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Traffic Management and Control along Owerri-Port Harcourt Road, Imo State, Nigeria: An Evaluation of Challenges and Strategic Interventions

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Abstract

Urban traffic congestion remains one of the most persistent transport challenges confronting developing cities. The Owerri–Port Harcourt Road corridor, one of southeastern Nigeria's busiest urban arterials, experiences chronic congestion and safety concerns. This study investigates the causes, effects, and management strategies of traffic congestion along this corridor, with a view to recommending sustainable traffic control measures. Primary data were collected through structured questionnaires administered to road users, commercial drivers, and traffic officers, supplemented by field observations. Descriptive statistics and correlation analysis were applied to evaluate the relationships between traffic volume, road infrastructure, and management efficiency. The findings revealed that inadequate road design, weak enforcement of traffic regulations, roadside trading, and poor drainage systems contribute significantly to traffic delays and accidents. The study recommends a comprehensive traffic management system incorporating intelligent transport technologies (ITS), improved road infrastructure, and coordinated institutional frameworks for sustainable urban mobility in Owerri.

Keywords: Traffic Congestion, Urban Mobility, Intelligent Transport Systems, Road Infrastructure, Traffic Management, Owerri, Nigeria

1. Introduction

Urban traffic congestion has emerged as a major challenge for sustainable transport and economic productivity, particularly in developing countries. The World Bank (2023) estimates that urban congestion costs African cities up to $15 billion annually in lost productivity, wasted fuel, and environmental degradation. Similarly, the International Transport Forum (ITF, 2022) reports that traffic congestion in major global cities increases travel time by an average of 37% and vehicle emissions by 20–30%.

In Nigeria, the problem is particularly acute. The National Bureau of Statistics (NBS, 2023) notes that road transport accounts for over 90% of the nation's passenger and freight movement. Yet, inefficiencies in road design, inadequate traffic control systems, and poor driver discipline lead to frequent gridlocks, accidents, and high maintenance costs. In cities such as Lagos, Abuja, and Port Harcourt, studies (Odeleye, 2019; Akinbode & Onifade, 2021) have shown that congestion causes an average travel delay of 2.5 hours daily, with significant economic losses.

Owerri, the Imo State capital, is no exception. The Owerri–Port Harcourt Road is a vital economic corridor connecting southeastern Nigeria to the Niger Delta. Its strategic importance for trade, education, and healthcare has increased vehicular demand beyond the road's design capacity. Despite being a dual carriageway, frequent congestion, poor traffic enforcement, and encroachments from roadside trading persist. These challenges hinder economic efficiency, increase accident rates, and reduce the quality of urban life.

While previous research on traffic management in Nigeria has focused mainly on megacities, limited empirical evidence exists for medium-sized urban centers such as Owerri. This study therefore assesses traffic control challenges along the Owerri–Port Harcourt Road, identifies underlying causes, and proposes practical, sustainable solutions for improved traffic management.

2. **Literature Review**

Concept of Traffic Management

Traffic management refers to the systematic planning, organization, and regulation of vehicular and pedestrian movement to ensure the efficient, safe, and sustainable use of road networks (Rodrigue et al., 2020). It involves the application of engineering, administrative, and behavioral strategies to optimize road capacity, reduce congestion, and minimize accidents. According to the World Bank (2022), efficient traffic management integrates infrastructure design, signal control, enforcement, and real-time monitoring systems to improve mobility and environmental performance.

The goals of traffic management include:

- Reducing congestion and travel time,
- Enhancing road safety and driver discipline,
- Ensuring smooth traffic flow during peak hours,
- Protecting the environment from transport-induced emissions, and
- Promoting equitable accessibility for all road users.

In developing countries like Nigeria, traffic management also involves balancing limited infrastructure capacity with rapidly growing vehicle populations (Odeleye, 2019). Effective

control strategies therefore depend on institutional coordination, data-driven decision-making, and public compliance.

Concept of Traffic Congestion

Traffic congestion occurs when traffic demand exceeds road capacity, resulting in slower speeds, longer travel times, and increased queuing (Button, 2020). It is a complex, dynamic phenomenon influenced by vehicle volume, infrastructure design, driver behavior, and land-use patterns (Litman, 2021).

Congestion can be recurring (during predictable peak hours) or non-recurring (caused by accidents, roadworks, or adverse weather). The Federal Highway Administration (FHWA, 2022) defines it as "the condition under which the number of vehicles attempting to use a road exceeds the available space or operational capacity."

The effects of congestion extend beyond mobility. Economically, it results in productivity loss and increased fuel consumption. Environmentally, it contributes to higher greenhouse gas emissions and air pollution. Socially, it reduces the quality of urban life and increases stress levels among commuters (OECD, 2019).

In Nigeria, congestion has been linked to poor road design, inadequate traffic control systems, illegal parking, and roadside trading (Edeh et al., 2020). The Owerri–Port Harcourt Road exemplifies these challenges due to its mixed-use environment and unregulated access points.

Concept of Traffic Control

Traffic control refers to the methods and devices used to regulate, warn, and guide road users to ensure safe and orderly movement (Akinbode & Onifade, 2021). It encompasses both manual control (e.g., traffic wardens, police enforcement) and automated control systems (e.g., traffic lights, CCTV monitoring, and Intelligent Transport Systems).

According to the United Nations Economic Commission for Africa (UNECA, 2022), effective traffic control reduces conflicts at intersections, optimizes flow through coordinated signaling, and prevents unauthorized maneuvers. The Highway Capacity Manual (2020) identifies three major control categories:

1. Regulatory Control – signage, lane discipline, and road markings.
2. Dynamic Control – adaptive traffic signals and real-time adjustments based on flow.
3. Physical Control – speed bumps, barriers, and channelization.

In Nigeria, manual control remains predominant due to limited technological integration, yet it faces challenges of inconsistency, personnel shortage, and non-compliance (Akpoghomeh, 2021). The growing emphasis on smart traffic systems (such as sensor-based traffic lights and GIS-enabled monitoring) represents an important innovation frontier for urban mobility management.

Concept of Road Infrastructure

Road infrastructure refers to the physical framework that supports transportation, including pavements, drainage systems, intersections, signage, pedestrian facilities, and safety installations (World Bank, 2023). The quality, design, and maintenance of these components determine a road's capacity and safety level.

According to Rodrigue et al. (2020), infrastructure inefficiencies—such as narrow lanes, potholes, poor drainage, and lack of pedestrian crossings—are primary causes of congestion and accidents in developing cities. Furthermore, the African Development Bank (AfDB, 2021) emphasizes that infrastructure deterioration in Sub-Saharan Africa leads to an estimated 30% increase in travel time and 20% rise in vehicle operating costs.

The Owerri–Port Harcourt corridor demonstrates typical infrastructure challenges found in Nigerian urban centers: damaged pavements, flooding during rainfall, and weak maintenance regimes. These conditions amplify congestion and constrain the effectiveness of traffic management interventions.

Concept of Urban Mobility

Urban mobility encompasses the ability of people and goods to move efficiently within urban spaces, ensuring access to employment, education, healthcare, and recreation (Litman, 2021). It integrates transport supply (infrastructure, vehicles, technology) and demand (population density, land use, travel behavior). Sustainable urban mobility promotes efficiency, safety, and environmental responsibility.

The United Nations Human Settlements Programme (UN-Habitat, 2022) emphasizes that smart mobility strategies—including public transport reform, non-motorized transport, and technology-driven traffic management—are critical for achieving inclusive and low-carbon cities. In Nigeria, rapid urbanization and motorization have outpaced infrastructure growth, creating a mismatch between demand and supply (Onyemaechi & Adeola, 2022).

Concept of Intelligent Transport Systems (ITS)

Intelligent Transport Systems refer to the integration of advanced information and communication technologies into transport infrastructure and vehicles to improve efficiency, safety, and

sustainability (Shaheen et al., 2020). ITS tools include real-time traffic monitoring, automated signals, electronic tolling, GPS navigation, and incident detection systems.

Globally, ITS has reduced travel time by 20–30% and traffic accidents by 15–25% (Tan et al., 2021). In Africa, however, adoption remains low due to high installation costs, poor data infrastructure, and weak policy frameworks (Mrema & Ngowi, 2021). Implementing ITS solutions in cities like Owerri would enhance coordination, support enforcement, and provide real-time data for traffic management decisions.

Relationship among Concepts

The interaction between traffic management, control, infrastructure, and urban mobility is systemic. Poor road infrastructure constrains control efficiency, while weak management leads to congestion and safety risks. Conversely, the integration of ITS and sound management policies creates feedback loops that optimize traffic flow and enhance urban mobility (World Bank, 2023).

Therefore, understanding these concepts holistically provides the foundation for designing sustainable, adaptive traffic management systems suitable for mid-sized cities such as Owerri.

The study draws on two major theories:

1. **Traffic Flow Theory (Greenshields, 1935):** Explains the relationship between traffic speed, density, and flow. It posits that as vehicle density increases beyond the optimal threshold, speed and flow decrease, resulting in congestion.
2. **Systems Theory (Von Bertalanffy, 1968):** Views traffic management as an interrelated system involving road infrastructure, human behavior, vehicles, and regulations. A failure in any component (e.g., enforcement) disrupts the entire system.

These theories provide a framework for evaluating the interaction between infrastructure adequacy, road user behavior, and management effectiveness in Owerri.

Globally, Shaheen et al. (2020) found that smart traffic systems in California reduced congestion by 23% and accident frequency by 15%. In Singapore, Tan et al. (2021) reported that adaptive traffic signals improved throughput by 25%.

In Africa, Osei and Agyemang (2020) studied Accra and found that poor enforcement and roadside trading accounted for 41% of daily congestion time. Similarly, in Kenya, Mwangi and Otieno (2021) demonstrated that lane management and signal coordination reduced travel time by 30%.

In Nigeria, Akpoghomeh (2021) and Adeyemi (2022) found that congestion is mainly caused by insufficient road width, unplanned bus stops, and parking violations. Studies in Lagos (Nwokedi et al., 2020) and Port Harcourt (Odeleye, 2019) confirmed that poor drainage and infrastructure

damage worsen traffic bottlenecks. Despite these findings, empirical studies on secondary cities such as Owerri remain limited, justifying this research.

3. Methodology

This study employed a descriptive survey design complemented by field observation to capture the realities of traffic flow and management practices. The study targeted road users, commercial drivers, traffic wardens, and officials of the Imo State Ministry of Transport. A total of 150 questionnaires were distributed, of which 135 were retrieved and analyzed (90% response rate). Data were gathered using structured questionnaires containing closed and open-ended questions on traffic causes, road conditions, control measures, and user satisfaction. Direct field observations were also conducted during peak and off-peak hours for seven days. Quantitative data were analyzed using SPSS version 25 for descriptive statistics (mean, percentage, frequency) and correlation analysis to determine relationships between variables (road condition, enforcement, congestion). Qualitative data were analyzed thematically.

Sample Size and Justification

A total of 150 questionnaires were distributed to respondents across major activity nodes along the corridor. Out of these, 29 copies were correctly completed and deemed valid for analysis. Although the valid sample size is relatively small for a major urban road corridor, it was accepted for the following reasons:

1. High rate of incomplete or improperly filled questionnaires, which rendered several responses unusable.
2. Time and accessibility constraints, particularly during peak hours when road users were unwilling to participate due to high traffic pressure.
3. Safety concerns that limited prolonged engagements during field distribution.

This constitutes a methodological limitation, and the findings should be interpreted with caution. Nonetheless, the study maintains analytical value because the valid responses were obtained from individuals directly exposed to the corridor's traffic dynamics.

4. Results and Discussion

Table 1. Road Use Characteristics and Travel Patterns of Respondents

Variable	Category	Frequency	Percentage (%)
Frequency of Road Use	Daily	12	41.4
	3–4 times weekly	9	31.0
	Occasionally	8	27.6
	Rarely	0	0
Road Condition Insight from Off-Peak Periods	Yes	18	62.1
	Maybe	6	20.7
	Not Really	3	10.3
	No	2	6.9
Period Mostly Used	Morning Peak (6–9am)	11	37.9
	Afternoon (12–3pm)	5	17.2
	Evening Peak (4–8pm)	10	34.5
	Late Night/Early Morning	3	10.4
Mode of Transportation	Commercial Vehicle	15	51.7
	Private Car	8	27.6
	Motorcycle	4	13.8
	Walking	2	6.9

Interpretation

Road users predominantly travel during peak periods (morning and evening), explaining heightened congestion at these times. Most respondents (62.1%) agree that off-peak periods still reveal underlying traffic problems, indicating persistent issues beyond high vehicle volume. Commercial vehicles dominate travel modes, increasing stoppages and informal loading activities that intensify congestion.

Table 2. Congestion Severity and Delay Time During Peak Hours

Variable	Category	Frequency	Percentage (%)
Congestion Rating	Very Light	3	10.3
	Heavy	14	48.3
	Very Heavy	12	41.4
Average Waiting Time	<15 minutes	2	6.9
	>15 minutes	6	20.7
	30–60 minutes	14	48.3
	Over 1 hour	7	24.1

Interpretation

A combined 89.7% rated congestion as heavy or very heavy, confirming severe peak-period delays. Nearly half (48.3%) spend 30–60 minutes in traffic, while 24.1% exceed one hour. This indicates that congestion is not episodic but systematic, aligning with field observations showing bottlenecks at damaged pavement sections and informal roadside activities.

Table 3. Institutional and Environmental Factors Causing Congestion

Factor	Frequency	Percentage (%)
Poor Road Conditions	10	34.5
Poor Traffic Management / No Wardens	9	31.0
Vehicle Volume	6	20.7
Roadside Trading / Street Parking	4	13.8

Interpretation

Infrastructure failure (34.5%) and weak enforcement (31.0%) are the dominant causes of congestion. Roadside trading and illegal street parking, though lower at 13.8%, were repeatedly observed along major intersections, confirming their relevance. These results show congestion is largely structural and institutional—not merely traffic-volume related.

Table 4. Assessment of Traffic Management and Suggested Improvements

Indicator	Category	Frequency	Percentage (%)
Effectiveness of Traffic Wardens/Police	Very Effective	4	13.8
	Somewhat Effective	11	37.9
	Not Effective	8	27.6
	Not Available	6	20.7
Preferred Improvements	Road Widening & Rehabilitation	13	44.8
	Strict Enforcement of Traffic Laws	7	24.1
	Alternative Routes / Bypass	5	17.2
	Functional Traffic Lights	4	13.9
Satisfaction with Traffic Management	Very Satisfied	2	6.9
	Satisfied	5	17.2
	Neutral	12	41.4
	Dissatisfied	6	20.7
	Very Dissatisfied	4	13.8

Interpretation

Most respondents rated enforcement as only "somewhat effective" or ineffective, confirming enforcement inconsistency. Road widening is the most preferred improvement (44.8%), reflecting respondent perception that infrastructure capacity is inadequate. The high "neutral" satisfaction rate (41.4%) indicates uncertainty or low visibility of traffic-management interventions, often observed where institutional responses are weak or poorly coordinated.

Discussion

The findings reveal a complex interplay between infrastructure deficiencies, enforcement gaps, and human activities along the Owerri–Port Harcourt Road. Poor road conditions emerged as the leading contributor to congestion (34.5%), supporting the first hypothesis and aligning with studies by Akpoghomeh (2021) and Odeleye (2019), which emphasized infrastructural decay as a central

factor in Nigerian urban congestion. Weak enforcement, identified by 31% of respondents, validates the second hypothesis and corresponds with findings from Mwangi and Otieno (2021), who demonstrated that inconsistent traffic control magnifies congestion in African mid-sized cities.

Roadside trading, although rated lower (13.8%), was consistently observed during the field survey, reinforcing Osei and Agyemang's (2020) conclusion that commercial encroachment significantly disrupts traffic flow. The high proportion of 'neutral' satisfaction (41.4%) indicates public uncertainty regarding traffic management effectiveness, likely driven by inconsistent enforcement and absence of visible control systems. This pattern is comparable to Mrema and Ngowi (2021), who found similar ambivalence where institutional interventions were poorly coordinated.

Overall, the study demonstrates that congestion along the corridor is not attributable to traffic volume alone but rather a systemic combination of design inadequacies, unregulated roadside activities, and institutional weaknesses. These findings affirm the relevance of Systems Theory and Traffic Flow Theory in explaining how disruptions in any subsystem—such as enforcement or infrastructure—can extensively affect overall traffic performance.

5. Conclusion and Recommendations

The study concludes that traffic congestion along the Owerri–Port Harcourt Road arises from poor road infrastructure, uncoordinated management, and non-compliance with traffic regulations. The socio-economic consequences are substantial, affecting productivity, safety, and environmental quality.

Recommendations

1. **Infrastructure Upgrade:** Rehabilitate road surfaces, improve drainage, and expand lanes at critical bottlenecks.
2. **Intelligent Traffic Systems:** Install synchronized traffic lights, CCTV monitoring, and real-time flow sensors.
3. **Institutional Coordination:** Establish a metropolitan traffic control unit integrating police, ministry, and municipal agencies.
4. **Public Awareness:** Launch campaigns to discourage roadside trading and illegal parking.
5. **Data-Driven Management:** Develop a centralized transport data hub to support evidence-based planning.

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