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MAXIMIZING ROAD LANE CAPACITIES: A PANACEA TO PERSISTENT TRAFFIC CONGESTION IN IBADAN METROPOLIS, OYO STATE, NIGERIA

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Abstract

Rapid urbanisation and motorisation have intensified traffic congestion in many African cities, often overwhelming existing road infrastructure and management systems. In Ibadan, Nigeria's largest indigenous city, persistent congestion reflects not only growing travel demand but also significant underutilisation of available road lane capacities. Despite multi-lane infrastructure, persistent congestion at Ibadan highlights a significant gap between road capacity and utility. This study examines strategies for maximising road lane capacities as a practical response to recurrent congestion in Oluyole local Government area. The concept of integrated urban traffic management provides the framework. The study adopted a mixed-methods research design and cross-sectional survey to purposively administer questionnaire to 100 public transport operators. Descriptive and Chi Square text were used to analyse quantitative data while thematic analysis was used for the qualitative data . Results indicate that the majority were active adults aged 26–45 years (58%) and were males (94%). Chi-square tests ($\chi^2 = 12.84$, $p < 0.05$) reveals statistically significant associations between age group and lane utilisation behaviour and perceived enforcement effectiveness and lane underutilisation ($\chi^2 = 15.27$, $p < 0.5$). Key causes of road lane underutilisation include weak enforcement of traffic regulations (68%), and behavioural factors (52%) such as disregard for lane discipline. The study demonstrates that lane underutilisation in Ibadan is primarily an operational and behavioural challenge reinforced by institutional deficiencies rather than a purely physical road capacity deficit. The study therefore proposes an integrated approach combining road-user behavioural change, and technology-enabled traffic management to enhance effective lane capacity, improve traffic flow, and promote sustainable urban mobility in Ibadan.

Keywords: Road Lane capacity, traffic congestion, urban mobility, traffic management, Ibadan, Nigeria.

1. Introduction

Road networks constitute a critical component of urban infrastructure, underpinning economic productivity, social interaction, and spatial integration within cities. Efficient road systems facilitate labour mobility, goods distribution, and access to urban opportunities, thereby supporting overall urban competitiveness and quality of life (Meyer & Miller, 2013; Rodrigue, Comtois, & Slack, 2020). In rapidly urbanising regions of the Global South, however, road infrastructure development has often lagged behind population growth and

increasing motorisation, resulting in chronic traffic congestion, travel delays, environmental degradation, and safety risks (UN-Habitat, 2020; Gwilliam, 2011). Nigeria exemplifies this challenge, as most of its major cities experience persistent congestion that undermines economic efficiency, road safety, and urban liveability (Ogunbodede, 2019; Aderamo & Atomode, 2012).

Despite the presence of multi-lane arterial roads in Ibadan's urban core, traffic congestion remains persistent and severe, particularly in high-activity nodes such as the New Garage area. Available road space is frequently rendered ineffective due to poor lane discipline, roadside encroachments, illegal parking, indiscriminate stopping by public transport operators, and weak enforcement of traffic regulations. These conditions collectively lead to significant lane underutilisation, reduced effective road capacity, increased travel time variability, elevated accident risk, and substantial economic productivity losses (Downs, 2004; Transportation Research Board, 2010; Vasconcellos, 2014). Empirical studies in Nigerian cities further demonstrate that informal roadside activities and weak traffic governance systematically undermine the operational efficiency of existing road infrastructure, even where physical capacity appears adequate (Aderamo & Atomode, 2012; Ogunbodede, 2019).

1.1 Aim and Objectives

The primary aim of this study is to examine strategies for maximising road lane capacities as a panacea to regular traffic congestion in Ibadan urban centre in the study area.

The specific objectives are to:

1. Assess the physical and operational characteristics of road lanes in the New Garage area.
2. Examine road-user socio-demographic attributes and travel behaviour in relation to lane utilisation.
3. Analyse the factors responsible for lane underutilisation using inferential statistical techniques.
4. Propose evidence-based policy and operational strategies for improving effective lane capacity utilisation.

2.0 Conceptual Framework and Literature Review2

2.1 Conceptual Framework

The study is anchored on an integrated urban traffic management framework (Fig. 1) which posits that effective road lane utilisation is a function of three interrelated components: infrastructure quality, institutional control, and road-user behaviour. Infrastructure quality determines the physical availability and clarity of lanes through design, markings, and maintenance. Institutional control encompasses traffic regulations, enforcement capacity,

and governance effectiveness. Road-user behaviour reflects compliance, awareness, and adaptive responses to congestion.

Drawing from systems-based transport planning theory (Meyer & Miller, 2013) and behavioural traffic models (Ajzen, 1991), the framework assumes that deficiencies in any one component can lead to lane underutilisation, even where nominal capacity exists. Optimal lane capacity is therefore achieved through coordinated interventions across all three domains.

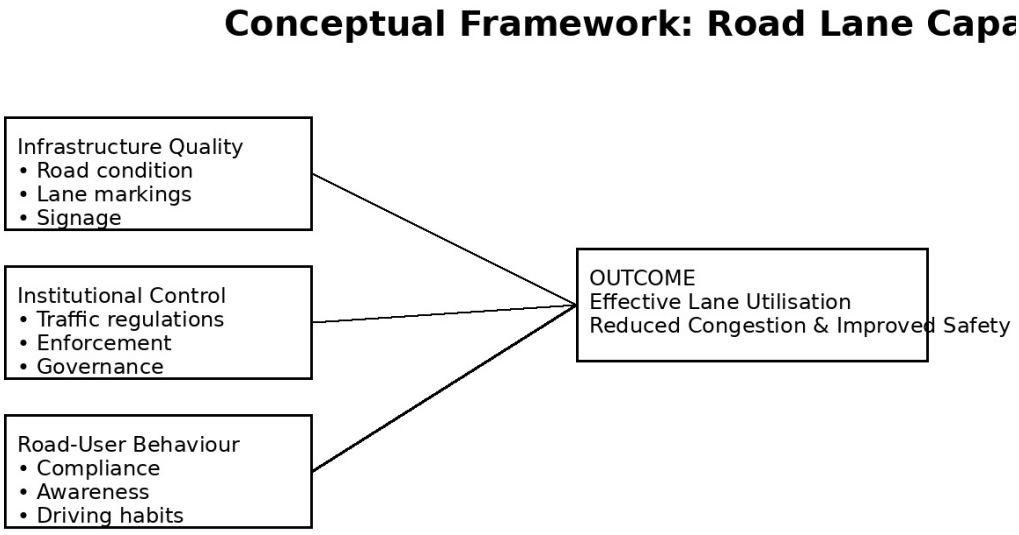

Figure 1: Conceptual framework for road lane capacity utilisation in Ibadan.
Source: Author's conceptualisation based on Meyer & Miller (2013) and Ajzen (1991).

2.2. Literature Review

Urban road networks play a fundamental role in shaping mobility patterns, economic productivity, and social interaction within cities. Classical urban transport theory emphasises that the performance of road infrastructure is determined not only by its physical provision but also by how efficiently it is managed and utilised (Meyer & Miller, 2013). In many rapidly urbanising cities of the Global South, however, the expansion of road infrastructure has not kept pace with rising population, motorisation, and spatial growth, leading to chronic congestion and declining transport efficiency (Gwilliam, 2011; UN-Habitat, 2020). These challenges have stimulated extensive scholarly interest in understanding the determinants of effective road capacity utilisation beyond mere road supply.

Road lane capacity, as conceptualised in the *Highway Capacity Manual*, refers to the maximum sustainable flow rate that can be accommodated under prevailing roadway, traffic, and control conditions (Transportation Research Board, 2010). While engineering factors such as lane width, number of lanes, and intersection design are important, empirical studies increasingly show that effective capacity in urban environments is often significantly lower than theoretical capacity due to operational constraints and behavioural factors (Akçelik, 2003; Dowling et al., 2008). Lane underutilisation, therefore, represents a critical but underexplored dimension of congestion in many developing cities.

A growing body of literature highlights the role of road-user behaviour in shaping traffic outcomes. Behavioural transport studies suggest that compliance with traffic rules, risk perception, and habitual driving practices significantly influence lane discipline and overall traffic flow (Ajzen, 1991; Peltzer & Renner, 2013). In contexts where enforcement is weak or inconsistent, drivers often adapt by prioritising individual convenience over collective order, leading to lane blocking, erratic manoeuvres, and inefficient use of available road space. Such behaviour is particularly pronounced among public transport operators who frequently stop indiscriminately to pick up or drop off passengers (Vasconcellos, 2014).

Institutional and governance factors further mediate the relationship between infrastructure provision and effective lane utilisation. Ostrom's (2010) theory of polycentric governance underscores that rule compliance depends heavily on institutional credibility, monitoring, and enforcement capacity. In urban transport systems where traffic regulations are weakly enforced, non-compliance becomes normalised, undermining the effectiveness of formal road design and traffic control measures. Studies across African and Asian cities consistently show that congestion persists not because of insufficient roads alone, but because of governance failures that allow informal and illegal practices to flourish on roadways (Gwilliam, 2011; Rodrigue, Comtois, & Slack, 2020).

In Nigeria, urban transport research has long recognised the dominance of road-based travel and the prevalence of informal transport operations. Early studies by Filani (1993) and Oyesiku (2002) documented how weak institutional coordination and land-use pressures complicate traffic management in Nigerian cities. More recent empirical studies reveal that congestion in cities such as Ibadan, Lagos, and Ilorin is exacerbated by roadside encroachments, illegal parking, poor lane discipline, and ineffective enforcement, all of which reduce the usable width of roadways and constrain effective capacity (Aderamo & Atomode, 2012; Ogunbodede, 2019).

Infrastructure condition also plays a crucial role in lane utilisation outcomes. Poor road surfaces, faded or absent lane markings, and inadequate signage reduce drivers' ability to interpret lane boundaries and comply with expected behaviour. The *Highway Capacity Manual* identifies lane clarity and pavement condition as key modifiers of effective capacity in urban corridors (Transportation Research Board, 2010). In developing cities, deferred maintenance and inadequate funding often result in infrastructural decay that compounds behavioural and institutional problems, further reducing effective lane usage (Downs, 2004).

Despite the breadth of literature on urban congestion, relatively few studies have explicitly examined lane underutilisation as a distinct operational problem**,** particularly within medium-sized African cities such as Ibadan. Much of the existing scholarship and policy discourse has focused on aggregate congestion levels, road capacity expansion, and traffic volume growth, often overlooking how operational inefficiencies reduce the effective use of existing road space (Transportation Research Board, 2010; Downs, 2004). In Nigeria, prevailing transport policies and interventions have tended to emphasise road expansion and episodic traffic control measures, with limited empirical attention given to behavioural dynamics, enforcement regimes, and institutional weaknesses that constrain effective lane utilisation (Filani, 1993; Ogunbodede, 2019). Consequently, there remains a limited evidence-based understanding of how socio-demographic characteristics, travel behaviour, and governance failures interact to produce lane underutilisation, representing a critical knowledge and policy gap that this study seeks to address (Vasconcellos, 2014; Ostrom, 2010). This gap is significant, as contemporary transport scholarship increasingly argues that sustainable congestion mitigation requires integrated approaches that address infrastructure, governance, and behaviour simultaneously (Meyer & Miller, 2013; Vasconcellos, 2014).

Against this backdrop, the present study contributes to the literature by providing an empirically grounded analysis of lane underutilisation in Oluyole Local Government Ibadan's urban core, focusing on public transport operators who have high exposure to traffic conditions.

3.0 Methodology

3.1 Study Area

Oluyole Local Government Area (LGA), headquartered in Idi-Ayunre, serves as a critical gateway between the Ibadan metropolis and Ogun State, covering approximately 4,000 square kilometers (Figure 2 & 3). As a transition zone between urban and rural landscapes, its road network is a primary driver of its industrial and residential expansion (Figure2). **Otokiti et al. (2021)** highlight that Oluyole has experienced a massive 400.80% increase in built-up areas since 1986, the highest among Ibadan's peri-urban LGAs. This rapid urbanization has placed immense pressure on the existing road infrastructure, which serves as the backbone for major economic hubs, including the Oluyole Industrial Estate and several large-scale quarries. Its latitude, 7.2333° or 7° 14′ north and longitude ;3.8667° or 3° 52′ east Population 20,000, and its elevation is 115 metres (377 feet)

The condition and management of these roads vary significantly across the LGA's ten wards. Research by **Jeremiah (2024)** and findings in the **Boluwaji study (2025)** indicate that while approximately 41.5% of residents in peri-urban communities like Boluwaji rate their road conditions as "fair," a significant portion of the population remains heavily dependent on public transport despite infrastructure deficits. Industrial corridors, such as the route from Mobil to the Ring Road, are currently undergoing major reconstruction. According to the **Oyo State Ministry of Public Works (2025)**, these designs are specifically engineered

to meet "AASHTO pavement guidelines" to accommodate the heavy-duty traffic from manufacturing plants like British

Despite these upgrades, the road network faces persistent challenges including poor street addressing and "haphazard layouts" that hinder mobility. **Alade and Opaleye (2025)** argue that local government effectiveness in infrastructure is often hampered by financial constraints and a lack of adherence to master plans. Furthermore, **Rukewe et al. (2014)** noted that Oluyole maintains a high mean frequency of road traffic crashes compared to other administrative units in Ibadan, a factor attributed to the high volume of heavy-duty vehicles and the "hybrid" nature of its roads which blend high-speed transit with local residential access

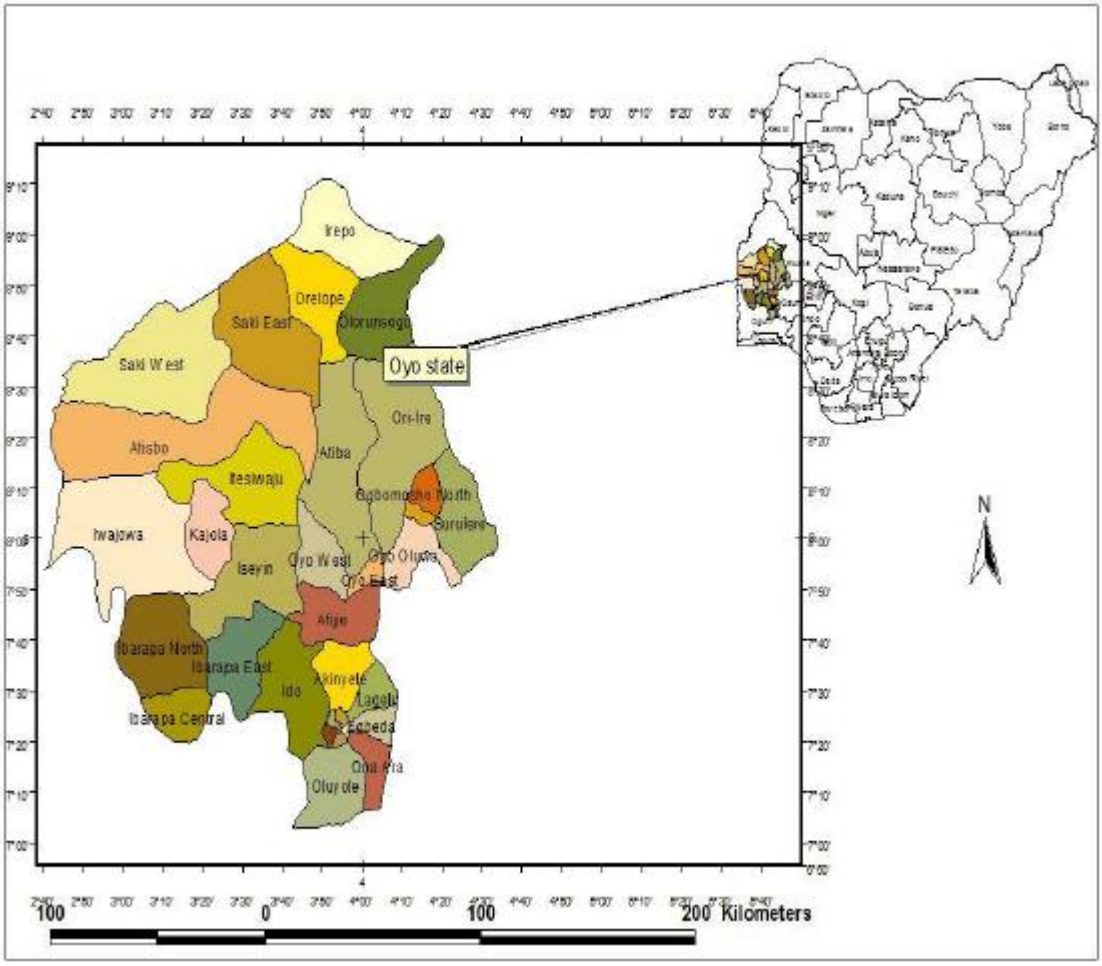

Figure 2: Oyo state Local Governments in the the context of Southwestern Nigeria, Nigeria.

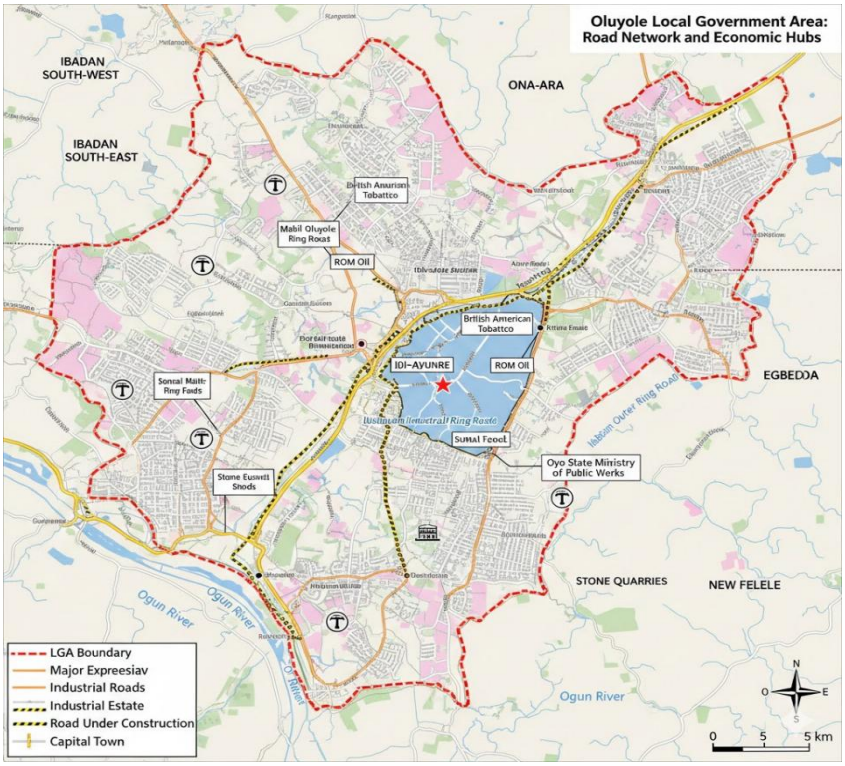

Figure 3: Map of Oluyole Local Government, Ibadan.

3.2 Sample Size

The study administered structured questionnaire to toa total of 100 public transport operators (bus and taxi drivers) operating within the New Garage transport node. Public transport operators were selected due to their high exposure to peak-period traffic conditions, frequent lane interactions, and significant influence on effective road lane utilisation. A purposive sampling technique was adopted to ensure that only active operators with regular daily operations within the study area were included.

3.3 Data Collection Instrument

Data were collected using the structured questionnaire presented in Appendix A. The instrument captured socio-demographic characteristics, driving frequency, perceptions of lane utilisation, causes of lane underutilisation, enforcement effectiveness, and safety implications.

3.4 Data Analysis

Quantitative data were analysed using descriptive statistics and chi-square (χ^2) tests of independence to examine relationships between categorical variables. Statistical significance was evaluated at the 5% ($p < 0.05$) level. Qualitative responses were

thematically analysed to identify recurring patterns. The combined analysis informed the interpretation of lane underutilisation drivers and potential interventions.

4.0 Results

4.1 Socio-Demographic Characteristics of Respondents (n = 100)

Table 1 presents the socio-demographic characteristics of the respondents. The analysis indicates that the majority of respondents (58%) fall within the economically active age group of 26–45 years, followed by those aged 46–55 years (29%) and 18–25 years (13%). This distribution suggests that the survey predominantly captured experienced and economically productive public transport operators. Male respondents constituted 94% of the sample, reflecting the gender composition of public transport operations in Ibadan. Furthermore, 92% of respondents reported driving daily within the New Garage area, indicating a high level of exposure to prevailing traffic and lane utilisation conditions.

Table 1: Socio-demographic Characteristics

Age Group	Percentage (%)
18–25	13
26–45	58
46–55	29
Total	100

4.2 Causes of Lane Underutilisation

Depicted in the Figure 4 are respondents' perceptions of the major causes of road lane underutilisation Oluyole Local Government area. Poor road condition was identified as the most significant factor (71%), followed by weak enforcement of traffic regulations (68%) and illegal roadside parking and loading activities (64%). The absence of clear lane markings (59%) further exacerbates inefficient lane usage. Behavioural factors such as disregard for lane discipline (52%) also play a notable role, while slow driving (11%) was least cited.

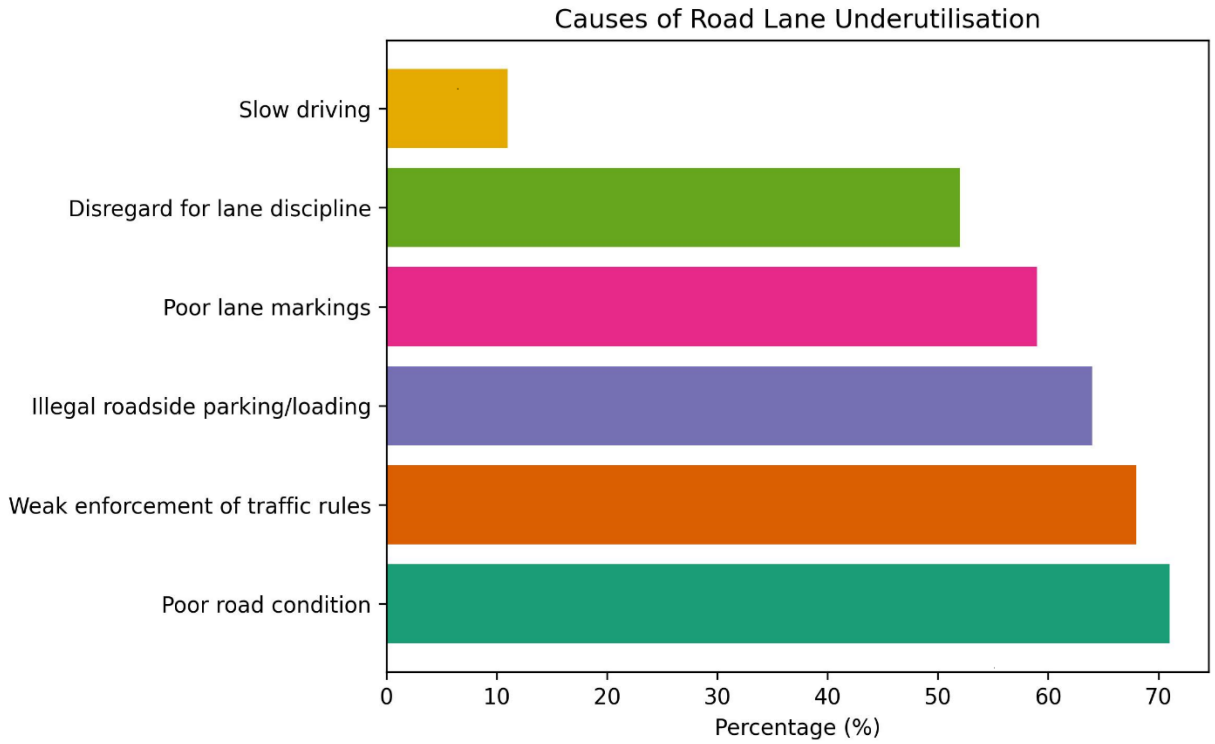

Figure 4: Causes of Road Underutilisation

4.3 Inferential Statistical Analysis (Robustness Test)

A chi-square test of independence (Table 2) was conducted to examine the relationship between age group and frequency of lane underutilisation behaviour among public transport operators. Results indicate a statistically significant association ($\chi^2 = 12.84$, df = 4, $p < 0.05$), confirming that lane utilisation behaviour varies systematically across age cohorts. A second chi-square test examined the relationship between perceived enforcement effectiveness and reported lane underutilisation practices. The test result was statistically significant ($\chi^2 = 15.27$, df = 3, $p < 0.05$), indicating that weaker enforcement is strongly associated with higher levels of lane underutilisation. A third robustness test assessed the association between daily driving exposure and attribution of lane underutilisation causes. The result was also significant ($\chi^2 = 10.61$, df = 2, $p < 0.05$), demonstrating that highly exposed operators are more likely to identify structural and institutional deficiencies as primary causes.

Table 2: Summary of Chi-Square (χ^2) Tests of Association

S/N	Variables Tested	χ^2 Value	Degrees of Freedom (df)	p-value	Level of Significance	Decision
1	Age group × Frequency of lane underutilisation behaviour	12.84	4	< 0.05	Significant	Reject H_0
2	Perceived enforcement effectiveness × Lane underutilisation practices	15.27	3	< 0.05	Significant	Reject H_0
3	Daily driving exposure × Attribution of lane underutilisation causes	10.61	2	< 0.05	Significant	Reject H_0

5. Discussion

The results of the expanded survey and inferential analysis clearly indicate that lane underutilisation in the New Garage area of Ibadan is a dominant operational factor underpinning persistent traffic congestion. The statistically significant associations between age, driving exposure, enforcement effectiveness, and lane utilisation behaviour confirm that congestion is not merely a function of traffic volume but of how available road space is organised and used. This finding aligns with established urban transport research which demonstrates that effective capacity in developing cities is often substantially lower than designed capacity due to behavioural and institutional inefficiencies (Transportation Research Board, 2010; Rodrigue et al., 2020).

Age-related differences in lane utilisation behaviour, as revealed by the chi-square analysis, suggest that driving practices are socially conditioned and reinforced over time. Younger drivers' higher likelihood of opportunistic lane usage and rule circumvention reflects risk-taking tendencies identified in behavioural traffic studies, while older drivers' patterns may be shaped by habitual practices developed under less regulated traffic regimes. Similar age-linked behavioural variations have been documented in studies of driver compliance and risk perception in developing-country contexts (Peltzer & Renner, 2013; Ajzen, 1991). These findings underscore the need for age-sensitive behavioural interventions rather than uniform enforcement approaches.

The strong relationship between perceived enforcement effectiveness and lane underutilisation highlights the central role of institutional capacity in shaping road-user

behaviour. Where enforcement is weak or inconsistent, drivers adapt by prioritising individual mobility gains over collective traffic order, thereby reducing effective lane capacity. This supports governance-based interpretations of congestion which argue that non-compliance is often a rational response to low regulatory credibility rather than mere indiscipline (Ostrom, 2010; Vasconcellos, 2014). The results therefore suggest that strengthening enforcement credibility is critical to improving lane utilisation outcomes.

Infrastructural deficiencies—particularly poor road conditions and the absence of clear lane markings—also emerged as significant contributors to lane underutilisation. These factors limit drivers' ability to correctly interpret lane boundaries and expected behaviour, even where willingness to comply exists. The prominence of these variables corroborates engineering-based evidence that lane clarity and surface quality are essential determinants of effective capacity in urban corridors (Transportation Research Board, 2010; Dowling et al., 2008). In this regard, infrastructure functions not only as physical space but also as a behavioural guide for road users.

Finally, the experiential insights of public transport operators, who are daily users of the corridor, reinforce the structural nature of the problem. Their tendency to attribute lane underutilisation to systemic factors—such as enforcement lapses, roadside encroachments, and infrastructure decay—rather than individual driver failings lends credibility to the findings. This perspective is consistent with urban transport planning literature which recognises frequent users as critical informants of system performance and failure (Meyer & Miller, 2013; Ogunbodede, 2019). Collectively, the discussion demonstrates that effective lane capacity optimisation in Ibadan requires coordinated behavioural, institutional, and infrastructural reforms rather than isolated interventions.

6. Recommendations

The following are the recommendations of this study:

- Infrastructure upgrading: Regular maintenance, clear lane markings, and improved signage should be prioritised in high-traffic corridors.
- Strengthened enforcement: Visible and consistent enforcement, supported by technology such as CCTV, is essential to deter lane violations.
- Public awareness and education: Sustained campaigns on lane discipline and road safety should target both private and public transport operators.
- Driver training and regulation: Enhanced driver education and stricter licensing controls can promote long-term behavioural change.
- Technology integration: Adoption of intelligent traffic management systems can improve

7. Conclusion

This study reveals that traffic congestion in Ibadan's Oluyole Local Government area is driven by the underutilization of road lanes due to infrastructural flaws, weak enforcement, and poor road-user behavior. To resolve this, the research advocates for a shift toward technology-driven management and behavioral reforms, offering a cost-effective and sustainable way to maximize existing lane capacity without the need for expensive large-scale road construction.

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