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# Ameliorating Urban Traffic Congestion for Sustainable Transportation.

A.A Busari<sup>1,2\*</sup>, R.T. Loto<sup>3</sup>, S.O Ajayi<sup>4</sup>, O. Odunlami<sup>5</sup>, Akintayo Folake<sup>6</sup>, Oyesomi Kehinde<sup>7</sup>, O. Olawuyi<sup>8</sup>

<sup>1</sup>Department of Civil Engineering, Covenant University, Ota, Ogun State, Nigeria

<sup>2</sup>Department of Civil Engineering, Tshwane University of Technology, Pretoria, South Africa

<sup>3</sup>Department of Mechanical Engineering, Covenant University, Ota, Ogun State, Nigeria

<sup>4</sup>Nigerian Building and Road Research Institute, Ota, Ogun State, Nigeria

<sup>5</sup>Department of Chemical Engineering, Covenant University, Ota, Ogun State, Nigeria

<sup>6</sup>Department of Civil Engineering, University of Ibadan, Oyo State, Nigeria

<sup>7</sup>Department of Mass Communication, Covenant University, Ota, Ogun State, Nigeria

<sup>8</sup>Department of Civil Engineering, Osun State University, Osogbo, Osun State

\*Corresponding Author; ayodebamiakinbode@gmail.com, +2348035419504

## Abstract-

Population, ownership of vehicles and economic growth are increasing at a geometric rate. Invariably, this will lead to an increase in traffic volume and the demand for limited road infrastructures. These has generated a lot of constraint on the few available road infrastructures in most developed and developing nations of the world. One of the consequences of this, is traffic congestion. This arises when the road system approaches vehicle capacity. Although governments and policy makers may never be able to eliminate road congestion, there are several ways cities and states can move to curb it. Hence, this review of literature assessed the myriad effect of traffic congestion, with focus on the economic and environmental impact. Additionally, long and short term measures to reduce the menace in 2030 were evaluated. This was done by assessing the relevant literature on the topic. The outcome of the review revealed that increase in income and living standard favours the ownership of automobiles thereby increasing traffic congestion. Households that reside in areas with compact, mixed land use own fewer vehicles, make fewer vehicle trips, therefore mixed land use should be encouraged in urban development. Additionally, level of Service (LOS) is another factor that affects traffic congestion and traffic crashes. The outcome of this review will aid the government and policy makers on the appropriate tool to adopt and the draw backs in a bid to reduce this menace now and in the foreseeable future.

**Key words:** Traffic, Traffic Congestion, Transportation, Sustainable Transportation, Traffic Crashes

## 1. Motivation

Globally, traffic congestion is a serious problem which affects the effective mobility of people. This has posed several negative impacts on the present and future development of major Central Business Districts (CBD). Some of these adverse effects include the excessive consumption of fuel, especially for compulsory daily trips. Additionally, it has increased the commuters estimated travel time and increased journey speeds. The environmental impact



includes the emission of gases which causes pollution and increases global warming. It has also created several public health issues craving for attention now. It is worthy to note that psychologically, it has contributed to road rages, especially during the peak travel hours of the day. This is a form of temper tantrum by frustrated drivers on the roadway among others.

The research of [1] avowed that over the years, population, ownership of vehicles and economic growth is expected to increase, this will invariably lead to an increase in traffic volume and the demand for the limited road infrastructures, thereby leading to traffic congestion.

If not properly managed effectively, this traffic congestion will jeopardize quite a lot of economic activities as transportation is an integral component of national growth and development [2-3]. Hence this review of literature seeks to critically assess the way forward for a smooth flow of traffic in line with the sustainable development goals as transportation is a centre of the sustainable development goals 2030.

### 1.1 Introduction

The efficient transportation network is the lifeline of any developed country as transportation is key to globalization and national growth [4-5]. This can be attributed to the fact that economic and social activities revolve around transportation. Virtually all daily activities revolve around transportation which is either intra-city or inter-city trips [6-7]. Over the years it has become a point of concern as most CBD's are trafficked choked.

However, the increase in population and car ownership has generated a lot of constraint on the few available road infrastructures in most developed and developing nations of the world. One of the consequences of this is traffic congestion. Traffic congestion arises when the road system approaches vehicle capacity [8-10] can also be defined as the obstruction to traffic because of the interrelationship between moving vehicles and traffic volume. This may be due to the depletion of road infrastructure as avowed by [11-12].

Consequently, this poses a lot of negative effects on road users as transportation by road accounts for the highest modal choice globally [13]. The negative effect of this includes the increase in tailpipe emissions, delays, environmental impact, among others [9-10]. The overall effects of traffic congestion can be broadly be categorized under the following:

- i. Health effects
- ii. Environmental effects
- iii. Economy effect [14]

Additionally, there are multiple externalities (Victoria Transport Policy Institute) from traffic congestion which has not been characterized based on the peculiarities of regions [15] avowed that multiple factors can complicate the disparity between economic and public health impacts of traffic congestion. Some of the non-linearities in transportation systems and variability globally are salient factors. To buttress this, the author affirmed that an increase in traffic volume could lead to a larger increase in delay in which case congestion will follow a non-linear function.

## 2. Review of Literatures

### 2.1 The negative effect of traffic congestion

Traffic congestion makes life in cities uncomfortable for people. Every year governments spend

huge budgets to solve this problem. The congestion problem is a common problem among developed and underdeveloped countries, so, it is a global problem [16-18]. This is because too many people want to move at the same time using the same road infrastructure. This is especially the case for compulsory trips. Invariably, this accounts for the high traffic volume in the morning and evening [3]. Additionally, the research of [19] avowed that increase in income and living standard favours the ownership of automobiles. The use of personal vehicles for both intra and intercity trips increases traffic congestion too. This is because most automobile owners find it more convenient and flexible for making trips. Additionally, an increase in household income also prompt people to shift modes from a slower or less expensive transport mode to a faster a mode often at a higher cost [3]. Contrarily, the study of Greco et al., 2005 asserted that an increase in the population a strong indication and pointer to an increase in population.

Demand for highway travel by people continues to grow as population increases, and as the standard of living increases. Figure 1 showed the increase in traffic congestion in Europe over seven (7) decades, particularly in the metropolitan area. This results when traffic demand approaches or exceeds the available capacity of the road system.

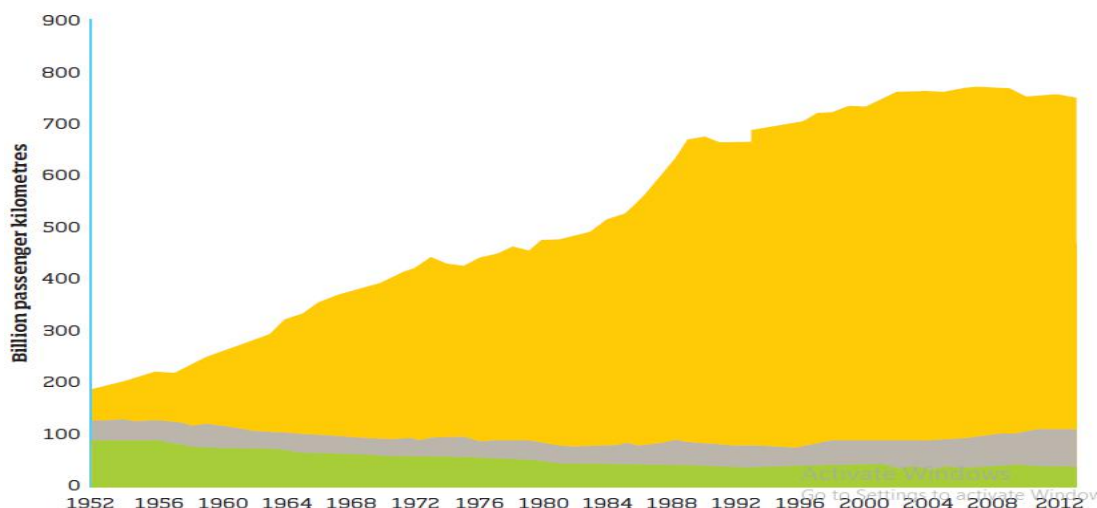


Figure 1: passenger transport by mode 1952 to 2013 (Transport Statistics Great Britain 2014)

Source: Department for Transport.

## 2.2 World's most trafficked choked cities

In a bid to come up with a sustainable and efficient transportation system, there is a need to monitor traffic conditions in real-time in a bid to reduce accident prone conditions. Most trafficked cities (Table 1) have serious traffic crashes too. Traffic congestion if left unattended, can influence traffic accident rates [20]. The research of [21] has established a positive relationship between accidents and Average Annual Daily Traffic (AADT/ road capacity). The outcome of research in Oregon, USA [21-23] showed that increases traffic volume increased accident rates. However, when single-vehicle accidents were considered, the relationship was the opposite and accident rates declined as traffic volume increased.

The same author affirmed that Level of Service (LOS) is another factor that affects traffic congestion and traffic crashes [22-28]. When using aggregated data from four classes of roads,

Dickerson, et al, 2000 produced the typical linear relationship between traffic flow and a number of accidents.

Table 1: World's most trafficked choked cities in 2019 and 2020

World's most trafficked choked cities 2019			World's most trafficked choked cities 2020		
City	Country	Percentage	City	Country	Percentage
Bangalore	India	71%	Bangalore	India	71%
Manila	Philippines	71%	Manila	Philippines	71%
Bogota	Colombia	68%	Bogota	Columbia	68%
Mumbai	India	65%	Mumbai	India	65%
Pune	India	59%	Pune	India	59%
Moscow Region	Russia	59%	Moscow	Russia	<59%
Lima	Peru	57%	Lima	Peru	<59%
New Delhi	India	56%	New Delhi	India	<59%
Istanbul	Turkey	55%	Istanbul	Turkey	<59%
Jakarta	Indonesia	53%	Jakarta	Indonesia	<59%

#### Highway and network management (2020).

##### 2.3 Categorizations of Congestion

An efficient transportation system is pivotal to the economic growth and development of any nation; it provides links to the various amenities needed for survival. It also provides access to different countries in the globe [30]. A good-established transportation system is not the only key to national growth but also serves as a catalyst for the economic development of a country. Thus, there is a relationship between transportation and productivity [31].

One of the frequently used categorizations of congestion is Vickrey's differentiation, in which successive phases of increasing disruptions in the vehicle traffic are considered [32-33]. It is worthy to note that Congestion also exists on the rail network with overcrowding arising in recent years. This as a result of the demand for railway facilities being higher than its capacity during peak hours. Triple convergence which is one of the least understood aspects of peak hour traffic congestion should be worked on for further studies.

In proffering a solution to this problem, empirical studies have shown that households in compact mixed land use own fewer vehicles and makes fewer trips. Additionally, this set of people make shorter trips (shorter trip lengths). To this end, a well-designed a well-designed land use gives commuters the options of assessing other travel modes such as transit,

ridesharing, walking, or biking, since they are not auto-dependent once at the site [34]. Other sustainable solutions to traffic congestions and the drawback are as shown in Table 2.

Table 2: Sustainable Solutions for traffic congestion reduction

S/N	Solution	Drawbacks	Country/region	Author
	Charging off peak-hour tolls.	<ul style="list-style-type: none"> <li>i. The poor will be at disadvantaged</li> <li>ii. Double taxation will occur</li> </ul>	Singapore, Norway, and London	[3]
	Expanding road capacity.	<ul style="list-style-type: none"> <li>i. This is expensive</li> <li>ii. May be impractical in some cities</li> <li>iii. Road under-utilization during non-peak hours.</li> </ul>	Most developing and underdeveloped Nations	[3]
	Expanding public transit capacity	May be ineffective as traffic congestion is usually in a few concentrated large, densely settled regions	Developed and developing nations	[3]
	Educating the road users	Not all populace's will be captured	Developing and underdeveloped nation	[14]
	Improving the existing infrastructure for increasing capacity.	Unsuitable in the long run		[35]
	Signalizing an uncontrolled intersection	Identified as the migration of congestion		
	Setting up of mobile courts	The frequent strive action of the public transportation union partly face it to park up	Nigeria	[14]

Municipal bus transport	It is not a permanent solution	Developing and underdeveloped nations	[14]
Re-distribution of the temporal pattern: <i>StaggerWork Hours</i>	Staggering of work hours. It is cumbersome and not effective for some job type	Developing countries	[14]

#### 2.4 Long term Strategy

The long-term strategy of combating traffic congestion involves the following viz:

- i. A land-use strategy compatible with transport capacity- This method involves the modification of the main radial city arteries as a high mobility road for commuter travellers. The approach also involves the banning of parking, and the prohibition of right turns while introducing traffic signals.
- ii. A Vehicle Ownership strategy compatible with road capacity: This approach utilizes the feature of choice of travel as an increase in vehicle ownership increases the need for road space and parking space. To this end, the effective utilization of this method involves the knowledge of the level of vehicle ownership that can be sustained in the city
- iii. A strategy for public transport compatible with population density: Public transportation is an essential mode of transportation in densely populated regions. As income and population increase, public transportation is a viable option.
- iv. As a part of the strategic planning process, the need for new modes of public transportation should be introduced. This is because as the income increases, the higher the need for better and sophisticated transport modes. If this is not available, then the use of a personal car will increase

Traffic congestion Reduction Measures: Vision 2030

Table 3:

		Value for money	Costs	Congestion reduction potential
1	Efficient pricing	excellent	revenue-neutral	excellent
2	Reform of bus services	excellent	inexpensive	very good
3	Parking control and enforcement	very good	revenue-neutral	moderate

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4	Car clubs	good	very inexpensive	limited
5	Connected car	good	inexpensive	moderate
6	Bus rapid transit (BRT)	moderate	moderate cost	moderate
7	Light rail and trams	moderate	expensive	good

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Source: Royal Academy of Engineering (2015).

### 3. Conclusion

This review of literature assessed the effect of the myriad of traffic congestion which is a global problem with a view to proffering a sustainable solution. The negative effect of traffic congestion was espoused. This was done by critically assessing the Traffic congestion Reduction Measures. Additionally, short term and long-term solutions were proffered in track with sustainable transportation planning. Also, the worlds most trafficked choked cities were espoused. The outcome of this review revealed that:

- i. Vickrey's differentiation is one of the most used categories of traffic congestion involving the increasing disruption of vehicular traffic.
- ii. The same author affirmed that Level of Service (LOS) is another factor that affects traffic congestion and traffic crashes.
- iii. A positive relationship exists between traffic congestion and traffic accident rates
- iv. A household with compact mixed land has fewer vehicles and so make fewer trips than other households.
- v. a well-designed land use gives commuters the options of assessing other travel modes such as transit, ridesharing, walking, or biking since they are not auto-dependent once at the site
- vi. the increase in population and car ownership has generated a lot of constraint on the few available road infrastructures in most developed and developing nations of the world

#### 3.1 Recommendation

Further research should focus on the effect of triple convergence aspect of peak hour traffic congestion

Recommendation for policy planners

- i. Policymakers should improve on the design of compact mixed land use as this will encourage the use of fewer cars, thereby reducing traffic congestion.
- ii. Non-motorized transportation should be encouraged by the design of pedestrian facilities.
- iii. Some essential social facilities should be constructed in a way that is clustered to make them conveniently co-located to aid accessibility.

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