

Reconceptualising Multimodal Transport Integration for Efficient Inter- and Intra-Urban Mobility in Lagos State, Nigeria

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ABSTRACT

Lagos, Nigeria, is one of the most rapidly developing megacities in the world, where rapid population growth has outpaced the development of transport infrastructure. This study examines inefficiencies in the Lagos transport system, which is typified by a road-dominant network, disjointed modal operations, and dependence on informal transport. Methodologically, the study is based on the qualitative meta-synthesis of secondary data. It examines the nature of inter- and intra-urban mobility, institutional and infrastructural factors that impede multimodal integration, and the interactions between formal and informal transport systems. Data was analysed using thematic content analysis to identify, analyse, and report patterns by systematically coding key findings into overarching themes. The results revealed that the main problem is not infrastructural deficit but the absence of a unified, system-level system of transport. Even though there have been investments in Bus Rapid Transit and Urban rail system in recent times, systemic integration has not been achieved, leading to traffic congestion, loss in productivity and socio-spatial disparities. The study recommends a Unified Multimodal Mobility system that incorporates infrastructure, governance, technology and user-centred design. The study adds to the existing research on urban mobility in the Global South by promoting a context-specific multimodal integration. In order for Lagos to have an effective and sustainable urban mobility plan, there must be a significant change towards transport planning with more emphasis on coordinating, being inclusive and achieving greater regional connectivity.

Keywords: Multimodal Transport, Lagos Megacity, Transport Integration, Sustainable Transport Systems, Urban Mobility,

1. INTRODUCTION

1.1 Background of the Study

In the global urban system, Lagos is a megacity where rapid population growth has outpaced the ability of institutions to provide adequate amenities and infrastructure. Its population of more than 15 million and an estimated annual growth of almost 3.2% mean that by 2100, Lagos will be the most populous city in the world (Oliver Wyman Forum, 2022). The human population density creates an astounding 172 billion kilometres of travel need every year, subjecting a crunching load to a transport framework that is geographically restricted by the lagoon-bound topography of the city (Macaulay, 2025). The mobility crisis in Lagos is not simply an inconvenience; it is a structural failure of urban structure and city governance. This persistent strain on infrastructure has led to the widespread reliance on informal transport systems to meet the city's growing mobility demands.

The informal transport means, which are made up of the Danfo (Minibuses), Korope (shuttle buses), and motorcycles (Okada), serve as critical elements of the Lagos Transport system. Although earlier studies saw these transport modes as temporary solutions, recent scholars argue that they show the failure of formal transport planning (Oshodi and Salau, 2016). This is evaluated as an informal mode of competition, which is

examined as predatory competition where the operators compete to get passengers in a manner that prevents traffic flow and jeopardises safety. But since these transport means provide a wide degree of connectivity, globally, of a capillary nature, which cannot be achieved by formal Bus Rapid Transit (BRT), they are indispensable. This forms a type of modal dualism, a collision between the state wishing to have a modern, controlled image of transport and the anarchy of everyday commuter survival (Lawanson, 2018).

During the past twenty years, Lagos State Government, through the Lagos Metropolitan Area Transport Authority (LAMATA), has made efforts to formalise mobility under the Lagos Urban Transport Project (LUTP) (Kumar, 2013; Mobereola, 2016; and LAMATA, 2022). This has introduced the first BRT system in Africa in 2008 and, more recently, the multi-billion railway lines, Blue and Red (Ozioma and McSharry, 2021). However, projects have been carried out as fragmented corridors and not a coordinated platform. An example is that even though the rail lines suggest a giant step up in terms of hard infrastructure, they tend to end where other hubs have inadequacy of integration of the soft infrastructure, including integrated water or bus terminals, digital ticketing, and pedestrian pathways that are safe to use (Macaulay, 2025). This intermodal non-fluidity implies that the last-mile journey is the most costly and time-intensive stage for commuters in Lagos.

Moreover, the extent of mobility in Lagos should be viewed in the context of inter-urban vs. intra-urban processes. Lagos forms the heart of a regional conurbation which extends into Ogun State. The border-town phenomenon, in which the population resides in Akute, Alagbole, Agbado, Olowora, Ibafo, Mowe, Arepo, Banku, and Magboro but commutes to Lagos, has led to wide tidal waves of traffic that are not considered by the existing intra-city planning (Danne Institute for Research, 2023). Such inter-urban commuters are in many cases compelled to use the same clogged arteries as intra-city travellers and the end result suggests what the city planners call the gateway point, such as Berger and the Lagos-Badagry Motorway. The inability to conceptualise Lagos transport as a regional, multi-modal ecosystem to include water, rail and road across state borders is an inherent gap in the contemporary transport policy frameworks.

1.2 Statement of the Problem

The wider discipline of transport and mobility has increasingly realised that mobility is not technically or logistically a mere problem but a socially organised process, which is determined by inequality, power relations, and practices of everyday life (Kaufmann, 2017; Hidayati, 2021). The equality of mobility, transport disadvantage, and unequal access to movement opportunities are the concepts that international scholarship has examined, including the impact of socio-economic status, gender, and occupation on travel behaviour and mobility consequences (Hidayati, 2021; Kristensen *et al.*, 2023). There has been tremendous focus on the social aspects of mobility, especially in the Global North cities. Efforts notwithstanding, critical gaps in the available literature on Lagos State still exist. To begin with, although research on transport in Lagos has been dominated by studies on infrastructure avenues, system efficiency, and policy provisions, there has not been much sociological involvement in determining how residents use and experience multimodal transport systems in daily activities. Multimodal transport is often regarded as a planning or operational concept, instead of a social context, where mobility practices are created, negotiated, and patterned (Fan *et al.*, 2025 and Günther *et al.*, 2020). . In addition, several studies have been conducted with regard to informal transport systems, with most having treated these as stand-alone systems rather than as part of an integrated transportation system (Robert Cervero, 2000; Graham Currie and Alexa Delbosc, 2011). There has, however, been a limited amount of research examining the interrelationships between both formal and informal transport modes within an integrated multimodal system and how these interrelations do, in fact, create shared spatial configurations and distinctive urban mobility patterns for various populations (Tanya Behrens, 2014; David Satterthwaite, 2010). As such, most of the research mentioned above do not provide an adequate understanding of how people use existing transport modes of various types at the same time and under certain constraints and, therefore, how their subsequent decision-making impacts their overall social and spatial context (Tim Cresswell, 2010; Mimi Sheller and John Urry, 2006). Besides, the interplay of the formal and in-

formal transport systems presents some more layers of complexity that have not been adequately theorised in existing literature. The informal transport modes cannot be simply examined as residual or temporary systems; they are institutionalised and socially ingrained and are adaptive behaviours to the systemic restrictions of a city and unequal access to formal forms of transport (Afolabi and Akibo, 2020). Multimodal transport needs to be examined sociologically to gain sociological insight into urban mobility in African megacities, as well as to advocate for more socially responsible transport governance and planning. The study examines multimodal transport systems and urban mobility trends in Lagos State, Nigeria. The paper seeks to answer the following questions among others

- What is the current state of multimodal transport systems in Lagos?
- What factors limit effective integration of transport modes?
- How do inter-urban and intra-urban mobility systems interact in Lagos?

The specific objectives of the paper are to:

- ◆ critically review existing multimodal transport systems in Lagos.
- ◆ analyse the structure and dynamics of inter- and intra-urban mobility patterns.
- ◆ identify key barriers to multimodal integration, including institutional and infrastructural constraints, and,
- ◆ formulate an operational framework for strengthening multimodal transport integration in Lagos.

1.3 Significance of the Study

The significance of the current research is that it has the potential to shape the paradigm of the urban planning of Lagos to be shifted towards a coherent, systems-based view, rather than a fragmented, modal-specific one. Theoretically, the study adds to the ever-building literature on Sustainable Urban Mobility (SUM) in the Global South through the deconstructive analysis of the modal-informal nexus. It opposes the mainstream Eurocentric Transit-Orientated Development (TOD) paradigm, providing a subtle reconceptualisation of the extensive high-density and resource-limited setting of an African megacity. Theorising the interstitial logic of multimodal transitions, the study seals a gap in the academic literature on how the utility of "hard" infrastructure (rail and road) can be enhanced by the application of a concept of

soft integration (digital systems and institutional policy).

In practice, the study is a strategic blueprint for the Lagos Metropolitan Area Transport Authority (LAMATA) and other stakeholders in the region by offering evidence-based ideas on how to address the existing inefficiencies. It provides a scalable framework of the Integrated Mobility-As-A-Service (IMaaS) that is necessary to ease the current 264-vehicle-per-kilometre density of the state, which is currently crippling the state.

2. LITERATURE REVIEW

2.1 Multimodal Transport Systems and Sustainable Urban Mobility (SUM)

The conceptual foundation of the current research is based on multimodal transport systems, according to which urban performance is not the result of the speed of each specific transport mode but rather a combination of the relationships between multimodal transport nodes (Kadem *et al.*, 2024). In the case of a megacity such as Lagos, the network effect, in which a system has more value as more people join it, indicates that it is no longer in place. This is also to be supplemented with the Sustainable Urban Mobility (SUM) model, where the focus is on access and not movement. According to Banister (2008) in his work about the sustainable mobility paradigm, the aim of any urban transportation is to minimise the necessity of motorised movement and provide smooth transitions to people who are forced to move. The BRT and rail line developments in Lagos violate this theory by putting commuters in the so-called modal traps, which they can only leave without losing much in terms of time and money (Ozioma and McSharry, 2021).

2.2 Sustainable Urban Mobility (SUM) Paradigm

The SUM paradigm, which was introduced by Banister (2008), changes the mission of urban planning (building more roads to satisfy the needs of more cars) to the one of access and integration. SUM focuses more on people than vehicles, and it has four main pillars, namely (1) substitution (lessening the necessity to travel), (2) modal shift (replacing private cars with public transit), (3) efficiency (fluid multimodal integration), and (4) inclusiveness (accessibility to all socio-economic

groups). The critical use of SUM in Lagos indicates that the existing system is auto-centric and inclusionary. The system confines the urban poor to lengthy and multiphase commutes, as 264 vehicles per kilometre (Danne Institute, 2019) are trapped by the system, with the growing middle class not taking public transportation because of inadequate interconnectivity and the last-mile problem. SUM offers the normative paradigm to claim that Lagos will not be able to develop its way out of congestion but needs to combine its way to a sustainable environment (Oliver Wyman Forum, 2022).

2.3 The "Informal-Formal Nexus" and the Politics of Reform

One theme that is prevalent in the West African literature on transport is the conflict between state-imposed modernisation and the hardy informal sector. Agbiboa (2017) critically deconstructs the war on Agberos (informal touts) to state that, when the Lagos State Government is trying to formalise mobility, it usually fails to recognise the social infrastructure that the informal sector offers. The state regards the presence of Danfos and Okadas as a hindrance to a megacity aesthetic, but Oshodi and Salau (2016) show that the informal transport system offers forms of connectivity in the form of capillaries that the formal BRT cannot mimic.

Research shows that urban transport systems in many developing cities are characterised by the existence of both formal and informal systems. The formal systems are usually supported by the state, while the informal systems exist to serve the greater numbers of urban residents who cannot obtain transportation in the same manner as the general urban population (Agbiboa, 2020; Tucho Gudina Terefe, 2022). Within a dual transportation system, the formal transportation systems usually include, but are not limited to, rail and Bus Rapid Transit (BRT). These types of formal transportation systems will generally serve a small number of customers and reflect a pre-planned and established pattern of mobility, whereas the informal transportation systems will provide the greatest number of low-income and underprivileged persons access to flexibility and mobility throughout urban areas, but applying regulatory measures to their operation is difficult (Agbiboa, 2022 and Rekhviashvili, 2020).

There is much debate about the place of informal transport in Lagos – for example, the role of Danfo, Korope, and Okadas. Historically, the government's approach to informal transport has classified it as a develop-

ment issue (Muinat Agunbiade, 2018). However, researchers (Agbiboa 2017, Oshodi and Salau 2016) argue that the formal approach to transport fails to consider the reality of many low-income residents who depend on these informal modes for their daily mobility. Furthermore, informal transport is a vital connection for many people travelling the last mile from public transport in Lagos, particularly in densely populated and poorly serviced communities where formal transit services like the BRT may not be able to provide last mile service (Agbiboa, 2017). Government efforts to formalise the informal transport sector have included initiatives such as the ban of Okadas, which have been expressed as socially exclusionary as they present a higher risk of "transport poverty" by removing reasonable, affordable and flexible transportation options without the provision of viable replacement options (Agbiboa 2017).

In comparison to other cities in Africa, studies regarding urban mobility indicate that informal transport systems comprise a necessary component of urban transport systems; however, they have little regulation and operate outside the parameters of other transportation systems (Behrens and Satterthwaite 2010). Informal transport cannot completely replace formal transport systems; therefore, efforts should be directed towards better regulation of and integration into the larger formal transport system so that informal transport can operate efficiently as a continuation of the formal transport system (Lawanson 2017).

2.4 The "Last-Mile" Problem and Interstitial Fragmentation

One of the gaps in the existing research is that it does not place emphasis on the interstitial spaces, the places of physical and digital connection between modes. In his review of the first BRT in Africa, Mobereola (2009) observed that the hardware (dedicated lanes) was working, but the software (feeder systems) was nevertheless poor. Later critical analysis by Kumar and Agarwal (2013) points to the fact that institutional settings in Lagos predispose the agency capture, with LAMATA (bus/rail) and LASWA (water) having overlapping jurisdictions but little technical interoperability.

This leads to the so-called last-mile problem, in which a commuter can gain time by using a high-speed ferry and lose all of it standing at a terminal because an inefficient bus is taking its time, which Macaulay (2025) calls a systemic friction.

In the past few years most of the transport investment in Lagos has occurred in large-scale infrastructure projects such as rail and ferry terminals, of which these projects are undermined by persistent last-mile problems. Ozioma and McSharry (2021) examine the demand of public transit and discover that commuters are very sensitive to the concept referred to as 'interstitial friction', which is the inconvenience of getting to a transit hub and the inconvenience of getting to the destination. This is a lot of friction in Lagos. According to Macaulay (2025), commuters getting to the Church Missionary Society (CMS) ferry terminal via Ikorodu can hardly avail themselves of the Blue Line Rail or a synchronised BRT bus without a tedious walk or an expensive Danfo ride.

The absence of a unifying link among multiple means of transportation (including physical structures and digital infrastructure) aside from the financial system, which is the Cowry Card, inhibits the degree to which transportation systems can be characterised as having an end-user focus and a comprehensive interface. More broadly, research into transportation system performance in the Global South demonstrates that both last-mile (and some similar terms) connectivity and intermodal interfaces are still inadequately addressed (Behrens *et al.*, 2016 and Cresswell, 2010). Thus, this study addresses this gap by examining the influence of integrated intermodal access on daily inter-urban and intra-urban mobility patterns in Lagos.

2.5 Inter-Urban vs. Intra-Urban Mobility Dynamics

One of the most important and yet critical themes that come out in the recent literature is the relationship between intra-urban and inter-urban (regional) mobility flows (Glaeser, 2011; Hall and Pain, 2006; Parnell and Pieterse, 2014).

Most research conducted on transportation in Lagos has been conducted primarily from the viewpoint of the city itself. Very little focus has been placed on other areas of the metropolitan region, especially with neighbouring Ogun State (Lawanson, 2017; Agbiboa, 2017; Oshodi and Salau, 2016). The city-centred focus does not account for the daily "tidal" movement of commuters between Lagos and nearby areas in Ogun State.

This limitation is corroborated by the Danne Institute for Research (2021), which identifies a "border town bottleneck" at the edge of Lagos' metropolitan area. Poor performance along major interurban routes, such as the Lagos-Ibadan Motorway, has caused serious congestion on the motorways within Lagos itself.

Also noted in studies of rapidly developing African metropolitan areas is that there remains no cohesive framework to manage large, multi-jurisdictional urban areas, such as Lagos and the adjacent communities in Ogun State (Parnell and Pieterse, 2014; Simone, 2004). In many city planning efforts, the boundary between Lagos and Ogun continues to be treated as an administrative boundary rather than as a functional metropolitan area (Hall and Pain, 2006).

The need for regional multimodal integration strategies to sustain economic productivity and maintain steady-state systems in core metropolitan areas is if global megacities are to survive the next few decades (Oliver Wyman Forum, 2022). Evidence has been provided in the form of Danne Institute for Research (2021, 2023) to provide specific data detailing how Lagos operates as a continuously flowing into and out of, not as a closed system, thus creating enormous strain upon the transportation network that connects the city with surrounding localities due to the sheer size of the volume of commuters from Mowe, Ibafo and Sango-Ota, as they create additional demand for limited resources daily (especially concentrated at gateway corridors including Berger and Lagos-Badagry Motorway, which serve as essential access points into the metropolitan portion of Lagos).

2.6 Digital Integration and the "FinTech" of Transport

Digital technologies are seen increasingly as an important aspect of improving how transport modes interact in cities. For example, recent studies are researching developments within urban mobility that focus on Mobility-as-a-Service (MaaS). With MaaS, digital platforms integrate various transport options (e.g., buses, rail, ferries) into one seamless user system (MaaS Alliance, 2020; MaaS Global, 2019; Hietanen, 2014). Therefore, the development of MaaS is especially relevant for cities

like Lagos, which have also become a focal point for the development of financial services technology (e.g., payment options, mobile money).

Several studies have also shown that digital payments (e.g., Cowry Card) have the potential to improve the connection between both formal and informal transport systems because passengers can use digital payments to pay for their journeys on formal bus services (Okonkwo and McSharry, 2021). However, digital payment systems are generally limited to formal transport modes and do not apply to informal modes (e.g., Danfo, Korope, Okada, and tricycle services) – these modes generally accept only cash. This divide presents a challenge when attempting to integrate the transport system through digital means and, as such, reduces the effectiveness of overall transport integration. The pessimistic view of Kadem *et al.* (2024) implies that the digital integration (combinations of payment and real-time scheduling information) is the connective tissue that transforms the disparate hardware (rail, road, and water) into a single and cohesive ecosystem.

Digitalisation also ties in with the issues of unequal access to digital infrastructure. Studies have shown that if informal operators are not included in the digitalisation of transport systems, they will only enhance a limited part of the transport network (MaaS Global, 2019; Shaheen and Cohen, 2020). Digitalisation is viewed as interconnectedness between various transit modalities (rail, road, and water) via a "connective layer", such as having unified payment systems, real-time travel information, and coordinated scheduling (Currie, 2021, and Hensher, 2020). However, this requires the inclusion of both formal and informal transit systems.

From an overall viewpoint, studies on the transportation system in the Global South have shown that digitalisation may have the capability to bridge the gap between informal and formal transport systems but will need to be created to include all operators, instead of perpetuating further inequalities (Behrens *et al.*, 2016; Sheller and Urry, 2006). Otherwise, digital transport systems will only assist the formal transport systems and continue to leave the informal transport system out of the equation.

3. METHODOLOGY

The study adopts the desk review approach in exploring the integration of multimodal transport and the dynamics of mobility in Lagos, Nigeria. The desk review approach used is appropriate for studies that sought to synthesise existing knowledge, generate evidence-based findings, and examine patterns without collecting primary data (Snyder, 2019). The desk review method is a widely used approach in urban and transport studies in analysing complex systems where elaborate secondary data and already existing empirical research exist (Grant and Booth, 2009).

3.1 Research Design

In order to implement a systematic and integrative review approach, the study adopts a systematic literature review and narrative synthesis. The systematic and integrative design enables the use of structure-relevant studies for identification, evaluation and synthesis, enabling the understanding of the context of findings and maintaining continuity throughout (Torraco, 2005 and Snyder, 2019).

3.2 Data Sources and Search Strategy

In order to collect data, the study accessed high-quality academic resources such as Scopus, Web of Science, ScienceDirect, JSTOR and Google Scholar, as well as institutional and policy reports from organisations like the Lagos Metropolitan Area Transport Authority (LAMATA) and the World Bank. The study employed a keyword and Boolean search strategy with related terms, such as multimodal transport, urban mobility, transport integration, Lagos transport system, BRT Lagos, urban transport Africa, and mobility as a service. The study limited its search strategy to peer-reviewed journal articles, conference papers, and credible policy documents published between 2015 and 2025. The search was limited to ensure relevance and currency.

3.3 Inclusion and Exclusion Criteria

In order to maintain a high level of quality and continued relevance, studies were selected according to the following criteria: (1) the focus of the study should be on urban transport systems and/or multimodal integration; (2) the relevance of the study should be for Lagos, Nigeria, or cities in the Global South that are similar to Lagos; (3) the study must

have been published in a peer-reviewed journal or by a reputable institution; and (4) the full text of the study must be available in the English language. Studies that are not scholarly, opinion pieces that do not have any type of empirical or theoretical basis, and studies that do not have a clear methodology were excluded from consideration.

3.4 Data Extraction and Analysis

Relevant studies were systematically reviewed, and key information was extracted, including the authorship, location of the study, method(s) used, key findings, and implications for the integration of multimodal transport. The analysis used a thematic synthesis approach which identified themes and recurring patterns from the literature (Thomas and Harden, 2008). Themes were then discussed in relation to each of the study objectives, i.e., the structure of transport systems, mobility patterns, barriers to integration and practical strategies for improvement. Furthermore, the study uses the comparative lens of examining urban areas of the Sub-Saharan Africa region and other developing areas, and hence it identifies commonalities and contextual differences that are relevant to Lagos.

4. RESULTS AND DISCUSSION

4.1 Critical Review of Existing Multimodal Transport Systems

Findings indicate that Lagos has an immature, though developing, multimodal transport system, which includes road transport, rail transport and water transport. The system is, however, too dominated by road transport.

Empirical data show that more than 90% of passenger and cargo traffic in Lagos is carried out through road transport, and informal transportation (minibuses, also known as 'Danfo') takes up a significant share of mobility (Lawanson, 2018). Recent policy experiences also corroborate that three-quarters of transport through roads are informal, as the institutionalisation of structured public transport is weak (LAMATA, 2025). This informal transport dominance underscores the low states of integration between modes as well as the lack of multimodal coordination.

The launch of the Bus Rapid Transit (BRT) system in 2008 was a huge milestone in the development of transport in Lagos. The results indicate that the

BRT system has enhanced efficiency, affordability, and accessibility for commuters (Oluwakoya, 2008). Recent investigations of the Ikorodu CMS corridor show that BRT has improved user satisfaction and decreased commuting time, but the issues of overcrowding and service quality remain (Akintola *et al.*, 2024).

The BRT system takes a very small share of total mobility demand. There is also evidence that BRT is an extremely small portion of the total road traffic, which means it cannot match the size of the population and transport demand in Lagos (Lawanson, 2018). The inadequacy of single-mode interventions to deal with systemic mobility issues was indicated.

The Lagos Blue Line rail transport is an important progression toward expanding mobility options in Lagos. Multiple studies have demonstrated that rail systems decrease traffic congestion and create travel efficiencies by offering quicker and more dependable transport options (e.g., Vuchic 2007, Cervero 1998, Oyesiku 2012). However, the current rail system coverage in Lagos is limited and substantially reduces any impact on mobility throughout Lagos City (Lagos Metropolitan Area Transport Authority 2023; Lawanson 2017).

While Lagos has an adequate coastal and lagoon geography that may provide suitable conditions for water transport, the ferry system is underdeveloped due to circumstances surrounding the lack of supporting infrastructure and limitations related to policy (Sustainable Urban Transport Project 2015; World Bank Transport Team 2014). Due to these limitations, maritime transport options are not a significant part of the mobility system in Lagos even though they have the potential to alleviate some of the congestion citywide.

Based on research performed on transportation planning, Lagos has established parts of a multimodal transportation system, but this system remains fragmented and dominated by road-based travel (Agbiboa 2017; Oshodi and Salau 2016). The inadequate coordination of the rail, road and maritime transportation systems in Lagos creates a low level of effectiveness among the mobility reform efforts currently being implemented throughout the city and contributes significantly to the inability of those efforts to address urban congestion.

4.2 Inter- and Intra-Urban Mobility Dynamics

The mobility pattern analysis shows that Lagos has complex, hierarchical, and spatially uneven mobility dynamics, which are determined by the rapid urbanisation

tion, economic concentration, and infrastructural constraints.

The population growth and urbanisation of Lagos have tremendously raised the demand for travelling. Research indicates that the population of the city, estimated to be more than 15 million, is leading to high rates of daily commuting, which are characterised by lengthy waiting times and uncertain commuting times (Paul and McSharry, 2021). These inefficiencies have promoted a change towards individual vehicle ownership and informal forms of transport that further worsens congestion.

The majority of intra-city transportation in Lagos is through corridors/radial routes. Everyday transit is primarily along main transport routes that connect residential suburbs to major commercial centres, including Ikeja and Lagos Island (Lawanson, 2017; Agbibo, 2017; Agbola, 2006). This indicates that commuting occurs along only a small number of high-demand corridors (compared with the city as a whole) and that commuting patterns are not dispersed throughout all parts of the city. Zonal and hierarchical movement patterns exist for the movement of both freight and passengers. Certain areas are typically strong nodes of economic/transportation activity while other areas function predominantly as residential or peripheral zones (Hall and Pain, 2006 and Glaeser, 2011). As a result of this zone/hierarchical pattern, a strong "hierarchy" is established, resulting in mobility being strongly structured around a few corridors/activity centres.

Temporal mobility patterns also indicate that there is peak-hour congestion, where the demand is concentrated in the morning and evening commuting hours. Empirical modelling work suggests that waiting times can be dramatically decreased by the transport service dynamic scheduling model, by up to 8%, which points at the inefficiency of existing transport systems based on their fixed schedule (Paul and McSharry, 2021). The inter-urban transport patterns, especially between Lagos and its environs (e.g., Ogun State in particular), are also defined by excessive use of road transport. The absence of interconnecting rail and regional transport systems restricts effective inter-city connectivity, which supports congestion on major highways (Lawanson 2017; Agbibo 2017; Oshodi Salau 2016). Mobility patterns are also influenced by socio-economic factors. Studies show that the use of transport

differs greatly according to income level, employment, and household features, with the populations with lower income depending more on the informal and public transport (Salau 2015; Cervero 2000; Satterthwaite 2010). This depicts the problem of access and equity in the transport systems in Lagos.

4.3 Barriers to Multimodal Integration

The study shows that there are a number of significant obstacles to effective multimodal transport integration in Lagos which can be generally divided into infrastructural, institutional, operational, and socio-economic barriers.

4.3.1 Infrastructural Barriers

One of the key limitations is the lack of adequate transport infrastructure. The road system in Lagos is overstretched with little development in other forms of transport like rail and water transport. Although policy hopes are on multimodal systems, little is done to use rail and water transport (Lawanson, 2018). There are also no intermodal terminals and transfer points, which further restrict integration. Commuters are also known to have problems when changing between transport modes because of lack of connectivity, poor facilities and disorganised transit hubs.

4.3.2 Institutional and Governance Barriers.

The other barrier is institutional fragmentation. There are many agencies and stakeholders in the transport sector of Lagos and mostly lack coordination and overlap in their duties. Despite the attempts by the Lagos Metropolitan Area Transport Authority (LAMATA) to centralise the transport planning, the issues of governance, financial resources, and policy implementation remain (LAMATA, 2025). Also, the preponderance of the informal transport sector is a challenge to the regulation. The informal operators tend to operate beyond formal planning systems, and it is challenging to incorporate them into a formal multimodal system.

4.3.3. Operational and Technological Barriers.

Multimodal integration is impeded by operational inefficiencies such as inconsistent scheduling, absence of real-time information system, and inability

to guarantee service reliability. Research results show that waiting time and the unpredictability of sojourn are the main discouraging factors to use a public transport (Paul and McSharry, 2021). Inadequacy of integrated ticketing systems also restricts seamless intermodal travel, which increases the costs of transactions and lowers the convenience of the user.

4.3.4 Socioeconomic Barriers

The affordability and accessibility are still a major concern. Although mass transit systems, including rail and BRT, have better services, their services are not evenly available to various socioeconomic groups. Income-deprived

communities tend to use informal transportation because of its cost and access (Salau, 2015). Moreover, the current urbanisation and population increase introduce constant pressure on the available infrastructure that contributes to congestion and decreases the efficiency of the system.

4.4 Development of the Unified Multimodal Mobility (UMM) Model

This paper, based on the above discussion, suggests a model of integrated multimodal mobility, given the socio-spatial conditions of Lagos.

The working model is based on four major pillars in figure 1:



Figure 1: Integrated Multimodal Mobility Framework For Lagos

Source: Authors' conceptualisation (2026)

4.4.1 Network Integration

The model proposed is based on the premise that transportation systems operate in an integrated multi-layered approach rather than just as individual modes of transport. In particular, road, rail and marine transport should operate as a single integrated transportation system, where each mode supports the others through a systematic arrangement of connections. Thus, the multimodal integration concept supports the argument that multimodal transportation systems generate efficiency if the passenger can move from one mode to another without interruption (Cervero, 1998; Vuchic, 2007). In the case of the global transportation systems, this kind of integration will reduce time spent travelling to/from various modes of transportation, improve accessibility and provide reliability to the system.

In Lagos, however, multimodal integration is only partially achieved. While the introduction of the BRT (Bus Rapid Transit) and the Lagos Blue Line rail represents a step forward, the overall inefficiency of the system can be attributed to poor physical and operational connectivity (Lawanson, 2017; LAMATA, 2023). For example, passengers frequently rely on informal transportation modes to complete their journeys because the feeder services that should connect them with the BRT stations are not coordinated with the BRT service. Research related to multimodal transportation systems in many African cities suggests that multimodal inefficiencies are primarily due to the existence of poor intermodal connections rather than insufficient infrastructure (Behrens, McCormick, and Mfinanga, 2016). As a result, to achieve a fully integrated transportation network in Lagos, routing, scheduling and physical interchange points must be coordinated.

4.4.2 Institutional Coordination

The effectiveness of multimodal transportation relies on having strong governance and institutional coordination to effectively implement across their legal frameworks. A fragmented environment where planning, regulation, and execution each are completed in isolation fails to achieve the goal of an integrated transport system. Global successful systems provide central leadership to provide coordination and integration of policies, infrastructure and operations of all transport modes (Gwilliam, 2003, and Cervero, 2013).

In Lagos, an example is supported through the Lagos Metropolitan Area Transport Authority (LAMATA), which serves as a coordinating agency leading and supporting the Lagos Urban Transport Project as well as supporting the ongoing development of Lagos' rail and BRT systems (World Bank, 2014); however, challenges continue to exist among different agencies at both the state and federal levels as well as between private operators. In addition, informal transport

operators have been excluded from the formal regulation of Lagos' transport system, and thus full integration is hindered (Agbiboa, 2017).

Urban transport governance comparative studies have indicated that fragmented institutional frameworks create duplicative and inefficient operations and lead to a lack of enforcement and compliance with transport policies (Pieterse, 2008; Parnell and Pieterse, 2014). Therefore, an improvement of the coordination of institutions should create further opportunity for stakeholders in each of the transport system modes to participate in the planning process through regulatory harmonisation and increased representation of informal transport operators.

4.4.3 Infrastructure Development

The development of infrastructure forms a key component of multimodal transport systems and provides the physical basis for seamless transfers between modes. This encompasses the development of intermodal terminals, rail corridors, ferry terminals, and improved roadways that facilitate connectivity rather than fragmentation.

Transport system theory suggests that infrastructure should be constructed to facilitate the transfer between modes as well as to minimise the inefficiencies of transferring between modes. (Vuchic 2007; Rodrigue 2020). As an example of the expansion of multimodal infrastructure in Lagos, the construction of the Lagos Blue rail line, the expansion of the BRT corridor, and the expansion of the water transport system through ferry services (LAMATA 2023) are indicative of efforts toward the establishment of multimodal transportation systems. The ferry system is supported by LAG-FERRY and, in addition to improving the efficiency of mobility throughout Lagos City, serves as an example of how to use the coastal geography of Lagos to improve mobility throughout the area.

Despite these steps toward multimodal development in Lagos, substantial gaps remain in relation to the provision of infrastructure to support last-mile connectivity and intermodal transfer facilities. Without well-designed transport terminals, passen-

gers are unable to transfer easily from one mode to another, thus limiting the effectiveness of investment in transport infrastructure (Cervero 1998). There is global evidence that shows cities that are most successful in developing an integrated multimodal transport system have focused most of their efforts on developing a connectivity-based approach to infrastructure as opposed to developing isolated systems (World Bank 2014). Lagos must therefore focus its efforts on developing integrated transport terminals that provide physical connections among the road, rail, and water transport systems.

4.4.4 Smart Mobility and Technology

Digital technology plays an increasingly prominent role in modern transportation systems, facilitating real-time coordination of services, integration of payment methods, and application of data-driven planning. Mobility as a Service (MaaS) is particularly important in this context because it provides consumers with one digital interface for accessing multiple modes of transportation (Jittrapirom *et al.*, 2017; Shaheen and Cohen, 2020). By allowing users to plan, book and pay for their multimodal journeys via a single interface, MaaS systems make for more efficient systems of mobility.

In Lagos, there are some early steps toward the digital integration of transport, for example, the Cowry Card system used in BRT operations, as well as ongoing pilot projects with various digital mobility platforms (Ozioma and McSharry, 2021). Digital fragmentation, however, continues to be an enormous obstacle to digital integration because most informal transport operators do not use digital payment systems, which has created a digital divide between formal and informal transport operators and limits the degree of integration that is possible.

Research on transport digitalisation indicates that transportation systems that use smart mobility systems will be more efficient when both formal and informal actors are included within a shared data ecosystem (Shaheen and Cohen, 2020; Behrens *et al.*, 2016). Additionally, real-time data systems contribute significantly to improved route optimisation, reduced congestion and enhanced commuter experiences (Lyons, 2016). For Lagos, achieving full smart mobility integration will depend on expanding the use of digital ticketing, deploying real-time passenger information systems and ensuring the involvement of informal operators in digital transportation platforms.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study concludes that the mobility issues in Lagos are not solely necessitated by inadequacy of infrastructural amenities but also more by institutional and structural bottlenecks. Inadequacy of coordination among transport agencies, poor policy execution and inadequacy of a coherent governance structure have posed a major challenge in ensuring seamless multimodal transport system development. Simultaneously, the use of informal means of transport highlights the flexibility of the system and the loopholes in the formal service delivery. It is also observed that interaction between inter-urban and intra-urban mobility systems is also weak, with little connectivity between regional and urban transport systems. This has added to congestion at major entry points into the city and made the commuter time longer. Moreover, mobility patterns are still influenced by space inequalities, with people living in low-income and peripheral regions experiencing a considerable obstacle in enjoying efficient and affordable transportation means.

5.2 Recommendations. This study recommends as follows:

1. Strengthen Multimodal Network Integration

There should be increased attention to building intermodal infrastructure that would ensure the smooth interaction of transport modes. Transport hubs that are well planned, which combine road, rail and water transport, will greatly enhance the efficiency of mobility. The improvement of the feeder services and the infrastructure system that makes the area pedestrian-friendly will also contribute to strengthening the transport network as a whole. Informal systems of transport must be integrated into formal planning systems in order to have a more inclusive and efficient mobility system. The identification of the informal operators and their integration into controlled systems will enhance service delivery without reducing the flexibility and accessibility that such structures have. This strategy will also minimise fragmentation and improve coordination within the systems.

2. Expand and Diversify Transport Infrastructure

The long-term investment in the railway system, water transport and upgrades of roads should be made. The development of rail networks and the redevelopment of inland waterways will decrease excessive dependence on road transport and increase capacity.

3. Enhance Institutional Coordination and Governance

The governance of transport should also be enhanced by increasing the level of coordination among the concerned agencies especially under the umbrella of LAMATA. Effective planning and implementation require clear policy frameworks and collaboration between stakeholders.

4. Formalise and Integrate Informal Transport Systems

Since informal operators prevail, policies must be directed towards the gradual formalisation, regulation and incorporation of these systems into the larger transport network and not necessarily exclude them. As an alternative to removal of informal transport modes (Danfo/Korope/Okada), Lagos needs a phased integration strategy. LAMATA is to create structured registration for these operators as part of mapping and accountability. These operators should be restructured into feeder service links to the BRT and rail systems; thereby creating a multimodal hierarchy. The way that digital/mobile platforms for fare collection and tracking allow for more efficient operations is important. Government can support co-op restructuring to enhance operators' collective bargaining ability. Physical infrastructure linkages – i.e. designated transit hubs – create seamless connectivity. This approach forms the basis of formalised mobility, preservation of livelihoods, and improved coordination among urban actors.

5. Leverage Smart Mobility and Digital Technologies

Real-time data systems, integrated ticketing platforms, and mobility-as-a-service (MaaS) solutions need to be implemented faster to enhance reliability of the services, minimise the waiting time, and improve the user experience.

6. Promote Inclusive and Affordable Transport Systems

Transport policies must be based on accessibility and affordability, with the low-income populations not being left out of the enhanced mobility systems. This may require subsidies and fair pricing systems.

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