EVALUATING TRAFFIC CONGESTION IN DEVELOPING COUNTRIES – A CASE STUDY OF NIGERIA.

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ABSTRACT

Road traffic congestion remains a global phenomenon that bedevils the cities of the world; especially developing countries, resulting in massive delay, unpredicted travel times, increased fuel consumption, man-hour and monetary loss. The phenomenon has arisen from poorly planned road network and traffic/management, resulting in elongated and unbearable traffic jams. Lagos – a megacity with over 15million people is chosen as a typical case study, being the fastest growing city in Africa.

In Lagos, for instance, several steps have been taken by the government on mass transit which includes the introduction of a **Bus Rapid Transit (BRT)** – first in Africa with its dedicated-lane, light-rail, and expansion of several roads, encouragement of water transportation and integration of different public transport system. There exist concurrent inter-city traffic congestion along major corridors such as Lagos-Ibadan and Lokoja-Abuja. It is prevalent greatly during weekends, public holidays and periods of major activities. Major causes of the congestion include lane indiscipline, high traffic density, low road network carrying capacity, poor traffic management and support infrastructure such as lay-bye, low response to removal of broken down and crashed vehicles.

This paper sets out to identify the diverse patterns of road traffic congestion in relation to human, road traffic environment and causative factors in a Nigeria's major city of Lagos, being the commercial nerve center of Nigeria and two major corridors, Lagos-Ibadan and Lokoja-Abuja, with a view to recommending some cost-effective and sustainable policy options for a better and enhanced intra-urban mobility.

The study findings revealed the pattern of road traffic bottleneck points, the health implications of congestion on road users, traffic management institutional arrangement and paucity of traffic management infrastructure.

The paper recommends the integration of an enduring urban traffic planning and management strategies, such as effective mass transit, strict land-use adherence, effective traffic control and enforcement and integration of traffic management institutions, mechanism at discouraging excessive car usage. The paper advocates for deployment of ICT tools in tackling the issue of traffic congestion and recommends a

co-ordinated integrated multi-model approach in transportation in general and traffic congestion resolution in particular

A. INTRODUCTION

Mobility is crucial to functionality of cities as it affects their socio-economic activities. It is also a fact that the economic development of a nation is closely linked to its transport system. Hindrance to effective mobility is road traffic congestion, which the World Bank (1999) stated that it constitutes about 54.5% of all noticeable urban transport externalities. This is as a result of the ever increasing urbanization, human activities and the resultant heavy dependence on road transportation that warrants increase in the number of vehicles, of different categories, on the road. Of interest also is the difficulty of movements on inter-city roads and other major corridors due largely to obstructions such as traffic crashes, broken down vehicles or certain land use activities located along these corridors or sheer traffic volume exceeding the road network capacity during festive seasons and some other major activities. The demand for transport especially in cities of developing countries has been on the increase following the rapid socio-economic growth and development of these countries. For instance, the rate of motor vehicle ownership and use is growing faster than population in many places, with the vehicle ownership growth rates rising to 15 to 20 percent per year. (Odeleye 2008). Traffic management has been quite poor in many developing countries, despite the growth in transport demand and supply. The resultant traffic congestion has become impediment to our livability.

Road traffic congestion, according to Goodwin (1997) can be defined as the impedance vehicles impose on each other, due to the speed-flow relationship, in conditions where the use of a transport system approaches its capacity. Banjo (1984), also defined congestion as the saturation of road network capacity due to regular and irregular reductions in service quality exemplified by increased travel times, variation in travel times and interrupted travel. Olagunju (2011) simply described road traffic congestion as a disproportion between the inflow and the outflow of vehicles into and out of a particular space. This is also in line with Ogunsanya (2002) conceptualization of road traffic congestion as a situation when urban road network could no longer accommodate the volume of traffic on it.

This papers looks at the causes of congestion and mitigation strategies with focus on developing countries and Nigeria as a mirror, using Lagos, the nation's economic nerve center and two major corridors of Lagos-Ibadan and Abuja-Lokoja as case studies.

B. FOCUSED AREAS

i. Nigeria

Nigeria has an area of 923,768.00 sq kilometres and lies between latitude 40 and 140 North of the equator and longitudes 30 and 140 East of the greenwich meridian. This is entirely within the tropical zone.

It is bounded on the West by the Republic of Benin on the North by the Republic of Niger and on the East by the Federal Republic of Cameroun. On the North-East border is lake Chad while also extends into the Republic of Niger and Chad and touches the Northernmost part of the Republic of Cameroun. On the South, the Nigerian coast- line is bathed by the Atlantic Ocean.

Nigerian roads are the most important means of transportation in the country, carrying 80% of the population and goods. There are 60,068 km of paved roads, which follow a grid system of North - South and West - East.(travel-business-country.com)

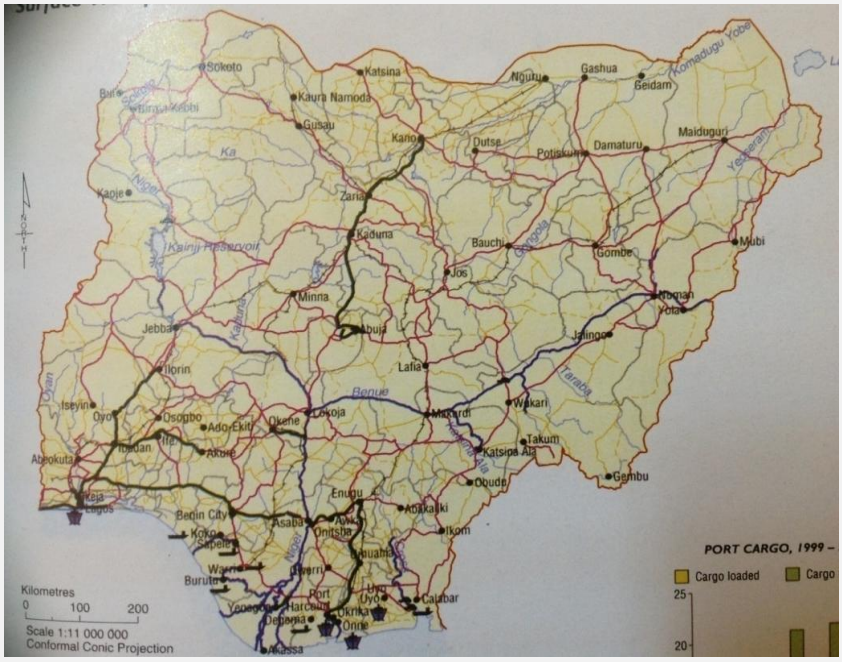


Plate 1: Road Map Of Nigeria

ii. Lagos

Lagos is a mega city in the South Western part of the country. Lagos state is situated within Latitude 6 degrees and 23'N and Longitude 2 degrees and 3 degrees 42'E. The more built up Mainland and Lagos Island make up the areas referred to as Metropolitan Lagos which accounts for about 80 % of the population of the state (Merem and Twwwumasi, 2008). Lagos with Population of 9,013,534 according to the National Population Census of 2006 is about 6.4% of the country's population. Taiwo (2005) stated that while Nigeria's population density is 100 persons per square kilometer, that of Lagos is about 2,400 persons\km^2 with annual population growth of 5.0 to 5.5%. It should also be noted that the Lagos State Government citing the United Nations' estimates among others disputed the official Population figure for Lagos as it believed the Population of the city should be around 20millon people.

Lagos with an area of 3,577 square kilometers is the smallest state in terms of land area in Nigeria. It represents only 0.4% of the country. However, the Federal Road Safety Corps records on vehicles and drivers revealed that Lagos with its 0.4% land mass, even with about 60% under water, accommodates about 25% of total vehicles and drivers in Nigeria. In terms of relating the road network capacity with the vehicular population, while the national vehicle per kilometer is about 16, Lagos has about 200. Road, water, air, pipe and rail transport modes are in use in Lagos, but the road mode accounts for more than 80% of all movements, Olagunju (2011)

Lagos has a total of 117 federal roads of 509.97km, 3,028 of State Government roads totaling 5,816.71km and 6,451 Local Government roads of 3,573.7 km. (Road Statistics, LSMW & Office of Infrastructure (2006).

iii. Lagos – Ibadan Expressway

The Lagos – Ibadan expressway unarguably is one of the busiest roads in Nigeria. The 127.6 km road was the first intercity dual carriageway in Nigeria. The road was commissioned in August 1978. The road has undergone series of remedial works and rehabilitation but lacked major maintenance since the construction about thirty four years ago. However, the highway is undergoing a total reconstruction costing the Federal Government of Nigeria a whopping sum of 167 billion naira (about $1 billion US Dollars).

The road currently is sub- divided into two sections. The first section is an Expressway from old toll gate of Oregun Motorway/Ikosi, Ketu in Lagos State to Shagamu interchange in Ogun State. The length of this section is 43.6 km. The second section is also an Expressway from Shagamu end in Ogun State to Ojo in Oyo State. The total length of this portion is 84 km.

The Lagos Ibadan expressway is one of the most important access roads in Nigeria linking the economic nerve centre of Nigeria to various other States of the

Federation. From the Lagos- Shagamu exit, it links the southeast, South-south and middle belt of Nigeria. On the other hand, from the Ibadan axis it links the Northern parts of Nigeria through Oyo State to Kwara, Niger, Kaduna, Kano etc. The road played a significant role in the economic development of Nigeria for movement of goods from the coastal city of Lagos to the hinterland States, (Federal Road Safety Corps. 2013)

Of major interest is the location of major religious organizations worship centers that attract several hundreds of thousands of worshipers periodically compounding traffic on the road whenever major activities are taking place at the centers. Such centers include the Camp of the Redeemed Christian Church of God (RCCG) at kilometer 46, the Mountain of Fire Prayer Ministry at kilometer 1, the Deeper Life Ministry at km 42 and Nasrul-Lahi-L-Faith Society of Nigeria (NASFAT) moslem camp sited at kilometer 20 all from Lagos.

iv. **Abuja – Lokoja Expressway**

The Abuja – Lokoja expressway is a 200 km road which is also very important to the socio economic development of the country. The road which before the commencement of the on-going dualisation work was a single lane before it was awarded by the Federal Government of Nigeria in 2006. The road is characterized by high traffic density, gridlocks and excessive speed by the commuters usually leading to reported cases of road traffic crashes.

The road links the northern and the southern-eastern and western region of Nigeria through Kogi state to Edo, Benue, Ondo, Osun, Enugu and Lagos to the South and also links the Northern states of Niger, Kaduna, Kano and Katsina to the North west and the North central States of Nigeria.

The initial construction of the road was completed in 1976.The road crosses on the river Benue at Lokoja, in Kogi State on a stretch of length of about 500 meters known as the Murtala Mohammed Bridge. The road witness high traffic volume of various categories of vehicles such as articulated vehicles and other commuters.
Presently, the road is under construction of major rehabilitation with the transformation of the road from the initial single lane to a dual carriageway, which is billed for completion before the end of year 2015

C. CONGESTION COSTS

Traffic congestion constrains the growth of Gross Domestic Product (GDP), Hook (1998) as it continues to impact negatively on cities economic environment. The consequences of traffic congestion include productivity loss, change in accident frequency and characteristics, increase in air pollutants and emissions, increased

vehicle operating costs and increased noise nuisance (Serageldini, 1993). The resultant effect could include relocation of businesses and homes from congested areas to more favorable locations forcing down the values for land and houses in addition to degradation of other economic values in such areas.

Sanders (2015) revealed that the cost of congestion in the United States of America included 87,606 crashes in work zones, 1,200 deaths, 37,476 injuries, 482 million hours lost in driver delays and $6.5billion lost time. Sanders also identified the accident costs to include property and medical but that the user delays costs are often the largest cost. The user delay from increased accidents and user delay from reduced lanes are enormous. Also identified as part of congestion costs are increased fuel consumption and reduced air quality.

The Nairobi city traffic jam costs Kenya 37 billion shillings annually, the country's Transport and Urban Decongestion committee reported, (This is Africa, 2014). McGregor and Malingha (2014) also put daily traffic cost of Nairobi at $570,000. Mobereola (2012) disclosed that commuters in Lagos spend on average 40% of their income on transportation. The World Bank's 2010 Cairo Traffic congestion study estimated the annual costs of the congestion in Cairo to be up to US $8 billion which is up to 4% of Egypt's Gross Domestic Product. The cost worldwide, especially in the developing countries is better imagined. Some cities in Africa with heavy congestion costs are; Lagos, Nigeria; Dar es Salaam, Tanzania; Kampala, Uganda; Gaborone, Botswana; Lusaka, Zambia; Khartoum, Sudan; Nairobi, Kenya; Johannesburg, South Africa; Cairo, Egypt; Addis Ababa, Ethiopia; Kinshasa, Democratic Republic of Congo and Luanda, Angola.

Reduced social interaction is also a cost of congestion as people are discouraged from social trips due to increased travel time that could also raise health challenges. Congested routes also attract raised transport fare.

Plates 2 & 3: Traffic Congestion In Lagos

The effects of road traffic congestion are visible on the economy, infrastructures, environment and health. The actual economic impacts of traffic congestion can differ from one area to other, depending on its economic profile and business location pattern. There have been prior attempts to estimate the economic impacts of congestion through business surveys, including most notably research in Chicago and Philadelphia. Weisbrod, Vary, and Treyz (2003) examined how various producers of economic goods and services are sensitive to congestion, through its impacts on business costs, productivity and output levels. As a result, it recognized different types of congestion costs, such as:

- **Travel Cost**: Congestion has an impact on the travelers (the added time) as well as increase costs of vehicle operators (fuel and spare parts) are the key components of travel system inefficiency.

- **Additional Business**: Operating Costs: Traffic congestion can impose additional costs to businesses associated with freight and service deliveries. For instance, delays in delivering time-sensitive freight in some cases can impose additional inventory and logistics costs of receiving and distributing the products, as a result a great impact is fall on the end users.
- **Man-hour loss**: The man/hour loss due to delay in traffic congestion is huge. This is a disadvantage for business men who must meet appointment and supply goods and services on time to clients who must meet set time and targets.

Other costs include;

- Pressure on road infrastructure: Roads infrastructures such as bridges and interchange bearing undue burden of traffic congestion. Bridges on such roads carry rest weights of vehicles that have to queue on them. The rest weights of these vehicles take a toll on the bridges with time, decay sets in earlier than expected. The roads too, develop pot holes and failed portions due to the weights of over loaded articulated vehicles,
- Global Warming: Most of the vehicles on the roads now are powered with derivatives from fossil and other hydrocarbons. The carbon monoxide emit by them warm up the environment so much so that the ozone layer has been so badly affected and the infrared wave now penetrates in the atmosphere causing green house effect. The ozone layer has been seriously depleted resulting in global warming affecting the climate.
- Health challenges: The emissions from motorized vehicles not only affect our environment but also our health. The effect of carbon monoxide on human and animals is devastating. Choking as a result of air pollution, high blood pressure and tension due to road rage are all after effects of prolonged stay in road traffic congestion. Al-Morgrin (2005) asserted that lead poisoning occurred more frequently due to traffic. He further identified the symptoms of lead poisoning to include vomiting, constipation or bloody diarrhea with central-nervous system effects such as insomnia, irritability, convulsion and even death. Other symptoms include headache, weakness and constipation.

D. WHY CONGESTION?

i. Vehicular Density

Once the vehicular density exceeds the designed capacity of a road network, a 'dead weight' or traffic congestion sets in and the intensity increases with more vehicles getting to the spot than leaving the point. Banjo (1984) revealed that congestion can be categorized into recurrent and non- recurrent congestion. Recurrent congestion is caused by factors that relate to rapid growth in population, urbanization and related growth in car ownership and use. Recurrent congestion occurs mainly when there are too many vehicles at the same time, consequently reducing traffic speed and increasing personal commuting time. This occurs typically during peak hours but can also occur off- peak i.e. at other weekday hours and during the weekend. On the other hand, non-recurrent congestion is associated with random conditions or special

and unique conditions, including traffic incidents (ranging from disabled vehicles to major crashes), work zones which slow traffic down and weather and special events. From this definition, the drivers, both the patient and the impatient, are responsible for the traffic build- up. Non recurrent congestion is associated with random, special and unique conditions such as obstructions from broken down vehicles, road traffic crashes and weather hence very difficult to predict and tackle.
Definitely, Lagos with 0.4% of Nigeria landmass accommodating about 25% of national vehicular traffic is faced with high vehicular density.

ii. **Urbanization And Increased Motorization.**

Closely related to vehicular density is urbanization which leads to increased motorization. Urbanization and increased motorization without corresponding increase in infrastructure and transport services form major causes of congestion. Odeleye (2008) postulated that the traffic congestion problem of Lagos is the imbalance in the travel supply-demand in the road traffic environment. The imbalance, according to him is visible to the geometric increase in the level of motorization and population of the city, without a commensurate level of growth in the provision of road traffic infrastructure, as well as multimodal mass transit facilities.

Plate 4:The Lagos Traffic- Effects Of Urbanization And Motorization

iii. **Dominance Of Low Capacity Minibus Taxi/ Overreliance On Road Mode**

A 2009 World Bank study revealed that the most popular form of public transport in most African cities is the minibus taxi because publicly run bus services are scarce, costly and inefficient. The problem with minibus taxis is their limited capacity of 15 to 20 passengers each. Their proliferation poses many problems including traffic

congestion, air pollution and frequent traffic accidents, Pabst (2014). A standard bus system can convey about 8,000 passengers in an hour, while an electric tramway system can carry about 20,000 people per hour while a Light Rail Transit (LRT) can convey 30,000 passengers per hour compared to 50,000 persons per hour for a Subway System.

Introduction of the Bus Rapid Transit (BRT) in Lagos in 2008 to serve major corridors and the under-construction LRT in the neighborhood of Okokomaiko, Iddo and Marina, which is isolated from vehicular traffic are meant to ease congestion and improve mobility in the city. The BRT which relies on the use of dedicated lanes separated from the main traffic is fast and reliable. Lagos Metropolitan Area Transport Authority records indicate that the system uses 220 buses to move more than 200,000 passengers daily between the hours of 06.00 and 22.00. The records also showed that over 400 million passengers have been conveyed in the last five years of the BRT operation in the state. The essence of the BRT is to improve mobility and transport affordability in the city of Lagos. (lamata.ng.com). Water transport has also attracted increased attention of the Lagos State government to enhance intermodal coordination of the city transport system.

Most countries in the developing world haul freight and petroleum products by road. These are conveyed to distance places by articulated vehicles. Fuel depots are often located along major highways. The parking lots provided for waiting vehicles are by the road side. At the peak of time, the park spaces are full and those that cannot be accommodated within the parking lots park along the road side, this further narrows the road and hinder flow of traffic. A breakdown or crash along such roads usually results in traffic congestion. Ogere, on the Lagos-Ibadan express road and Apapa in Lagos are good examples of such locations. In a normal situation petroleum products are moved through the pipelines and using the rail. Rail also has comparative advantage over the road in freight movements. These would have reduced the volume of these 'tankers and trailers' (articulated vehicles) on the road resulting in better traffic flow and management.

Plates 5 & 6: Bus-Rapid Transit In Lagos

iv. Improper Land Use

Rapid urbanization without proper land use planning especially in the location of certain specialized activities such as concentration of workplaces in some areas, residential and recreational facilities in some other areas and often far from each other results in crisscrossing movements compounding traffic problems. Most often, traffic impact assessments are not carried out before facilities are located in the cities. The problem is more severe during the peak hours as most people resume and close from work respectively in the morning and evenings at the same time. Inappropriate sitting of certain facilities such as having many of the high traffic attracting religious worship centers on the Lagos-Ibadan expressway also constitute major traffic nuisances.

Also, most public facilities such as banks, shopping malls and petrol stations are, for ease of access to them, located at road junctions. They are so located for ease of patronage but the influx of vehicles to these places and the non provision of car parks often create traffic bottle neck. Motor parks, especially 'trailer parks' for articulated vehicles are illegally located on the road, causing traffic congestion at such points. There are about 250 of such collated by the Federal Road Safety Corps (FRSC) nationwide. On the Lagos-Ibadan, we have such parks at Mowe, Ibafo and Ogerre. These areas are known points of traffic obstructions on the road. Apapa is also notorious for 'trailer parks' induced traffic congestion in Lagos. In some instances too, markets are also located along the road. FRSC records revealed that there are over 200 improperly located local markets along major highways in Nigeria. The buying and selling on the road slows down traffic and exposes a lot of the traders and their patrons to injuries and deaths through road traffic crashes that further compound traffic situation when they occur.

Plate 7: A Market Located On A Major Nigerian Road

Plate 8: An Illegal Trailer Park

v. Frequent Breakdown Of Vehicles And Road Traffic Crashes

In most of the developing countries, particularly in Nigeria, most of the vehicles on the roads are used vehicles, popularly known as 'tokunbo' imported from Europe or America. The maintenance culture is very poor. Such vehicles, left at the mercy of near illiterate mechanics and fake spare parts vendors, often break down and cause the already narrow road to further get choked. Broken down vehicles, and those involved in crashes that are not immediately cleared away from the road often cause traffic to build up and hence the inevitable resultant traffic congestion.

Plate 9: FRSC Removing Obstruction Away From The Road

Plate 10: A Crash Scene :A Vehicle On Fire

vi. Low Road Network Capacity, Poor Infrastructure And Road Conditions

In most African cities the road network is not expansive to carry the potential traffic. It is an issue of battling with low resources; hence new modern and expansive roads cannot be accommodated in their budgets while they also find it difficult to secure international financing for such projects. In some others, they are limited by harsh topography. There is a limit for example, to expansion of road network in Lagos because of the large aquatic environment. Lagos-Ibadan express has low capacity and it is presently been expanded while the Abuja-Lokoja road is just being dualized to increase its capacity too. When the capacity is low, there will be many vehicles competing for a little space, hence traffic congestion. Road condition is also a major factor of road traffic congestion. Bad roads, narrow roads, collapsed and failed roads affect free traffic. This situation causes traffic congestion that can be chaotic.

Non provisions of good road furniture like road signs; absence or inappropriately located bus stops, car parks, lay bye, traffic lights among others also affect free flow of traffic, hence traffic congestion. Non stable power supply is also a major issue as traffic lights powered by public power supply which is erratic, hardly work in many places resulting in confusion on the road. Trams and other electric transport system cannot be introduced in an environment of epileptic power supply hence more pressure is exerted on the road daily.

vii. Security Checks

The security challenges facing many countries presently have necessitated the need to tighten security network. Insurgents often use cars loaded with Improvised Explosive Devices (IEDs) to cause havocs. Nigeria has had a fair share of this ugly experience with the 'Boko Haram' issue and has taken drastic measures to mitigate its occurrence. One of such measures is the stationing of military check points on major corridors and at the entrances and exits of all the major cities in the country. These check points have caused the roads to be so narrowed and have greatly slowed down traffic to a bottle neck situation. Some roads have been closed while traffic on some others has been re-routed for security reasons. Road traffic congestion abounds on major roads in the cities and many corridors across the nation. Lagos city, Lagos-Ibadan and Abuja-Lokoja roads do experience security induced congestion on daily basis.

Plate 11: Traffic Situation Is Compounded By Long Queues of Vehicles Caused By Security Checks Of Vehicles

viii. 'VIP' Movements

There is a culture of 'VIP' movements in Nigeria as well as in most African countries. When political leaders and senior government officials are moving on the road, the roads they are using might be closed to other road users. Siren blarring pilot and escort vehicles lead a convoy of vehicles conveying the 'VIPs' which simply means Very Important Persons, (apology to the Nigerian musical legend, late Fela Anikulapo Kuti). The effect of such movements and closure of major roads during VIP movements is enormous on traffic while the 'big men' movements last. There is usually a heavy traffic congestion. The 'importance' of the personalities determines the duration of such movements and the consequence effects. The distortion in the traffic equilibrium is usually high and it may take a long time to get normal traffic restored.

ix. **Poor Travel Information**:

Proper and adequate information to promptly guide and direct motorists and other road users will aid their decision making. When guiding information does not exist, they are bound to make mistakes which could be costly in terms of drivers changing lanes. Sudden exiting or entering main roads could cause road traffic crashes which will in turn compound traffic situation and result in traffic congestion.

x. **Fewer/Narrow Lanes**:

When the lanes are few, the capacity of the road is small or reduced and the inability of the carriage way to adequately accommodate the vehicular volume will result in congestion. Same goes for situations where the lanes are narrow.

xi. **Construction Activities**:

Road construction activities which could lead to blockage of the carriage way or part of it or diversion of traffic will result in forcing the traffic to slow down, hence, traffic congestion.

xii. **Lower Speed Limits**:

When the speed of vehicles are slow in built up areas or work zones, more vehicles will arrive those points than leaving the areas which may result in traffic congestion.

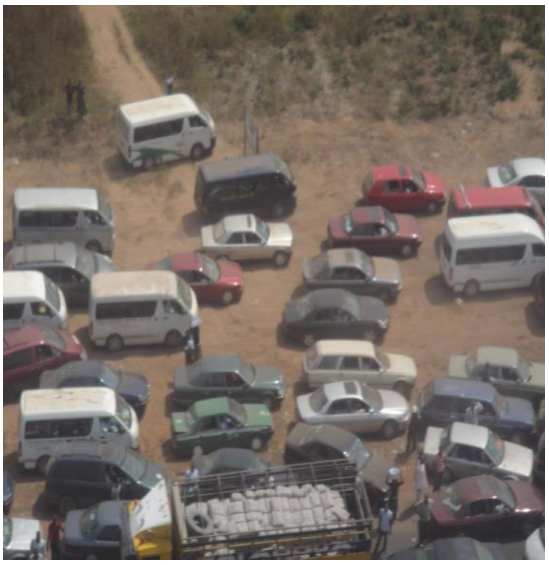
xiii. Traffic Law Violations And General Indiscipline

A lot of Nigerian motorists, especially in cities like Lagos violate traffic rules and regulations. Many of them drive against traffic, park in wrong places and repair their broken down vehicles right there on the road without giving any consideration to the effects of their actions on the traffic. Many of the users perceive law enforcement as weak hence quick to disobey the rules. A lot of road users are impatient as they form multiple lanes or move to the other lanes for oncoming traffic whenever there is an obstruction on the road. These actions, of course create traffic problems. Hawkers also sell their wares in the traffic and while relating with their customers, they slow down movements. Some traders display their wares on the road reducing the lanes from two to one in major areas of Lagos communities. These are common sights in Okokomaiko, Agege, Ojodu, Berger, Pen Cinema, Iyana Ipaja, Ikeja areas, among others in Lagos.

Non-recurrent congestion occurs on Lagos-Ibadan and Abuja-Lokoja road whenever there are obstructions, mostly RTC related or as a result of security checks or when major religious activities take place in any of the major worship centers on the Lagos-Ibadan express road. Seasonal movements for celebration of Christmas, New Year or Sallah which normally attract some holidays are usually heavy. Because the traffic density is high, a delay caused by any obstruction to the free flow of traffic on the roads results in traffic congestion. Due to high level of indiscipline, many of the impatient drivers result to lane indiscipline and other form of traffic violations which in most times result in total gridlock as the roads are completely blocked, sometimes for several hours. Accessing the gridlock points by law enforcement officers and traffic control officials to clear obstructions or sort out the traffic problem, is also made impossible. Appraising the situation might also be very difficult except through aerial surveillance. Such traffic gridlocks usually span several kilometers and it takes several efforts of many hours to restore normal traffic. The effects of such 'standstill' are instantly felt nationwide.

Another form of indiscipline is when drivers of articulated vehicles blocked the road with their vehicles while protesting encounter of one or some of their coleagues from law enforcement agents. Such disruptions to traffic flow usually take several hours

as it takes a long time to agree to terms of negotiation. This attracts long queues of vehicles and huge man-hour loses. Traffic had been paralyzed many times on Lokoja-Abuja and Lagos-Ibadan due this blockade of the roads by this category of drivers.



Plates 12 & 13: Aerial Surveillance- Over Ten Illegal Lanes Formed By Impatient Drivers Outside The Normal Traffic Channel On Abuja-Lokoja Road As Captured From An Aircraft During Aerial Surveillance By The Author

E. ADDRESSING THE TRAFFIC CONGESTION PROBLEM

Webber (2000) postulated that 'the most publicly attractive solution is to provide sufficient roads for all vehicles wishing to use them'. He however asserted that the approach 'is just not practical. Even cities as rich as Los Angeles are unable to provide sufficient road space to eliminate heavy traffic congestion on their freeway networks. A more politically difficult option is to restrict the use of cars. This, too, has not proven to be practical except in dictatorial regimes'. Roth (1999) on his part identified five categories of solutions which were 'add roads, restrict the use of cars, improve public transits, change land use regulations or charge fees to use the most congested roadways. A sixth approach which is do nothing while hoping that congestion itself will discourage excessive car use –is rarely preached but often practiced by cities authorities'. Shopade (2010) stated that since traffic congestion or traffic jam as the case may be is a classic demand and supply problem it may be solved by either increasing road capacity (supply) or reducing traffic (demand). He also identified the limitations of the two approaches and stated that 'different situations require unique solutions which may include the application of either one of the two approaches or the application of both the approaches in varied degrees in order to come up with a solution which optimizes road space utilization at the most economical cost'. Shopade then suggested a three tier approach of Tactical measures

which entail early detection of incidents on the motorways; Strategic Measures that deal with actions to take once congestion arises; and Pre-emptive measures that look at ways of avoiding congestion altogether through studies.

Several efforts had been made in the past to address traffic congestion problem of Lagos. Apart from the physical traffic control efforts of the policemen and traffic wardens, the Odd and Even numbers restraint of 1970 under a military government was also introduced. Access to the Lagos Island then was dependent on whether the vehicle registration number was odd or even on specific days of the week. The arrangement did not solve the problem. Institutional arrangement which led to the creation of the Lagos State Traffic Management Authority (LASTMA) to enforce traffic laws, clear the road of obstructions and educate road users and also the Lagos establishment of the Metropolitan Area Transport Authority (LAMATA) saddled with the responsibilities to improve the traffic environment and infrastructure that would improve mobility in the state. LAMATA also midwife the Bus Rapid Transit (BRT) which conveys on the average 200,000 passengers daily and had conveyed over 400 million in the last five years of operations. A Light Rail Transit (LRT) is also about to be commissioned. The road network in Lagos has also been improved in the last ten years. A specialized Traffic Radio, broadcasting traffic situations in the city has also been established by the government. Definitely these strategies, which could be copied by other developing countries, have impacted greatly in improving mobility in Lagos.

Also, the expansion of the Lagos-Ibadan expressway and the dualization of the Abuja-Lokoja highways, when completed will improve traffic situation on the two corridors. The activities of the Federal Road Safety Corps, the lead agency on road safety in Nigeria and the Federal Roads Maintenance Agency (FERMA) have also been assisting in mitigating congestion and ensuring safer mobility on the major corridors, including Lagos-Ibadan and Abuja-Lokoja highways.

The road map to further tackle the problem of traffic congestion that I am presenting looks at the Congestion Mitigating strategies that also involve the use of technology.
These are proactive and congestion management strategies that are to enhance mobility in our cities and on the major highways

i. **Research**

Research into the causes of congestion in different parts of the city and on different corridors is necessary since different areas could present unique situation requiring different solutions. The mistake many city authorities make is the belief that they can replicate solutions that worked in other climes without conducting any

study to determine the suitability or that the same strategy is applicable in every part of the city.

ii. Expanding The Road Network

Roads and other transport infrastructure in the cities should be continually expanded as efforts should be made to attract local and international financing.
This will improve mobility through the supply angles.

iii. Traffic Monitoring

I strongly agree with the deployment of technology to ensure that incidents on the roads are detected as soon as they occur as proposed by Shopade (2010). Installation of traffic sensors to alert relevant authorities on abnormal flow or obstructions could aid prompt mitigating responses before congestion actually occurs. This also tallies with Sanders (2015) idea of Smart workzone where technology such as radars, bluetooth, cameras, and computer system are deployed to monitor traffic. Close Circuit Television (CCTV) and some smart traffic monitoring devices are required in Lagos and other major cities for evident based traffic management. Major intercity corridors should also be enveloped with smart devices

iv. Positive Traffic Guidance

Motorists, motorcyclists, bicyclists and pedestrians need clear and traffic guidance through built up areas such as work zones. The process by which this is accomplished is termed Positive Guidance, Sanders (2015). This eliminates traveler's confusion that can lead to crashes which creates traffic problems.

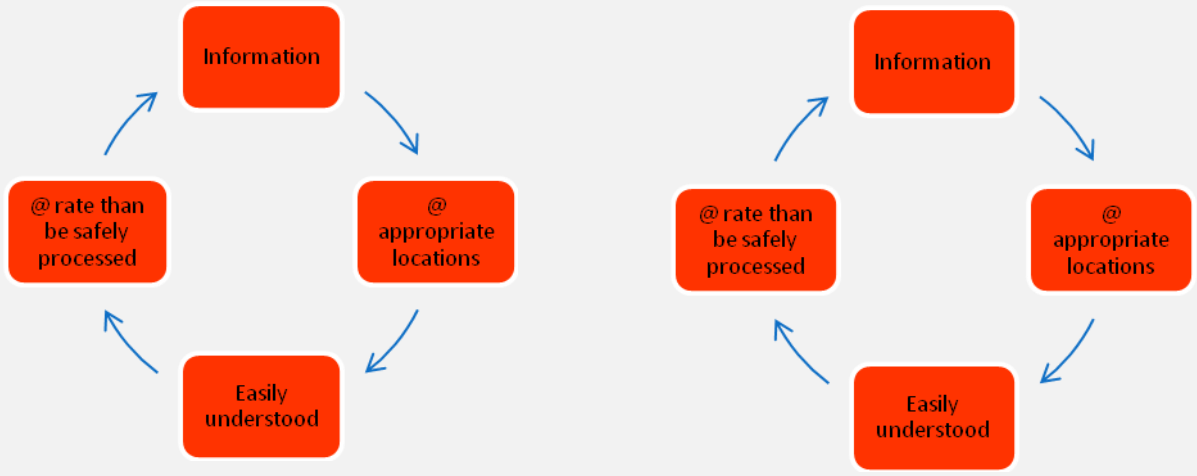


Plate 14: Positive Guidance In Work Zones
Basic Principles *(Source :Irf Webinar: Work Zone Congestion Mitigation, February, 2015)*

v. Providing Road Users Traffic Situation Reports In Real Time

Smart system uses technology to give motorists real-time traffic information to increase safety and allow making safer, more efficient driving choice as they commute in the city.

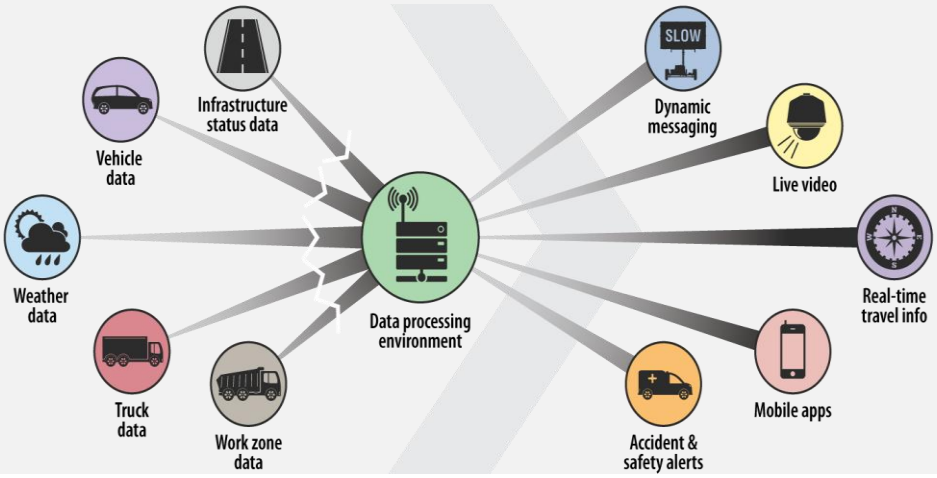


Plate 15: Its Data Capture & Management *(Source:IRF Webinar: Work Zone Congestion Mitigation, February, 2015)*

Wikipedia (2013) revealed that Nigeria has a total of 181,345,953 connected telephone lines. This can aid Intelligent Transport System as subscribers could be made to download application on traffic information. Such apps could be free or attracting a token. Information on congested routes, crash reports, obstructions on the highways, route diversion, and road closure among others could be provided to road users that subscribed to the arrangement for good and safer timely decisions to be made by travelers. Geo-fencing could be deployed to filter information that may not be useful as information on cities or routes located in far places from the subscribers may not be desired. There should be interactive arrangement for the subscribers to also provide verifiable traffic information on their locations to guide other road users. This is known as 'crowd sourcing'

Traditional media such as the print and electronic media can also be used to inform road users of traffic situation in Lagos and other major cities and on main traffic corridors. Over 80% of Nigerians have access to the mass media, especially the radio. More traffic radios for real –time information on traffic situation should be established while radio and television stations are encouraged to have traffic reports as part of the programmes.

Social media such as the Facebook, twitter, LinkedIn, Instagram, among others can also be used to provide traffic and crash reports. When quality information is made available to road users, they are able to plan their journeys, decide on options of alternative routes or modes among others.

Plates 16 & 17 Frsc Facebook And Twitter Accounts

vi. Emergency Toll Free Telephone Number

There should be a 3-digit emergency toll free telephone number which will assist users of the road in reporting obstructions, crashes and other emergencies. They are encouraged to make good reports as the line is toll free. FRSC Nigeria, for example uses 122 while 112 is being used on national level as the country's emergency number.

Plate 18: Frsc, Nigeria Emergency Toll Free Telephone Number

Plate 19: National Emergency Number

vii. Control Of Traffic At Construction Zone / Ramp Metering

There should be proper traffic control at construction zones in the cities and on major corridors where road rehabilitation activities are ongoing. In most cases, traffic officials are deployed on traffic control at such places. However, authorities could try **'Ramp Metering'**. The application of control devices to regulate the number of vehicles entering or leaving the freeway, in order to achieve operational objectives is known as Ramp Metering. It is also known as 'Merge Signals' or 'Flow Lights'. It is used in large metropolitan areas and has been shown to reduce traffic congestion and increase overall safety, Heydt (2015)

Plate 20: What Does Ramp Metering Look Like?

SOURCE: IRF Webinar: Work Zone Congestion Mitigation, February, 2015

Ramp Metering is not effective in every location. It worked well in some cities and has been discontinued in some others. A study could be conducted while it is deployed on a pilot or test running case to determine its usefulness in local situation like

managing traffic at construction zone or at security check points in Lagos and some other cities and major corridors.

viii. Proper Road Transport Regulation

There is also the need to properly regulate activities of transport operators as it is presently done in Nigeria through the Road Transport Safety Standardization Scheme (RTSSS). RTSSS, operated by the FRSC, makes it mandatory for all fleet operators (Organizations, Companies and Road Transport Owners) with at least five vehicles, to be properly registered and regulated to improve the safety of their operations. The concept of the RTSSS includes the following;

- Regulate road transportation in Nigeria
- Ensure safe and standardized fleet transport operations for all
- Check excesses of transport operators which often lead to loss of lives and property
- Entrench a culture of safety consciousness in organization and companies with fleet of vehicles

When operators abide by rules and regulations and yearly certification requirements, their vehicles will be well maintained, drivers properly trained and their operational activities will also be safe. Evacuation and rescue strategies are also expected to be put in place. That takes care of promptly removing their broken down vehicles on the highways before they constitute obstructions on the road. The drivers are also expected to be disciplined which will also discourage their involvement in blocking the road when aggrieved or other illegal activities such as driving against traffic.(see www.frsc-rtsss.org and www.frsc.gov.ng.

ix. Separating City From Inter-City Traffic

It is always better to have road developments where those who have no businesses in the cities can always use bypasses so that they don't add to the urban traffic. The construction of a bypass which makes it possible for vehicles from the eastern part of Nigeria not come into Benin City has reduced traffic congestion in the city. Many cities like Lagos need such ring roads.

x. Inter-Modal Coordination And Good Transport Planning

There should be proper planning which will make all transport modes of transport properly engaged in areas where they have comparative advantage. This will reduce the pressure on the road. The BRT and LRT as well as the development of water transportation in Lagos are quite positive.

There is need for proper transport planning that relates land use with traffic. Traffic impact assessment should always be carried out before location of facilities

in our cities and on major roads. There should be a design around the major religious centers on Lagos Ibadan to remove or lessen the traffic conflicts around the worship centers.

xi. Traffic Management

Indiscipline is a major factor of traffic crises in our cities and on our roads. Oyeyemi (2015) believes that enforcing traffic laws strictly without fear or favor will enhance the livability of our cities. He also stated that traffic management agencies like the state traffic agencies such as the Lagos State Traffic Management Authority (LASTMA) should collaborate with the Federal Road Safety Corps to enforce the laws, educate road users, clear the road of all sorts of obstructions and evolve strategies that will lead to safer road culture in Nigeria.
With proper synergy among all the traffic management agencies and cooperation of all and sundry, movements in our cities and on major highways will be better.

Proper planning of transportation in the cities entails understanding the dynamics of the transport demand and supply. Relating transport service delivery to land use, infrastructural developments, law enforcement and general traffic management is critical. These roles are presently scattered in different government institutions and establishments that are not usually be on the same page. There must be effective inter modal coordination which is basically the deployment of modes with comparative advantages to enhance improved mobility and affordability. These have not been the case in managing traffic in many of our cities. Though there have been some positive efforts such as the introduction of the BRT, LRT and the establishment of the Lagos Metropolitan Area Transport Authority (LAMATA) and the Lagos State Transport Management Authority (LASTMA) in Lagos, as well as the Federal Road Safety Corps and the Federal Roads Maintenance Agency (FERMA) at the federal level, more efforts in terms of proper funding will go a long way in making the organizations more effective in tackling traffic congestion matters.

Plates 21 & 22: The Capacity Of The Law Enforcement Agencies Must Be Enhanced

F. CONCLUSION

The enormous causes of Traffic congestion in major cities in the world have compelled evolving workable strategies which of course include huge deployment of technology to address the situation. There should be "home grown strategies " to tackle the unique situations presented in every city. This does not for-close sharing of experiences among city administrators to broaden their exposure as they get some of the borrowed experiences domesticated. Lagos has had a lot of strategies tested with some jettisoned and others working to improve the livability of the Megacity which is fast growing. New strategies must emerge to tackle or mitigate the ever present traffic congestion in the city. The non-recurring traffic congestion on major inter-city corridors such as; Lagos-Ibadan and Abuja-Lokoja also deserve the sustained attention of all traffic management institutions in Nigeria. It is hoped that the solutions proffered in this paper will assist smooth committing on our major corridors and in making the city of Lagos and other similar urban centers better places to live in.

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