

APPRAISAL OF TRAFFIC CONGESTION AT ROAD INTERSECTIONS AND ITS MANAGEMENT TECHNIQUES IN OSOGBO, NIGERIA

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ABSTRACT

This paper evaluates road traffic congestion in the major traffic intersections of Osogbo, Nigeria. The study uses primary data which were obtained through accidental and purposive sampling techniques from 250 respondents in Osogbo. Direct observation was also adopted in the study. The variables used in the analysis include: intersection characteristics, traffic volume and composition, causes and effects of road traffic congestion, land use activities and management techniques adopted for road traffic control. Analysis of variance (ANOVA) and frequency distribution in form of percentages were used for the data analysis. Findings from this study revealed that statistical variations exist in traffic flows and delays at the studied intersections as reported by Analysis of Variance (ANOVA) of $F=54.774$ and $P=0.000$. Also, high volume of traffic, parking problems and street trading were found to be the greatest causes of delays, while lateness to work is what respondents described as being the most undesirable effects of road traffic congestion at the road intersections in the city. The study recommends that the road intersections be signalized and vehicle parking be strictly prohibited at road intersections to reduce traffic congestion and delays at road intersections in the city.

Key words: Traffic congestion, Road intersection, Management techniques

Introduction

Cities are locations with a high level of accumulation and concentration of economic activities, which form complex spatial structures that are supported by transport systems. The transportation systems according to Berry and Hurton (1970) are the veins and arteries of urban areas linking together social and functional zones. One of the most significant urban transport problems is traffic congestion.

It is experienced when the supply of the urban transport networks can no longer meet the demand for them. Today nearly all cities in both developed and developing countries suffer from traffic congestion. It manifests itself

predominantly in recurrent queues, delays and time wastage which commuters experience along major networks especially during rush hours.

The problem of traffic congestion in urban areas is worse at road intersections. Indeed, there is no other point on cities roads that can be greatly congested as road intersections. As defined by O'Flaherty (2002), intersections (where two or more roads meet), are points of vehicle conflict. Similarly, Mchane *et al* (1998) noted that at no other location within the street and highway systems are so many potential and actual conflicts than at road intersections. This is because at intersections, vehicular flows from several

different approaches making either left-turn, through and right-turn movements seek to occupy the same physical space at the same time. In addition to these vehicular flows, pedestrians also seek to use this space to cross the street and thereby worsening the already bad traffic situation.

The issue of traffic congestion in Osogbo like many other state capitals in Nigeria draws significant attention each day. Intra-urban movements to work, recreational centres, markets, shops and schools are becoming more and more difficult and are characterized by discomfort, delays, waste of time, energy and resources. The problem is more pronounced during the peak periods of morning and evening when vehicles stand still in long queues resulting in stress and reduction in the productive hours of commuters. Although the situation in Osogbo has not grown out of control, signs of potential bottlenecks are already emerging along some routes. It is against this background that this study examines spatial variation of traffic congestion and management techniques adopted in curbing the ugly trend in Osogbo, Osun State capital, Nigeria.

Literature Review

Traffic Control at Road Intersections

Road junctions are major accident points in the road traffic system. If the traffic is light, and drivers obey simple traffic rules, then there might not be any serious conflict at road intersections. However, as the traffic volume increases, the risk of collision or accidents at road junctions increases. Traffic control measures at road junction therefore seek to ensure the safety of motorists and reduce delay at junctions due to increased traffic capacity of roads. Various techniques of traffic control at road intersections are available and they are discussed hereunder.

Traffic Congestion

Traffic Congestion can be defined as the incremental delay resulting from interference between vehicles in the traffic stream. Traffic congestion can be *recurrent* (occurring regularly on a daily, weekly or annual cycle, making it easier to manage) or *non-recurrent* (due to accidents, special events or road closures) (Galtina, 1999).

The term 'Traffic congestion' can be expressed as a result of too many vehicles crowding available road space along with a lack of alternative travel options (Gilbert, 1982).

Traffic congestion is pervasive in large regions and is worsening throughout the United States. In the future even small, urbanized areas are likely to experience congestion common in mid-sized areas today. The cause of this increase is not wastefulness but increasing population and preferences for private mobility, combined with limited additions to road capacity (Haget, 1972).

Increased use of the private vehicle Population and economic growth spur travel demand, which, in the absence of other travel options, results in disproportionate increases in the use of motor vehicles (Gilbert, 1982).

Traffic congestion occurs when a city's road network is unable to accommodate the volume of traffic that uses it. This situation is caused by rapid growth in motorization and with less than corresponding improvement in the road network, traffic management techniques and related transport facilities. Thus, traffic congestion is a phenomenon that is associated with urban environment all over the world. This is because we need transport to move from one place to another, especially when trekking becomes inefficient.

While traffic congestion has been managed very well in some developed countries, it has continued to defy solutions in the developing world. The forecast of Global Traffic Volume (GTV)

shows that the phenomenon would double between 1990 and year 2020 and again by 2050 (Lehman and Geller, 1990a). This type of growth pattern, as envisaged by the end of year 2020 and 2050, is an indication of what the future congestions portends for people living in urban environment (Ogunbodede, 1999).

Research Methodology

The **sample frame** for this study includes some major traffic intersections in Osogbo. They are: Olaiya junction, Okefia junction, Old garage junction, Dugbe junction, Gbaemu junction, Igbona adenle junction, Ayetoro junction and Oja-Oba central market junction. For **Sample Size**, the commuters in the 4 (50%) selected out of 10 motor parks (i.e. Oke fia park, Iwo-Ibadan park, Ikirun motor park and Ilesa garage) were sampled for questionnaire administration. The reason for this is that there is no way those board vehicles will not pass through these intersections of the study. Those who are willing to respond (accidental survey) among commuters and vehicle operators were given questionnaire to elicit information from them. **Purposive Sampling technique** was also used to gather information from the vehicle operator and commuters in the aforementioned motor parks. In all, a total of 250 questionnaire were administered and used for the analysis. Descriptive statistics was used to describe transport infrastructural facilities, incidence of traffic congestion, and traffic composition in the study areas. Analysis of Variance (ANOVA) was also used to examine relationship between road condition and incidence of traffic congestion in the study area.

The Study Area

Osogbo is located at the centre of Yoruba land (Osun central). It is about 96 kilometers by rail and 96 kilometres by road North – East of Ibadan, the capital of Oyo State. It is about 237 kilometres or approximately three hours drive from

Lagos. The mean annual temperature of the study area is about 26.10°C. The lowest temperature is experienced in August, with a mean temperature of 24.20°C while the highest temperature is in March with a mean temperature of 28.60°C. Osogbo like other places in South-Western Nigeria has the mean annual rainfall of about 1,247mm. There are two rainfall peaks within a year, these occur in the month of June and September. Except for recent anomalies resulted from climate change, when no one can not easily predict as it was before.

Results and Discussion

Transportation Networks in Osogbo

Osogbo is served by four categories of road network – Trunk 'A' (Federal Roads), Trunk 'B' (State Roads), Trunk 'C' (Local Government Roads) and DFRRI Roads. The Federal Roads are tarred but most of them are not good condition, some State Roads are also tarred with most of the tarred one are in good condition, most of the Local Roads are untarred, while few of the DFRRI Roads are tarred and with few in good condition. The 8.0 m wide Trunk 'A' Roads which total 27.2Km in Osogbo township. The State Roads sum up to 16.90Km and varies in width between 7.3m wide Oja Oba/Osun River and Sabo/Ayetoro through the 8.0m wide Aromole/Kajola streets to the 32.0m wide Okefia/Alekuwodo/Odo Olowo/Ita Olookan dual carriage way are all tarred but not totally smooth.

The Trunk 'C' (Local Government Roads) total up to 102.5Km with few of them tarred. The tarred ones are not even smooth; most of them have no drainage. They are poorly connected, some are not even motorable. Few of the DFRRI Roads are tarred. They sum up to 176.14Km and are 7.3m wide. Only 70.3Km are tarred while the remaining 105.84Km are untarred. These roads service the suburban settlements and the hinterlands. The table 3.3 and 3.4 shows the summary of the

roads in Osogbo by types, numbers, distances, width, and conditions.

Table 1: Roads Types, Numbers and Distances in Osogbo

S/N	Road Type	Number	Total Length (Km)
1	Federal Roads	3	18.50
2	State Roads	6	16.90
3	Local Government Roads	58	102.50
4	DFRRI Roads	20	176.14
	TOTAL	77	314.04

Source: Memorandum on Planning Proposals for Osun State and Osogbo Local Government (1999)

Table 2: Road Types by Conditions

S/N	Road Type	Road Conditions and Distance Covered			
		Tarred	Distance (Km)	Untarred	Distance (Km)
1	Federal Roads	3	18.50	-	-
2	State Roads	4	9.90	2	7.0
3	Local Government Roads	19	20.30	39	-
4	DFRRI Roads	1	-	20	-
	TOTAL		50.70	61	-

Source: Memorandum on Planning Proposals for Osun State and Osogbo Local Government (1999).

Characteristics of Road Intersection in Osogbo

The table 3 shows that 3 of the intersections constituting 37.5% are 4-legged and 5-legged respectively. The 4-legged intersections include Gbaemu junction, Ayetoro Junction and Oja-Oba central market junction. The 5-legged intersections which also constitute 37.5%

are Olaiya Junction, Dugbe Junction and Igbona Adenle Junction. The remaining two intersections consists of 6-legged and 7-legged are Okefia Junction and Old Garage Junctions constituting 12.5% each of the total intersections under study.

Table 3: Intersection Characteristics and Associated Land Use

S/N	Intersection Name	Intersection types	Land-use Characteristics
1	Olaiya junction,	5 legged	Commercial centres, place of worship, residential, retailing shops
2	Okefia junction,	6 legged	Government residential area, motor parks, retailing shops
3	Old garage junction,	7 legged	Commercial centres, motor park, retailing shops, institutional, place of worship
4	Dugbe junction,	5 legged	Residential, retailing shops
5	Gbaemu junction,	4 legged	Retailing shops, Residential, place of worships
6	Igbona adenle junction	5 legged	Markets, commercial centre, retailing shops
7	Ayetoro junction and	4 legged	Residential, institutional, place of worship
8	Oja-Oba central market junction.	4 legged	Residential, place of worship, retailing shops, commercial centres (fuel station).

Source: Author's Fieldwork, 2017

In terms of land use characteristics of the studied junctions, majority of them are located where institutional, commercial, markets, retailing shops, motor parks predominate. The intersecting arms also connect residential estates, public and private institutions and other major activity-centres in the city like church and mosques.

As noted above, the studied intersections are comprised of 4-legged, 5-legged, 6-legged and 7-legged road junctions selected from different locations on major roads in Osogbo. The intersections serve as links to major routes which connect different types of land use

activities in the study area. All the studied intersections are unsignalized but traffic flows are controlled by traffic wardens. Also common to all the intersections is the presence of road-side hawkers and traders, and the location of retailing shops along the intersecting roads. These result in road-side obstructions and parking problems from customers who patronize the sold products and thereby impeding the free movements of vehicles. Associated with these problems are the problems of narrowness and poor or no channelization of the intersecting roads to separate the traffic streams.

Pattern of Road Traffic Composition

Table 4: Different Types of Vehicle Plying the Study Area

Types of vehicle	Percentage (%)	
	Yes	No
Motorcycle	68.8	31.2
Tricycle	65.6	34.4
Private cars	90.4	9.6
Taxis	44.4	55.6
Light commercial vehicle (korope)	85.5	14.5
Buses	90.4	9.6
Trucks, Trailers, Lorries, Tankers, Tipper etc.	54.4	45.6

Source: Author's Fieldwork, 2017

Different types of vehicle that are plying the study area according to respondents were presented in table 4 According to the table, buses (90.4%) are said to be more common, while light commercial vehicle

also known as Korope (85.5%)also predominant in the area. Other vehicles that gain prominence include private cars (90.4%) and motorcycle (68.5%).

Table 5a: Total Daily Volume of Traffic

Intersection Name	Days of the Week			
	Monday	Wednesday	Friday	Total
Olaiya Junction	12149	16832	10300	39281
Okefia Junction	9522	7297	4244	21063
Oja Oba Junction	1645	4749	2728	9122
Igbona-Adenle Junction	6174	7866	6083	20123
Old garage Junction	12636	10237	11832	34705
Dugbe Junction	8311	5621	7210	21142
Gbaemu Junction	6300	3950	3342	13592
Ayetoro Junction	4540	5821	5100	15461
Total	61277	62373	50839	174489

Source: Author's Fieldwork, 2017

It is observed in table 5 that volume of traffic is highest in Olaiya Junction (39,281) followed by Old Garage Junction (34,705) and Dugbe Junction (21,142). Volume of traffic recorded in Okefia Junction, Igbona Aadenle Junction, and Ayetoto Junction are 21,063, 20,123,

15,461, while the remaining Gbaemu Junction and Oja-Oba Junction pulled 13,592 and 9,122 respectively. It can however, be deduced Olaiya Junction is where volume of traffic recorded highest during our field survey (traffic count).

Table 5b: Analysis of Variance (ANOVA) of differences in traffic congestion across the major Road Intersections in Osogbo

ANOVA					
Traffic Congestion					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	405.176	4	101.294	54.774	.000
Within Groups	1337.042	723	1.849		
Total	1742.218	727			

Source: Author's computation, 2017

Table 5b presents variation in the traffic congestion across the major road intersections in Osogbo. According to the table, with F-value of 54.774 and P-value of 0.000, it is observed that there is significant differences in the incidence of traffic congestion along the major road intersections in Osogbo at $p < 0.05$

confidence level. This however, implies that the situation of traffic congestion experiences in each of the major road intersections in Osogbo does not remain the same, a situation which pose serious dangers to the mobility of people particularly and quality of life of people in general.

Table 6: Average Volume of traffic at selected Junctions

S/N	Intersection Name	Morning Peak		Afternoon peak	
		VPH	% of total	VPH	% of total
1	Olaiya junction,	19,201	21.41	20,080	23.67
2	Okefia junction,	11,000	12.27	10,063	11.87
3	Old garage junction,	17,615	19.64	17,090	20.15
4	Dugbe junction,	12,150	13.55	8,992	10.60
5	Gbaemu junction,	6,965	7.76	6,627	7.82
6	Igbona adenle junction	11,145	12.43	8,978	10.58
7	Ayetoro junction	7,360	8.21	8,101	9.55
8	Oja-Oba central market junction.	4,250	4.74	4,872	5.75
	Total	89,686	100	84,803	100

Source: Author's Fieldwork, 2017. VPH= Volume per Hour

Table 6 shows that for both morning and afternoon peaks, Olaiya junction recorded the highest volume of traffic among the studied roads. These are 19201 vph (21.41%) and 20,080 vph (23.67%) of total volume for morning and afternoon peaks

respectively. This is followed by Old Garage junction with 17615 vph (19.64%) and 17090 vph (20.15%) for morning and afternoon peaks respectively. Dugbe junction ranks third recording 12150 vph (13.55%) and 8992 vph (10.60%) morning

and afternoon peaks respectively while Igbona-Adenle junction ranks fourth recording 11145 vph (12.43%) morning peak and 8978 vph (10.54%) afternoon peak.

Okefia junction ranks fifth recording 11000 vph (12.27%) morning peak and 10063 vph (11.87%) afternoon peak. Ayetoro junction ranks sixth with

7360 vph (8.21%) morning peak and 8101 vph (9.55%) afternoon peak while Gbaemu junction ranks seventh with 6965 vph (7.76%) morning peak and 6627 vph (7.82%) afternoon peak respectively. Oja-Oba central market junction ranked the least having 4250 vph (4.74%) morning peak and 4872 vph (5.75%) afternoon peak.

Table 7: Time spent in the traffic congestion (Traffic delay time) at selected junctions

S/N	Intersection Name	Delay time (minutes)			
		Morning Peak		Afternoon peak	
		Minutes	% of total	Minutes	% of total
1	Olaiya junction,	102	15.94	95	15.68
2	Okefia junction,	117	18.28	108	17.82
3	Old garage junction,	87	13.59	82	13.53
4	Dugbe junction,	79	12.34	71	11.72
5	Gbaemu junction,	68	10.63	62	10.23
6	Igbona adenle junction	50	7.81	55	9.08
7	Ayetoro junction	92	14.38	85	14.03
8	Oja-Oba central market junction.	45	7.03	48	7.92

Source: Author's Fieldwork, 2017

Table 7 shows that in terms of distribution of peak-hour delay time during morning and afternoon peak, Okefia junction ranked first (18.28% and 17.82%) followed by Olaiya Junction (15.94% and 15.68%), while Ayetoro Junction ranked third (14.38% and 14.03%). Old garage junction ranked fourth (13.59% and 13.53%), Dugbe junction taking position of fifth (12.34% and 11.72%), while

Gbaemu junction ranked sixth (10.63% and 10.23%). The seventh and eight junctions in rank are Igbona-Adenle (7.81% and 9.08%) and Oja-Oba Junction (7.03% and 7.92%) respectively. Overall, the delay times are associated with the traffic volumes at the various junctions which ultimately translate to traffic congestion.

Causes of Traffic Congestion in the Road Intersection

Table 8: likely causes of road traffic congestion

Causes of traffic congestion	Percentage (%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
High volume of traffic	40.0	15.0	25.8	19.2	0.0
Increase in population	39.8	25.6	11.8	30.0	18.3
Increase in household income	40.8	7.5	20.0	20.0	11.7
Increase in level of car usage	46.3	23.8	15.0	15.0	0.0
Poor transport design and planning	31.3	42.9	21.0	4.8	25.8
Disobedience of traffic rules	8.8	40.8	18.3	15.0	17.1
Operators' impatience	42.9	18.3	0.0	31.3	7.5
Indiscriminate On-street parking	44.2	23.8	16.3	0.0	15.8
Street trading	59.6	24.6	8.3	7.5	0.0

Source: Author's Fieldwork, 2017

It is observed in the table 8 that people adduced causes of road traffic congestion to many factors. Accordingly, the highest proportion (40.0%) of respondents strongly agrees that high volume of traffic do cause traffic congestion, while 19.2% of respondents disagree with that view.

Increase in population is another identified cause of road traffic congestion as noted by the respondents, where the majority of respondents (39.8%) strongly agree and 25.6% agreed with that position. It is also observed from the table 4.26 that 40.8% also strongly agree that increase in household income contributed to the high road traffic congestion, which leads to increase in car usage as 46.3% of respondents strongly agreed with that opinion. Poor transport design and

planning is also major cause of road traffic congestion as observed by the respondents where 31.3% strongly agree and 42.9% also agreed.

Respondents were also mentioned disobedience of traffic rules by the road users as one of the cause of road traffic congestion, where about 50% of them agreed to that disposition. Operators' impatience, indiscriminate on-street parking and street trading were some of other causes of road traffic congestion, in which 60.0%, 68.0% and 84.2% of respondents affirms that position. It can however, deduced from the above analysis that street trading is one of the major factors that responsible for road traffic congestion in the study area.

Effects of Road Traffic Congestion in the Study Area.

Table 9: Effects of Road Traffic Congestion

	Effects of traffic congestion	Percentage (%)	
		Yes	No
1	Late to work	85.2	14.8
2	Fail to meet appointment	70.8	29.2
3	Unable to meet health emergency	80.2	19.8
4	City ground to a halt	72.8	27.2
5	Economic activities paralyzed	75.2	24.8

Source: Author's Fieldwork, 2017

Concerning the effects of road traffic congestion on the people of the study area, respondents gave diverse opinion in that regard as shown in table 9. According to the table, 85.2%, 70.8% and 80.2% of respondents attributed late to work, failure to meet appointment and unable to meet health emergencies to the effects of road traffic congestion, while 72.8% and 75.2% are of the respondents accounted for the fact that traffic congestion brings about a situation where city ground to a halt and as well as economic activities paralyzed. It can be deduced from the foregoing that

lateness to work is what respondents described as being the most undesirable effects of road traffic congestion.

Management Techniques Adopted for Road Traffic in Osogbo.

Officials of Federal Road Safety Commission (FRSC), Nigerian Police Force and Vehicle Inspection Unit (VIU) were interviewed to obtain information as to what traffic management techniques they used in managing road traffic in the study area. Their response is contained in table 10.

Table 10: Traffic Management Techniques in Osogbo

	Traffic Management Techniques	Percentage (%)	
		Yes	No
1	Use of Traffic warden	84.2	15.8
2	Use of traffic light	35.5	64.5
3	Lane marking	30.2	69.8
4	Parking restriction	45.2	54.8
5	Public enlightenment campaign	52.4	47.6

Source: Author's Fieldwork, 2017

Table 10 shows some of the road traffic management techniques adopted in the study area. According to the table, 84.2% of respondents mention the use of traffic warden, 35.5% highlights the use of traffic light, while 30.2%, 45.2% and 52.4% of respondents accounted for the fact that lane marking, parking restriction and public enlightenment campaign are being used as road traffic management techniques.

Recommendations and Conclusion

The findings from this study have implication for urban transportation planning:

- The designs of the road intersections in the study area should be reviewed such that the approaches are broad for a distance of about 200 metres to avoid obstruction of side turning vehicles by the straight moving ones. All the approaches to the intersections should also be channelized to separate traffic streams.
- Also, road-side hawking and trading and all forms of commercial activities should be strictly restricted up to a distance of 200 metres from the intersections. Town planning control mechanism should be used to control developments around the intersections.
- The public transportation system in the city should be improved by introducing high-capacity buses and tricycles to work alongside

with taxis and motorcycles for the conveyance of people in the study area. This will reduce the number of vehicles on the road.

- Besides, there is the need to signalize the intersections by installing traffic lights and signals to serve as substitute for the ineffective human labour of traffic management.
- In addition, there is the need for provision of off-street parking spaces in Osogbo and along the intersecting roads. Also on-street parking of whatever types should be strictly restricted up to a distance of 200 metres away from the intersections. This can be done by installing NO PARKING and NO WAITING signs at the intersections to discourage arbitrary parking.

Many of the problems identified at the studied junctions are common to other road intersections in the city. The recommendations made are therefore useful for solving traffic congestion problems at road intersections generally in the city.

The study examined traffic congestion problem at road intersections in Osogbo and has offered useful suggestions for improving traffic flow at the junctions. Though the traffic flow problem in Osogbo has not yet assumed the dimension of those of Lagos, Ibadan, Port-Harcourt and other bigger urban centres in Nigeria, signs of potential bottlenecks are already emerging. There is therefore the need to

evolve more effective traffic management method for the city. As population increases and people become more affluent, traffic congestion problem becomes worse. With the high rate of growth of Osogbo, traffic problem should

not be left until it deteriorates to the level of larger urban centres in Nigeria. It is on this note that this study has suggested immediate solutions to traffic congestion and delay problems at road intersections in Osogbo, the study area.

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