efficient operations. One tricycle rider interviewed said:

“Every day we pay to union officials, sometimes for tickets, sometimes without reason, and the roads are not helping either.”

Objective 3: To examine how infrastructural and organizational issues impact transit efficiency

Commuters and officials were asked to evaluate the impact of infrastructure and union issues on transit service quality.

Issue	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Poor roads delay transport	68	54	18	6	4
Union conflicts cause disruption	60	50	22	12	6
Insufficient terminals/ bus stops	72	46	20	8	4

Interpretation:

Over 80% of respondents agreed that infrastructure deficits such as poor

roads and lack of designated stops affect efficiency. Also, transport union disputes often disrupt operations. Interviewed officials emphasized the need for greater government oversight and infrastructure investment.

Objective 4: To propose strategies for improving public transport in Akure Respondents were asked to suggest improvements to the mass transit system. Common themes from open-ended responses and interviews include:

- Upgrading road infrastructure
- Introducing city buses and formal transit systems
- Regulating para-transit operations
- Reducing internal union conflicts
- Training drivers on safety and customer service

Interpretation:

The general consensus is that formalizing and expanding the public transport system with proper investment in roads and regulation would greatly enhance service delivery. Respondents also emphasized the importance of a central body to manage both formal and informal transport actors.

4.4 Summary of Findings

- Urban growth has significantly increased pressure on existing transport systems.
- Para-transit operators face infrastructural, financial, and regulatory challenges.
- Infrastructural deficits and union disputes negatively affect transit efficiency.
- Stakeholders support strategies such as infrastructure upgrades, formalized systems, and better regulation to improve mass transit.

Chapter Five: Summary, Conclusion and Recommendations

5.1 Summary of Findings

This study assessed mass transit operations in Akure, the capital of Ondo State, Nigeria, focusing on the impact of urban growth, the challenges of para-transit systems, infrastructural and organizational bottlenecks, and strategies for improvement. The research employed a descriptive survey method, using structured questionnaires and interviews with commuters, transport operators, and officials.

Key findings include:

- Urban expansion in Akure has significantly increased the demand for mass transit services, with existing systems struggling to cope.
- Para-transit operators such as motorcycle and tricycle riders face numerous challenges including poor road conditions, multiple taxation, lack of formal regulation, and harassment from union officials.

- Infrastructure deficits, such as inadequate road networks and absence of designated bus terminals, along with internal conflicts within transport unions, negatively impact the efficiency of public transportation.
- Respondents supported a range of improvement strategies, including road upgrades, introduction of formal city bus systems, better regulatory oversight, and capacity-building initiatives for transport workers.

5.2 Conclusion

The study concludes that Akure's mass transit system is under considerable strain due to rapid urban growth, unregulated para-transit operations, and weak infrastructure. Informal transport systems currently dominate, yet lack the structure and efficiency needed to meet growing commuter demands. Additionally, organizational conflicts and poor coordination among unions further hinder smooth operations.

Addressing these issues requires a collaborative approach involving the government, transport unions, and private sector stakeholders. Without significant reforms and investment, Akure's mass transit sector will continue to struggle, impeding economic productivity and commuter well-being.

5.3 Recommendations

Based on the findings, the following recommendations are made to improve mass transit operations in Akure:

1. Infrastructure Development
    - The Ondo State Government should prioritize the construction and rehabilitation of key transport roads within the city.
    - Designated terminals and bus stops should be constructed to organize and control transit flow, reduce congestion, and ensure commuter safety.
2. Introduction of Formal Mass Transit Systems
    - Public-private partnerships (PPPs) should be explored to introduce reliable, government-regulated city bus services that are affordable and accessible to all.
3. Regulation of Para-Transit Operations
    - A formal registration and licensing framework should be developed for motorcycle and tricycle operators.
    - Periodic training and safety workshops should be mandatory for all operators to enhance professionalism and service quality.
4. Streamlining Transport Unions
    - The government should mediate existing conflicts within transport unions and implement a centralized monitoring system to reduce duplication of levies and internal power struggles.
    - Transparent systems of dues collection and grievance reporting should be established.
5. Stakeholder Collaboration and Policy Reform
    - A Transport Development Committee should be established in Akure to include urban planners, union leaders, transport

officials, and community members.

- Updated policies should reflect emerging urban realities and global best practices in sustainable urban mobility.

5.4 Suggestions for Further Research

Future studies could explore the environmental impact of Akure's current transport practices, assess the feasibility of implementing smart mobility technologies, or examine gender-based experiences within the city's transit system.

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