Critical Examination of the Factors that Contribute to Road Traffic Congestion in Lagos State

Abstract

Road traffic congestion has become a problem for road users all over the world. It reduces productivity and raises the overall cost of transport services. The menace of congestion occurrence is a matter of serious concern to freight transportation companies because transport operating costs have been drastically increasing and unstable. Therefore, this study identified the significant factors that contribute to road traffic congestion in Lagos state. The study was carried out in Lagos State. The population of the study was 353 haulage company staff. Data was sourced primarily. Descriptive statistics and factor analysis were used to identify the significant factors that contribute to road traffic congestion in Lagos state. The result of the study extracted three (3) factors out of twenty-one variables that cause traffic congestion in Lagos state and they accounted for 89% variation. These factors include peak period (0.6296), poor transport policy (0.7928), increased number of freight (0.9002), and poor road condition (0.9127) among others. The study concluded that there are significant factors such as peak periods, poor transport policy increased number of freights, and poor road condition that causes road traffic congestion in Lagos State. It was recommended that freight transportation companies should have a well-planned schedule and good timing for their delivery to avoid simultaneous movement of freight vehicles on the road.

Keywords: Transport, Congestion, Traffic Congestion, Freight Transport, Road Transport, Urban Transport.

1. Introduction

Transportation is an important component of modern society which is planned to facilitate efficient and cost-effective movement among other components of the society to provide maximum mobility to all citizens (Luo, et al., 2019). It is essential to all economic activities, including the movement of raw materials, labour, inputs, and outputs along supply chains, consumers to services, and products to customers (Andrew et. al., 2015). However, freight transport involves the movement of goods from one point to another through different modes of transport. However, in Nigeria, road transport has been a dominant mode of moving goods. According to Retallack, and Ostendorf, (2019), congestion is caused by random events such as accidents and unusual weather conditions (rain, storms, etc.), which are unexpected and unplanned. Kirschner, and Lanzendorf, (2020) posited that congestion can be perceived as an unavoidable consequence of the usage of scarce transport resources, particularly if they are not priced.

However, traffic congestion occurs when there is an imbalance between transport demand and supply at a specific point in time and in a specific section of the transport system (Akhtar, & Moridpour, 2021). It implies that the available transport infrastructure at that given time is being overstretched. Congestion can be perceived as an unavoidable consequence of the usage of scarce transport resources, particularly if they are not priced. The last decades have seen the extension of roads in rural but particularly in urban areas, most of them free of access (Iimi, et al., 2018). Those infrastructures were designed for speed and high capacity, but the growth of urban circulation occurred at a rate higher than often expected.

The Lagos State Road traffic congestion problem is a complex challenge that harms urban mobility, economic productivity, and environmental sustainability. While Lagos has seen a host of investments in transportation and traffic control systems, challenges of congestion persist, which is an indicator of a gap in the understanding of the root cause and effective solutions to the problem. Studies, including Engström (2016), draw our attention to poor road infrastructure, speedy urbanization, and inadequate public transport systems as the main factors of Lagos traffic congestion. The two of them emphasize how bad urban planning and the mushrooming of informal public transport operations contribute to the worsening of traffic congestion. The problem is worsened by behavioral factors such as driver indiscipline and inadequate enforcement of traffic laws, as highlighted by Afolabi (2016). A critical analysis of these factors would help in a better understanding of Lagos's traffic situation. This will require the development of specific tactics to tackle not only the infrastructural bottlenecks but also the social aspects of the problem, hence setting the foundation for a sustainable urban mobility plan for Lagos State. Therefore, the objective of this study is to identify the significant factors that contribute to road traffic congestion in Lagos state.

2. Literature Review

2.1 Road Traffic Congestion

There is no universally accepted definition of traffic congestion since it is both a physical and a relative phenomenon (Rahane & Saharkar, 2014). As a physical phenomenon, it is characterized as a scenario in which demand for road space exceeds supply, resulting in slower speeds, longer journey durations, and greater motor vehicle queuing (Falcocchio, et al., 2015). It is a relative occurrence where there is a disparity between road performance and road user expectations (Elmansouri, Almhroog, & Badi, 2020). Congestion may be seen as an unavoidable result of insufficient transportation amenities such as road space, parking areas, road signals, and good traffic management (Newman *et. al.*, 2020). Thus, traffic congestion on road networks develops as a result of excessive usage of road infrastructure beyond capacity, and it is characterized by slower speeds, longer journey hours, and greater vehicle queuing. Any economically busy and thriving city will rarely be free of traffic congestion (Yildirim, 2001). There are two major competing opinions on traffic congestion (Raheem, et al., 2015). The first point of view is that it may be seen as a sign of economic progress as well as an urban way of life. The second point of view is that it is regarded as a signal of the decline of urban life.

2.2 Types of Traffic Congestion

Retallack, and Ostendorf, (2019) defined three forms of congestion: recurrent congestion, non-recurring congestion, and the pre-congestion condition, as illustrated in Table 1. These classifications are based on the frequency and predictability of traffic congestion, both of which affect driving behavior. Congestion expenses are expected to vary depending on the type of congestion. Non-recurrent congestion costs may be more difficult to measure because of the scarcity of relevant data, it may be claimed that the costs are higher since drivers have not been able to factor in the likelihood of congestion when planning their travel, or the costs might be lower. Some routes are increasingly subject to non-recurrent congestion just like accident black spots. In these cases, drivers may ‘learn’ an expected cost in terms of likely delay and successful contingency routes. Pre-congestion

will bear some costs equivalent to congestion, including loss of driver environmental control, environmental degradation, and other consequences. For freight transport companies, the increase in road congestion is more than just a time-consuming annoyance. High levels of traffic congestion have been recognized as reducing the number of travels a truck driver can do in a day, increasing the cost of transportation.

According to Brownfield et. al., (2003), congestion can be divided into the following segments:

- **Recurrent Congestion**: This happens regularly at a certain location. Road users who typically use the route during certain times might anticipate it. Morning or evening peak hour congestion, or congestion caused by a regular event, such as a street fair on the same day each week, are examples of recurring congestion.
- **Non-recurrent Congestion**: This occurs at a spot at irregular intervals. It is unanticipated and unforeseeable by the driver and is usually caused by situations such as accidents, vehicle breakdowns, or other sudden loss of road capacity.
- **Pre-congestion (borderline)**: This occurs when free-flow conditions have been broken but complete congestion has not yet developed. This might happen on either side of the period when congestion develops, or it might happen upstream or downstream of congestion that is already happening.

3. Methodology

This study was carried out in Lagos State, South-western, Nigeria. In Lagos State, freight transport is an important part of economics and social activity. Industries rely on some goods movement to maintain commerce, which may range from large shipments of bulk commodities to package delivery within and outside Lagos State (Somuyiwa, 2010). The study focused on road freight transport operators in the study area. Therefore, there are forty-one (41) registered haulage companies operating within Lagos State. Three hundred and fifty-three (353) respondents (Staff) were randomly selected from haulage companies in the study area which are TSL; Noask; GPC; Ekili; GMT; Starlink and GHRL. Questionnaires were administered to the management and drivers of the companies. Questionnaires and personal interviews were the main instruments for data collection in the study. The questionnaire was structured in line with the study objectives and hypothesis and was administered to the selected respondents within 14 days due to the location differences of the selected companies. The objective of the study which is to identify the factors that contribute to road traffic congestion in Lagos state was analyzed using factor analysis because it is an appropriate tool to extract significant factors from wide intended causes of road traffic congestion in the study area (Shrestha, 2021).

4 Result and Discussion

This study conducts an in-depth analysis of numerous aspects behind road traffic congestion as viewed by freight transportation companies and the result is shown in Table 1. 90% of the people answered that worsening road conditions were a major cause why the traffic was worse, which is the opinion which can be shared by most of the answers. To add to this, a stunning 92.3% expressed that the increasing urban population is the major cause of the extensive traffic congestion which demonstrates the direct role of population dynamics in urban movement.

In addition, the contribution of old vehicles to the worsening traffic congestion was also immensely refuted by an impressive 87.7% of the respondents this is not a determining factor. Unlike others, however, the issue of traffic flow timing gained ground rapidly, and the participants in the study were almost unanimous that traffic peaks during certain periods, which indicates a temporal pattern of the traffic problem dominating the urban landscape.

Besides, there is the reveal of a very important human factor that causes congestion where 78.1% of respondents pinpointed poor driving habits as the main driver of traffic congestion, hence the human element in traffic management. On the other hand, the structural inadequacies such as the pedestrian bridges and the governmental transport policies were mainly exonerated from the blame, as an overwhelming majority denied their involvement in traffic congestion. Additionally, maintaining roads brings up a crucial issue; 90.6% think that bad maintenance matters and thus suggest better maintenance to sort out traffic. Nevertheless, the inadequacy of road construction and overhead bridges did not raise much concern among the majority of the voters; further suggesting that the majority did not view infrastructural impact on traffic flow as a priority.

Further to that, the study looks into the social aspect, where the respondents unanimously rejected the suggestion of street bad people as a cause of traffic congestion. Moreover, the increasing presence of commercial vehicles on the road was highlighted as a primary reason by 89.4% of respondents. This finding is consistent with concerns about the violation of traffic rules by both drivers and other road users. This analysis highlights the multi-faceted nature of traffic congestion as well as the imperativeness of an integral approach to traffic management and urban planning.

This study's results are similar to others, highlighting the complex nature of what causes traffic congestion on roads. Similar to the ones done by Afrin, and Yodo, (2020) the previous studies that have been done have shown that poor road conditions, urban population growth, and inadequate infrastructure are the major factors that lead to urban traffic congestion worsening. In addition, the behavioral dimension involves the issue of drivers' attitudes and compliance with traffic regulations are consistent with the view of Rahman (2022) that human factors have an essential role. Such cooperation with existing literature not only endorses the current study's results but also emphasizes the need for coordinated traffic management that involves both infrastructure upgrades and behavioral interventions that deal with congestion management in a comprehensive manner.

Table 1: Factors that Causes Road Traffic Congestion

S/N	Factor	Eigenvalue	Difference	Proportion	Cumulative
1	Factor1	7.29581	4.13163	0.4932	0.4932
2	Factor2	3.16418	1.46503	0.2139	0.7070
3	Factor3	1.69915	0.72218	0.1149	0.8219
4	Factor4	0.97697	0.10869	0.0660	0.8879
5	Factor5	0.86827	0.29414	0.0587	0.9466
6	Factor6	0.57413	0.10307	0.0388	0.9854
7	Factor7	0.47106	0.24242	0.0318	1.0173
8	Factor8	0.22865	0.11163	0.0155	1.0327
9	Factor9	0.11702	0.02181	0.0079	1.0406
10	Factor10	0.09521	0.01602	0.0064	1.0471
11	Factor11	0.07919	0.05992	0.0054	1.0524
12	Factor12	0.01927	0.03955	0.0013	1.0537
13	Factor13	-0.02028	0.01087	-0.0014	1.0524
14	Factor14	-0.03114	0.00911	-0.0021	1.0503
15	Factor15	-0.04025	0.01651	-0.0027	1.0475
16	Factor16	-0.05677	0.02965	-0.0038	1.0437
17	Factor17	-0.08641	0.01739	-0.0058	1.0379
18	Factor18	-0.10381	0.02849	-0.0070	1.0308
19	Factor19	-0.13230	0.02241	-0.0089	1.0219
20	Factor20	-0.15471	0.01447	-0.0105	1.0114
21	Factor21	-0.16918	0.00000	-0.0114	1.0000

Source: Field Survey (2021)

4.3 Extraction of Factors Contributing to Road Traffic Congestion

For data suitability (sampling adequacy), the study conducted the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO index is 0.8 02(>50) and this ascertained the adequacy and suitability of the data used for the study. Also, Bartlett's sphericity test was significant at $p < 0.05$ which is good for factor analysis. The KMO and Bartlett's sphericity test results are presented in Table 2.

Table 2: KMO and Bartlett's Sphericity Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.802
Bartlett's Test of Sphericity	Approx. Chi-Square	5653.212
	Df	210
	Sig.	0.000

Source: Researcher's computation (2021)

4.3.1 Eigenvalues and Factors Extraction

To extract the factors that cause road traffic congestion in Lagos State, Kaiser's criteria which are eigenvalues were used to extract factors. The golden rule is to extract factors with eigenvalues greater than one and as a result of this, three (3) factors were extracted out of twenty-one (21) factors identified to be the causes of traffic congestion. The first three factors accounted for most of the total variability in the data as shown by the cumulative proportion (89%) while the remaining factors accounted for a small proportion of the variability and are likely unimportant. Table 3 revealed the factors extracted, eigenvalues, proportion, cumulative proportion, and the uniqueness of the factor extracted. Uniqueness is the percentage of variance for the variable that is not explained by the factors. Values of uniqueness greater than 0.6 are considered too high as it implies that variables are not well explained by the factors. Thus, for the three factors extracted, the uniqueness is lower than 0.5 which means that the variables are well explained by the associated factors. Moreso, the scree plot on Figure 1 was used where the eigenvalues are plotted against the factor number.

Table 3 Eigenvalues and Factors Extraction

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	7.29581	4.13163	0.4932	0.4932
Factor2	3.16418	1.46503	0.2139	0.7070
Factor3	1.69915	0.72218	0.1149	0.8219
Factor4	0.97697	0.10869	0.0660	0.8879
Factor5	0.86827	0.29414	0.0587	0.9466
Factor6	0.57413	0.10307	0.0388	0.9854
Factor7	0.47106	0.24242	0.0318	1.0173
Factor8	0.22865	0.11163	0.0155	1.0327
Factor9	0.11702	0.02181	0.0079	1.0406
Factor10	0.09521	0.01602	0.0064	1.0471
Factor11	0.07919	0.05992	0.0054	1.0524
Factor12	0.01927	0.03955	0.0013	1.0537
Factor13	-0.02028	0.01087	-0.0014	1.0524
Factor14	-0.03114	0.00911	-0.0021	1.0503
Factor15	-0.04025	0.01651	-0.0027	1.0475
Factor16	-0.05677	0.02965	-0.0038	1.0437
Factor17	-0.08641	0.01739	-0.0058	1.0379
Factor18	-0.10381	0.02849	-0.0070	1.0308
Factor19	-0.13230	0.02241	-0.0089	1.0219
Factor20	-0.15471	0.01447	-0.0105	1.0114
Factor21	-0.16918	.	-0.0114	1.0000

LR test: independent vs. saturated: chi2(210) = 5683.79 Prob>chi2 = 0.0000

Source: Researcher's computation (2021)

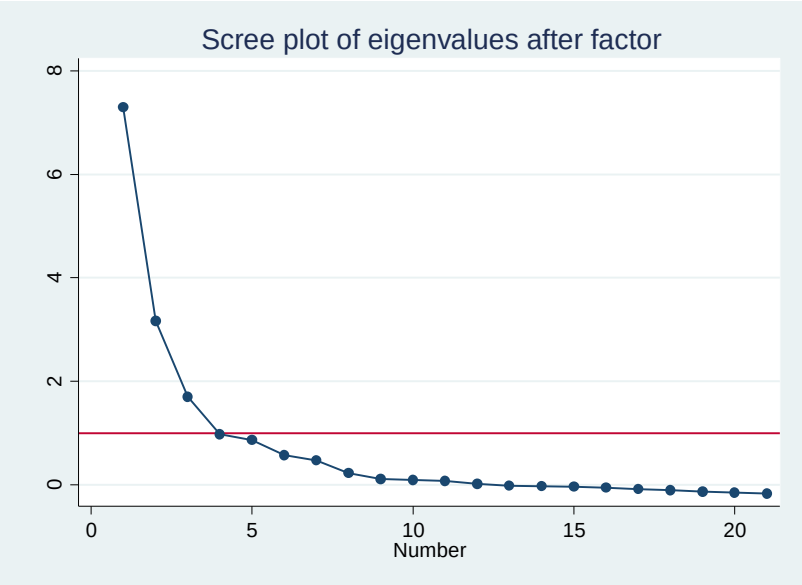

Figure 1Scree plot showing eigenvalues and factor number

Source: Researcher's computation (2021)

4.3.2 Rotated Factors Matrix on Factors Causing Road Traffic Congestion.

The rotated factor matrix for all variables is presented in Table 4. The maximum likelihood factor analysis with a cut-off point of 0.5 and Kaiser's criterion of eigenvalues greater than one produced a three-factor solution as the best fit for the data. The findings revealed that variables like peak period (0.6296), poor transport policy (0.7928), increased number of freight (0.9002), poor road condition (0.9127), unionism (0.6273), daily vehicle routine (0.7770), bad road network (0.6265) and non-compliance with road traffic (0.6344) have highest positive loadings. Furthermore, for the second factor, variables such as urban population increase (0.7945), driver's attitude (0.5190), poor road maintenance (0.6614), freight drivers' compliance with traffic rules (0.591), and road user's attitude (0.6403) have the highest positive loadings. Lastly, variables such as old vehicles plying the road (0.548), and inadequate pedestrian bridges (0.789) are the highest positive loading on Factor 3.

Table 4: Rotated Factor Loadings (Pattern Matrix) and Unique Variances of Factors causing road traffic congestion

Variables	Factor 1	Factor 2	Factor 3
Badroads			
Urb_pop_incr		0.7945	
Oldveh			0.548
Peakperiod	0.6296		
Drivatt		0.5190	
Indpedbrid			0.798
Badgovpol			
Badcomppol	0.7928		
Poorroadmain		0.6614	
Roaduseratt		0.6403	

Freightnum	0.9002		
Poorrdnwk		0.6265	
Poorroadco	0.9127		
Inadoverbr			
Tautandmiscr			
Unionism	0.6273		
Vehdailyrout	0.7770		
Poorexpres			
Roaduseradh			
Freightdri			0.5931
Absoftraff	0.6344		

Method: principal-Component Factors

Rotation: Orthogonal Varimax (Kaiser off)

(Blanks represent abs (loading) <.3)

Source: Researcher's Computation, (2021)

5. Conclusion and Recommendations

The study identified the factors that cause road traffic congestion in Lagos State to be three factors. These factors comprise: bad roads, an increase in the urban population, an increase in the number of old vehicles on the road, peak periods, bad drivers' attitudes, inadequate pedestrian bridges, government transportation policy, companies' transportation policy, poor road maintenance culture, bad attitude of the road users, increase in numbers of daily freight vehicles plying urban road, poor road network/connectivity, poor road construction, inadequate overhead bridge provision in urban sites, taut and miscreant activities on the road, activities of the transport unionism, increase in number of commercial vehicles daily routine on the road, poor construction of express roads along the urban roads, inability of the road users to adhere to traffic rules and regulations, inability of the freight drivers' to adhere to traffic rules and regulations hereby cause congestion and absents of traffic regulator on the road daily.

Hence, it is recommended that the freight transportation company should have a well-planned schedule and good timing for their delivery to avoid simultaneous movement of freight vehicles on the road. Also, freight transportations are implored to travel much at night when most commercial vehicles are not operating to reduce traffic congestion.

References

Afrin, T., & Yodo, N. (2020). A survey of road traffic congestion measures towards a sustainable and resilient transportation system. *Sustainability*, *12*(11), 4660.

Akhtar, M., & Moridpour, S. (2021). A review of traffic congestion prediction using artificial intelligence. *Journal of Advanced Transportation*, *2021*, 1-18.

Andrew M., Taner O., Brian D. T. & Trevor T. (2015). Congested Development: A Study of Traffic Delays, Access, and Economic Activity in Metropolitan Los Angeles. A Report to the John Randolph and

Dora Haynes Foundation. *Institute of Transportation Studies UCLA Luskin School of Public Affairs* 3250 Public Affairs Building Los Angeles, CA 90095-1656 (310) 562-7356 its@luskin.ucla.ed

Brownfield, J., Graham, A., Eveleigh, H., Ward, H., Robertson, S., & Allsop, R. (2003). Congestion and accident risk. *Department for Transport, Road Safety Research Report No. 44*. Retrieved from http://www.dft.gov.uk

Elmansouri, O., Almhroog, A., & Badi, I. (2020). Urban transportation in Libya: An overview. *Transportation research interdisciplinary perspectives*, *8*, 100161.

Engström, R. (2016). The Roads' Role in the Freight Transport System. *Transportation Research Procedia*, 14, 1443–1452.

Falcocchio, J. C., Levinson, H. S., Falcocchio, J. C., & Levinson, H. S. (2015). Managing nonrecurring congestion. *Road Traffic Congestion: A Concise Guide*, 197-211.

Iimi, A., Mengesha, H. A., Markland, J., Asrat, Y., & Kassahun, K. (2018). Heterogeneous impacts of main and feeder road improvements: evidence from Ethiopia. *World Bank Policy Research Working Paper*, (8548).

Kirschner, F., & Lanzendorf, M. (2020). Parking management for promoting sustainable transport in urban neighbourhoods. A review of existing policies and challenges from a German perspective. *Transport Reviews*, *40*(1), 54-75.

Luo, C., Huang, C., Cao, J., Lu, J., Huang, W., Guo, J., & Wei, Y. (2019). Short-term traffic flow prediction based on least square support vector machine with hybrid optimization algorithm. *Neural processing letters*, *50*, 2305-2322.

Newman, P. (2020). Cool planning: How urban planning can mainstream responses to climate change. *Cities*, *103*, 102651.

Rahane, S. K., & Saharkar, U. R. (2014). Traffic congestion-causes and solutions: A study of Talegaon Dabhade city. *Journal of Information, Knowledge and Research in Civil Engineering*, 3(1), 160–163.

Raheem, S. B., Olawoore, W. A., Olagunju, D. P., & Adeokun, E. M. (2015). The cause, effect and possible solution to traffic congestion on Nigeria Road (A Case Study of Basorun-Akobo Road, Oyo State). *International Journal of Engineering Science Invention*, *4*(9), 10-14.

Rahman, M. M., Islam, M. K., Al-Shayeb, A., & Arifuzzaman, M. (2022). Towards sustainable road safety in Saudi Arabia: Exploring traffic accident causes associated with driving behavior using a Bayesian belief network. *Sustainability*, *14*(10), 6315.

Retallack, A. E., & Ostendorf, B. (2019). Current understanding of the effects of congestion on traffic accidents. *International journal of environmental research and public health*, *16*(18), 3400.

Retallack, A. E., & Ostendorf, B. (2019). Current understanding of the effects of congestion on traffic accidents. *International journal of environmental research and public health*, *16*(18), 3400.

Shrestha, N. (2021). Factor analysis as a tool for survey analysis. *American Journal of Applied Mathematics and Statistics*, *9*(1), 4-11.

Somuyiwa, O. A. (2010). Impact of freight flows on city logistics in a megacity of a developing economy. *Journal of Geography and Regional Planning*. 3(2), 029-034.