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Public Transport Sector Development in Port Harcourt, A Road Map for Reducing Traffic Congestion

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Abstract
Port Harcourt city has experienced explosive growth in population and this growth has in turn influenced the number of cars available in the city in the past 20 years leading to traffic congestions along major roads. To address this challenge, a lot of research works have been carried out. In this study, Ikwerre road was considered as a case study. A traffic study was carried out along the road to determine the number of vehicles along the road and also a well-structured questionnaire was distributed to 200 road users to determine the actual cause of traffic congestion along the road. The responses from the questionnaires were analysed using the Relative Importance Index (R.I.I) method. Results obtained from this study, revealed that inadequate road capacity is responsible for traffic congestion which is as a result of the number of private cars. The number of private cars was875 which was the highest followed by buses (617), taxis (486) and trucks (52). In terms of percentage, private cars make up 42%, buses make up 30%, taxis make up 23% while trucks make up 5% of the total volume of traffic. Furthermore, the responses showed insecurity is a major problem in the use of public transport system. It was clearly stated that if security is put in place, public transport system will be attractive. Out of the 166 respondents, 73% of the respondents are willing to use public transport while 27% are not. Also, the elimination of 14-seater buses and taxis, and the reduction of private cars by 50% with the introduction of 45-seater buses in a well-planned transport system improved the traffic flow and increased the road capacity.
Keywords: *Public Transportation, Traffic Congestion, Traffic Flow. Road Capacity*

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I. Introduction

Port Harcourt city has experienced explosive growth in population and this growth has in turn influenced the number of cars available in the city in the past 20 years. This can be attributed to the quest for better living for people living in the villages and suburban areas of Rivers State. The use of cars has now increased since many families have moved out of the villages to satisfy their movement needs daily. The significant consequences of this development are well known to residents of Port Harcourt. People living in the city spend longer times on short journeys with increase in cost of transportation.

The city of Port Harcourt is now vulnerable to unsustainable growth in traffic and congestion. Inter-local government journeys within the state are becoming quicker but within the city is almost paralyzed by traffic. Car use in the city has increased the level of noise and pollution. Therefore, the need for a sustainable public transport system development of the city should no longer be a theoretical subject for politicians and opinion leaders to debate, but now needs to be put into practice.

Port Harcourt city is undergoing many-sided problems because of speedy urbanization. One of these problems is traffic congestion. Traffic congestion is one of the unbearable problems of urban areas because of sudden increment in the private transport sector which is affecting urban society and economy (Kumar & Sing, 2017). There are numerous urgings in respect of congestion and its principal causes and suggestions towards a lasting solution have been put forward. However, in this part of the world, the arguments incline to either be political or myopic. They mostly focus on the problem that is most relevant to their situation ignoring the other factors that may be related across the road network. Some studies in major cities in Nigeria have stated some main causes of congestion. According to Uwadiegwu (2013), factors responsible for congestion include physical, technical, land use and human factors. Also, Ogunbodede (2007) in a study of traffic congestion using GIS approach, showed that traffic congestion increases with increase growth in motor vehicles without any improvement in road network. But the idea of constructing new roads or increasing the road network and improvement of intersections has been seen as a temporary relief because it does not work always for different reasons such as political, environmental, or financial and sometime may attract traffic and increase the road occupancy (Kumar & Sing, 2017; Rahane & Saharkar, 2013). This has been confirmed with the construction of

the new flyovers at Garrison and Rumuokoro intersections. Therefore, there may be other factors that may be responsible.

Factors responsible for traffic congestion has been identified in many studies. Bashiru and Waziri (2008), stated that the factors responsible for traffic congestion in Lagos are: Existence of pot holes/bad road, trading along the road, parking along the road, loading and offloading of goods and passengers along the road, illegal bus stops, flooding as a result of poor drainage systems, vehicle breakdown, narrow road sections, religious activities, high volume of traffic, lack of parking space and lack of traffic light at some road intersections. Momoh (2011), also argues that lack of transportation system planning in Nigeria has led to over dependence in motor vehicles resulting in too many vehicles leading to traffic congestion. This problem of poor planning/design and management has been restated in many papers presented during the Nigerian Society of Engineers (NSE) conferences (Haruna 2011, and Igwe, 2011)

Although studies have been carried out regarding traffic congestion in urban areas, traffic congestion and related problems in urban areas still demands contemplation, taking local issues into consideration. Moreover, real ideas to solve traffic issues that can be executed in growing urban areas like Port Harcourt are still lacking in literatures. In this paper, the traffic issues along Ikwerre road were studied. Field studies on vehicular traffic, pedestrian traffic and public transport within the study area were performed to establish an idea of substitution.

II. Materials and Methods

A wide-ranging causes of traffic congestion along Ikwerre road in Port Harcourt was produced from the road users comprising drivers of both Private and Commercial vehicles, passengers, pedestrians, and traffic control officers. The causes, effects and solutions to traffic congestion along the road were listed in well-structured questionnaire and administered to 200 road users (Drivers, pedestrians, passengers and traffic control officials). Results obtained from the questionnaire were analyzed using Relative Importance Index (R.I.I).

The Relative importance index was used to determine the actual cause of traffic congestion along Ikwerre road. It is a four-scale system converted to Relative Importance Index (R.I.I) for each factor as shown in Equation 2.1(Lim & Alum 1995).

$$R.I.I = \frac{(4n_1+3n_2+2n_3+n_4)}{4N} \quad (2.1)$$

Where:

n_1= Number of respondents for strongly agree
n_2= Number of respondents for agree
n_3= Number of respondents disagree
n_4= Number of respondents for strongly disagree
N= number of respondents

Also, a traffic survey and observation along the road at peak periods (7.00am to 10.30am and 4.00pm to 8.30pm) were carried out to determine the volume of traffic and classify the vehicles accordingly. In addition, the Lighthill and Whitham theory was adopted to understand the traffic flow at major intersections along the road.

According to Lighthill and Whitham, (1955), to understand traffic flow, the knowledge of fluid flow based on kinematic waves is important. This theory applies "continuous flow" approach in fluid dynamics in solving traffic problems. Noting that, at any point on the road, the flow (Q) is a function of the concentration (K).

In solving the problem related to this study, the application of the above theory is narrowed to dealing with bottlenecks for flow greater than the capacity of the bottleneck only.

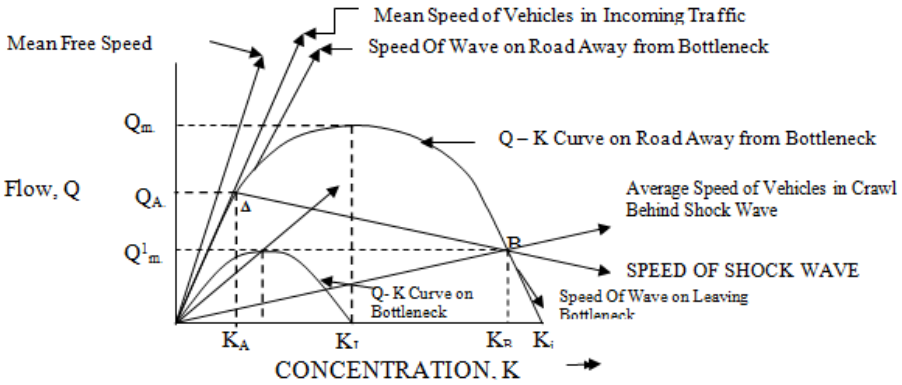

Fig. 1 Q – K Curves of Bottleneck, with Flow Greater Than Bottleneck.

The point A represents a traffic condition with flow Q_A greater than the bottleneck capacity $Q_{max.}$ The speed of the vehicles through the bottleneck drops from $\frac{Q_A}{K_A}$ to $\frac{Q^l_{max}}{K_j}$. The point B represents the flow condition on the second half of the Q – K curve of the road away from the bottleneck, with a concentration equal to the bottleneck capacity $Q^1_{max.}$ The crawl speed of traffic behind the shock wave is represented by $\frac{Q^l_{max}}{K_B}$ which is very much lower than the speed of vehicles through the bottleneck itself. This shows that the speed of vehicles through the bottleneck itself is higher than the speed of crawl behind. The speed of the shock wave is represented by the

slope of the line AB = $\frac{Q_A - Q^l_{max}}{K_B - K_A}$ (2.2)

In solving the mathematical traffic problems related to this research, the two major equations used are:

Jamming concentration, $K_j = \frac{1000}{s}$ (2.3)

Traffic volume/ flow, $Q = \frac{V_{sf} \times K_j}{4}$ (2.4)

Where:
K_j = Jamming concentration.
S = Average spacing.
Q = Traffic volume/ flow.
V_{sf} = Average mean speed.

III. Results and Discussions

The results of the traffic study and analysis done are presented in the tables below.

Table 1: Traffic Flow Rate at Intersections along Ikwerre Road

Intersection	Free Speed (Km/hr)	Spacing (m)	Density (k) Veh/hr	Jam Density (k) Veh/hr	Observed Flow (Q)	Maximum Flow (Q)	Minimum Flow (Q_m)	Speed influenced by Bottleneck (Km/hr) Before	At	After
Rumuokoro	65	12.5	80.00	160.00	2403	2600.00	1300.00	8.29	32.50	41.45
Rumuigbo	68	8	125.00	250.00	1925	4250.00	2125.00	10.16	34.00	59.15
Rumuokwuta	60	8.5	117.65	235.29	2123	3529.41	1764.71	8.45	30.00	48.94
Wimpey	65	12.5	80.00	160.00	1800	2600.00	1300.00	8.87	32.50	50.53
Market Junction	63	6.25	160.00	320.00	1875	5040.00	2520.00	9.78	31.50	56.46
Agip	65	8	125.00	250.00	1822	4062.50	2031.25	9.73	32.50	56.64
RSU	67	8.5	117.65	235.29	2340	3941.18	1970.59	9.46	33.50	54.85

Table 2: Causes of Traffic Congestion along Ikwerre Road

S/N	Causes	n1	n2	n3	n4	N	R.I.I	Ranking
1	Road side market	70	55	35	21	181	0.74033	4
2	Poor driver habit	94	85	42	23	244	0.75615	2
3	Inadequate road capacity	101	81	33	16	231	0.78896	1
4	No packing facility	73	52	43	36	204	0.69853	5
5	No pedestrian crossing facility	61	94	67	42	264	0.66477	8
6	Too many buses and taxis	87	91	65	42	285	0.69561	6
7	Poor traffic control	66	53	55	29	203	0.69212	7
8	Inadequate bus stop capacity	79	59	44	18	200	0.74875	3

Table 3: Respondents on the use of Public Transportation

If the public transport system is safe, can you use it?	Number of Respondents	Percentage
Yes	121	73%
No	45	27%

Table 4: Present and Expected Flow Rate along Ikwerre Road

Type of Vehicle	Average Volume Veh/hr	Average Number of Passengers	Average Total (Veh/hr)	Free Speed (Km/hr)	Observed Speed (Km/hr)	Calculated Speed (Km/hr)	Predicted speed (Km/hr)
Before Elimination							
Trucks	52	2					
Private Cars	872	3					
Taxis	486	5					
14 -Seater Buses	617	14	2079	65	40	39.21	
After the Elimination of 14-seater buses and Taxis (introduction of 45-seater buses)							
Trucks	52	2					
Private Cars	436	3					
Taxis							
45 -seater Buses	275	45	763	65			80.5

3.1 Field Observation Along Ikwerre Road

A proper observation along Ikwerre road was carried out to ascertain the actual condition of the road during congestion. It was observed that, the use of private cars along the road though has made mobility of individuals easy and comfortable, but its unrestricted use has a negative effect on the environment. Some of these effects noted are:

i. **Space utilization**: the moving and parked cars occupied more space along road.
ii. **Air Pollution:** the quality of air along the road is poor.
iii. **Noise Pollution.**

3.2 Discussion

Table 1 shows the flow rate at the major intersections along Ikwerre road. From the results, an average free speed of 65Km/hr was observed along the road. However, at the intersections, because of the bottlenecks introduced as a result of indiscriminate on-street parking, road side market, pedestrian crossings and boarding/alighting of passengers at bus stops close to the intersection, reduced the speed to 9.2Km/hr before the bottleneck, and increased to 32.40Km/hr and 52.5Km/hr as the vehicles gradually pass through the bottleneck areas. The reduction in speed is 14.2%, 49.9% and 80.8% respectively.

In Table 2, 200 questionnaires were given out but 166 were collected. Using the Relative Importance Index (R.I.I), inadequate road capacity ranked number 1 showing that it is the major cause of congestion along the road. This agrees with Popoola et al., (2013). However, from the field observation the number of private cars seen moving and parked on the road are more (See Table 4). With the increasing population in Port Harcourt if not controlled, this menace will continue to increase.

Public transportation in Port Harcourt has so many challenges, but one challenge that was noted by the respondents is safety (Insecurity). Table 3 has shown clearly that if security is put in place, public transport system will be attractive. Out of the 166 respondents, 73% of the respondents are willing to use public transport while 27% are not.

In Table 4, the number of private cars (875) along the road was the highest followed by buses (617), taxis (486) and trucks (52). In terms of percentage, private cars make up 42%, buses make up 30%, taxis make up 23% while trucks make up 5% of the total volume of traffic. This has also has been established in a recent study (Otto & Ogboda 2022). During the survey, 40Km/hr was observed to be the average operating speed along the road during the peak period before the intersections. This was validated using the Lighthill and Whitham theory. Usually, the average free speed along the road is 65Km/hr during the off-peak period. Considering a situation where 50% of the private cars, taxis and 14-seater buses are eliminated, and 45-seater buses are introduced, the speed increases to 80.5km/hr because the volume of traffic per hour has been reduced to 763Veh/hr. This shows clearly that reduction in private cars and improving the public transport sector will increase the capacity of the road since inadequate road capacity has been identified as the major cause of congestion.

IV. Conclusion

Increase in population, Insecurity and the rapid urbanization of Port Harcourt have resulted in increased usage of private vehicles and transportation facilities, which in turn has led to traffic congestion and related problems. Analysis of the collected data exposed space utilization (inadequate road capacity) as a major cause of traffic congestion. Therefore, to maximize the available space, the use of public transport must be encouraged.

V. Solutions

To reduce congestion in Port Harcourt city the following must be considered.

i. Government must deliberately put security in place.
ii. Government should partner with the private sector to develop a public transport system for taxis and buses like Bolt transport system to handle security challenges while in transit.
iii. Introduction of strict parking policies and implement the rule of law to traffic defaulters.
iv. Introduction of bus bays off the road.
v. Introduction of pedestrian crossing facilities at intersections.
vi. Introduction of fast and reliable transport modes like train, tram and ferry boats.
vii. Development of park and ride facilities at major entry points to the city.
viii. Give the public transport a reserved right of way.
ix. Development of pedestrian friendly environment with attractive public transport access within market and business areas.
x. Port Harcourt car journeys should be suitably charged (introduction of tolls)

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