

Traffic Management Strategies and Traffic Flow in Enugu Urban Areas of Enugu State, Nigeria

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Abstract

Research Purpose: Enugu urban traffic congestion was seen as a very complex problem that posed a challenge for all the road users and in the development of Enugu metropolis. This propelled the establishment of urban and traffic management agencies and the introduction of traffic lights by the state government. This study critically looked at how traffic management strategies in Enugu urban, including Enugu Capital Territory Development Authority (ECTDA), MOT cadets and traffic lights have helped to improve traffic flow.

Methodology: The study adopted survey research design and used structured questionnaires for data collection. The population of the study was 968,300 people of Enugu urban. As a survey research, all the respondents to this study were selected through purposive sampling technique. With this sampling technique, the researcher selected those who have the requisite information that led to sound conclusions.. The data collected were presented and analysed using frequency, percentage, mean, and chi-square (χ^2) statistical tools.

Finding: The study revealed that the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets have significantly helped in the management of traffic flow in Enugu urban. Further findings revealed that the current traffic light in use at Enugu urban has positively contributed to the management of traffic flow.

Conclusion: The significance of alternative ways to solve gridlock increase since infrastructural extensions and adjustments requires large investments and also takes time is very important. New traffic management measures are required in Enugu Urban, as well as smart software that can enable a specific traffic surplus route allowing green light longer or more often and improvement to other existing measures.

Recommendations: The study therefore suggested among other solutions the provision of regular traffic education, modern Intelligent Traffic Light Controller, adequate parking spaces, and the need to carefully sanitise the MOT cadets and other traffic personnel to fish out the corrupt ones and replace them with more honest people.

Key words: *Traffic, Management, Traffic management, Traffic management strategies, Traffic Flow.*

1.0 INTRODUCTION

In modern society, quick mobility is one of the most basic needs. Therefore, people are able to use different transportation facilities such as automotive vehicles, subways, and bicycles. However, among all these transportation facilities, automotive vehicles remain the most adopted due to their comfort and practicality. In this way, assuming a continuous population growth, the number of vehicles in large cities will increase much faster than transportation infrastructure. Consequently, traffic congestion will become a pressing issue. Etim (2016) noted that this creates several negative concerns for the environment and society such as increase in number of traffic road accidents, economic impacts, and high levels of greenhouse emissions.

Road traffic congestion is synonymous with urbanisation and city growth. This is because of the influx of people, increase in socio economic activities, and traffic generation among others that take place on the environment. The increasing number of cars on major roads due to high travel requirements which often overwhelm transport systems during peak periods is an emerging problem in most urban areas of the world (Chao, Edward & Leslie, 2014). Rapid urbanisation in most cities has given rise to urban centres with poor physical planning, deteriorating environment and increasing mobile congestion especially in developing countries due to unrestrained population growth and lack of proper planning (Etim, 2016).

Traffic management is important and essential, especially in urban areas as life relies more on vehicular movement (road transportation) for various daily activities. On a daily basis people go to work, school, shopping etc., scrambling for the right-of-way among all road users. This often creates what is referred to as traffic conflict and congestion (traffic bottlenecks or crashes) (Giuseppe & Maurizio, 2018)). Therefore, traffic planning and management is required to resolve traffic conflicts in order to ensure free flow of traffic and safe motoring.

Enugu urban, a dynamic and rapidly growing metropolis is the capital of Enugu state. It started as a mining town and later became the headquarters of the former eastern Nigeria region in 1954 and capital of former east central, defunct Anambra and Enugu states. This notwithstanding, the impact of its former status is still being felt today. Its land is diversified and can be grouped into mining, commercial, industrial, residential, administrative, education, recreational and transportation. The city is serviced with roads, rail lines and airport. Its degree of urbanisation is closely connected with the aforementioned transport facilities.

In Enugu urban, the rapid growth in population and vehicle ownership has resulted in increased traffic congestion especially at peak periods between 7am to 10pm and 4pm to 8pm especially workdays (Chukwurah & Chijioke, 2018). The situation is so common, even traffic holdups appear to be the accepted excuse for an absence from work or even official meetings. However, the application and deployment of traffic management strategies needs to be considered in view of the fact that Enugu city is experiencing a high level of traffic

congestion. In addition to the existing police traffic officers, the Enugu State Government has established the Enugu Capital Territory Development Authority, the installation of traffic lights and traffic signals, and traffic enforcement officers from the Enugu State Ministry of Transport popularly known as MOT. The responsibilities of the ECTDA and MOT range from checking wrong traffic activities among the intra-urban bus, taxi and tricycle commercial services on transportation routes, and unauthorised structures disrupting free flow of traffic among other traffic control functions.

Despite great achievements of these measures in traffic control in Enugu urban areas, a lot of questions, misconceptions, doubts, criticisms and cynicism have been trailing their efforts and activities in the management of traffic. It is against this background that Traffic Management Strategies and Traffic Flow in Enugu Urban Areas of Enugu State, Nigeria becomes the focus of this study.

Statement of the Problem

In Enugu urban areas, the growing concern about traffic congestion is driving the State Government to establish Traffic Management Agencies and Strategic Plans. Enugu's urban traffic congestion, which poses a challenge to all road users in the city, was seen as an extremely complex problem. Traffic congestion on city streets in Enugu is a frequent problem for many people each day. This situation, however, is becoming so frequent that excuses for missing office hours or even official and informal meetings appear to be accepted as a result of delays in traffic. This situation has become so alarming that new and lasting measures are needed to combat this threat.

The evident traffic difficulties in Enugu urban, however, appeals for the application and deployment of traffic management strategies, the introduction of the Enugu Capital Territory Development Authority (ECTDA), installation of traffic lights, mechanised road marking, road signs and MOT cadets. Since the introduction of these measures by the state government, lots of credits, commendations, questions, misconceptions, doubts, criticisms and cynicism have been trailing their efforts and activities in the management of traffic. The mix-feelings have become so worrisome that many are demanding for new and sustainable measures to combat this menace. It therefore becomes necessary to assess the effect of traffic management strategies on traffic flow in Enugu Urban Areas of Enugu State, Nigeria, with a view to proffer lasting solutions to exclude Enugu urban from traffic dilemmas.

Objectives of the Study

In specific terms, the objectives of the study are to:

1. Examine how the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets have helped in the management of traffic flow in Enugu urban.
2. Determine how the current traffic light in use at Enugu urban has contributed to the management of traffic flow in Enugu urban.

Research Questions

1. How have the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets helped in the management of traffic flow in Enugu urban?
2. How has the current traffic light in use at Enugu urban contributed to the management of traffic flow in Enugu urban?

Hypotheses

The study was guided by the following hypotheses

1. The approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets have significantly helped in the management of traffic flow in Enugu urban.
2. The current traffic light in use at Enugu urban has positively contributed to the management of traffic flow in Enugu urban.

2.0 REVIEW OF RELATED LITERATURE

Conceptual Reviews

Traffic and Traffic Management

According to Ajala 2016, traffic on the roads is composed of people, including pedestrians, riders or herded animals, vehicles, streetcars, buses and other transport modes that use public routes for travel. In a number of jurisdictions, traffic is formally organised through marked lanes, junctions, intersections, interchanges and road signs. The type of traffic is often defined as heavy vehicles, for example: cars, trucks, etc. Other vehicle types such as bicycles or mopeds are also commonly used. Different classes may share speed limits and easement, or may be segregated. Some jurisdictions may have very detailed and complex rules of the road while others rely more on drivers' common sense and willingness to cooperate (Organisation for Economic Co-operation and Development (OECD) (2017).

To Asiyanbola, Osoba & Adewale (2012), traffic management strategies could be regarded as systematic and sustained measures aimed at directing and controlling all traffic on our roads to make them free of the negative effects of the transport system. This includes alternative routing, parking guidance strategies, city-compatible routing, and value-dependent traffic control according to defined limits. Traffic authorities have one primary goal: to be able to react as best as possible to planned or even unforeseeable events inside the traffic system. It therefore means that traffic management is:

- a. A conscious effort to ameliorate problems resulting from automobile use;
- b. A systematic and sustained effort of directing and controlling traffic; and,
- c. The application of a range of traffic engineering and administrative techniques.

The goals of Traffic management strategies according to Ajala (2016) are majorly four: ensure free flow of traffic, reduce congestion and delay, increased road capacity, reduced road

traffic crashes (accident). Nevertheless, they can be expanded depending on the situation and circumstance. Road crashes have become a major concern in the world in recent times. It is acknowledged as the fifth leading cause of death across the world (UN, 2011). Every goal of traffic management is set to achieve safety of lives and property. Efficiency and effectiveness of the road transport system is tied to safety. From designing roads to construction of vehicles, and training of operators, safety is the first consideration. Whatever policy or physical measure a traffic manager is trying to adopt therefore, safety of road users is the paramount consideration. It, therefore, means that traffic management's primary aim is to reduce loss of lives and property on highways.

Concept of Traffic Flow

Traffic Flow is the movement of individual drivers and vehicles between two points and their interactions with each other. In the area of transport, traffic flow is an interaction among passengers, including pedestrians, cyclists, drivers and their vehicles and infrastructure such as highways, signs etc. in order to understand and develop a suitable transportation network which will efficiently move traffic and minimise congestion problem (Olorunnimbe, Giwa & Oduyebo, 2020).

Traffic flow is influenced by the complex interactions of vehicles, displaying behaviours such as cluster formation and shock wave propagation. Key traffic stream variables include speed, flow, and density, which are interconnected (Weje, Obinna & Abibo, 2022). Free-flowing traffic is characterised by fewer than 12 vehicles per mile per lane, whereas higher densities can lead to unstable conditions and persistent stop-and-go traffic. In a free-flowing network, traffic flow refers to the traffic stream variables of speed, flow, and concentration. These relationships are mainly concerned with uninterrupted traffic flow, primarily found on freeways or expressways. Flow conditions are considered "free" when less than 12 vehicles per mile per lane are on a road. "Stable" is sometimes described as 12-30 vehicles per mile per lane. As the density reaches the maximum mass flow rate or flux and exceeds the optimum density above 30 vehicles per mile per lane, traffic flow becomes unstable, and even a minor incident can result in persistent stop-and-go driving conditions. A "breakdown" condition occurs when traffic becomes unstable and exceeds 67 vehicles per mile per lane. "Jam density" refers to extreme traffic density when traffic flow stops completely, usually in the range of 185-250 vehicles per mile per lane (Odogwu & Ideh, 2022).

2.2 Empirical Review

Olorunnimbe, Giwa. & Oduyebo (2020) carried out a study titled An Assessment of the Effectiveness of Traffic Management Techniques on Traffic Flow at Ikotun CBD, Lagos, Nigeria. The research adopted quantitative research techniques using field observations and the parameter measurement, including traffic count and flow analysis. The findings shows that the inadequate and inappropriate traffic management techniques such as the: absence of traffic light; bus stop laybys; pedestrian walkway; motor park and poor roundabout and intersection

design, are the major problems affecting the free flow of traffic at Ikotun CBD, this is the more reason why commuters and vehicles experience more delay before getting out of the Ikotun CBD.

Weje, Obinna & Abibo (2022) conducted a similar study on Evaluation of Traffic Management Techniques on Major Roads in Port Harcourt, Rivers State, Nigeria. The study adopted the passive observational research design. Analysis of traffic count on sampled roads shows both spatial and temporal variations. Of the 7 days survey period of vehicle density along Port Harcourt-Aba express road (12th, 18th, March 2022), the highest average hourly traffic volume per week was recorded on Monday with 88,461 Passenger Car Units (PCUs), and the lowest was on Sunday 22,305 PCUs. The weekly average hourly volume of traffic was highest between 6pm-7pm 63,950 vehicles, while the lowest was between 1pm-2pm with 9,170 PCUs. For Ikwerre road, the highest average hourly traffic volume per week was recorded on Wednesday with 57,257 PCUs, and the lowest was on Sunday with 25,472 PCUs. The weekly sum and average hourly volume of traffic was highest between 6pm-7pm with 47,561 PCUs, while the lowest was recorded between 1pm-2pm with 10,974 PCUs.

Sholesi, Abdul-azeez & Dopamu (2024) investigated the Burnout of Traffic Managers and Its Effect on Road Safety: Evidence from Lagos State Traffic Management Authority, Lagos State, Nigeria. The study used a descriptive research design; fifty respondents were selected on the basis of an efficient sampling method. Pearson product moment correlation and multiple regressions using the S.P.S. 27.0 versions were used to test three hypotheses. The results showed a moderate relationship between exhaustion and road safety of 50.2% and a strong relationship between mental distance and road safety of 68.4%. The findings further revealed that exhaustion and mental distance account for 47.3% of road safety which is the combined effect of the indicators of burnout on road safety.

2.3 Theoretical Framework

This study utilises the Modernization Theory originated with the ideas of German sociologist Max Weber (1864-1920). Weber's approach provided the basis for the modernization paradigm as popularised by Harvard sociologist Talcott Parsons (1902–1979), who translated Weber's works into English in the 1930s and provided his own interpretation (Dibua, 2006). Modernization theory is used to explain the process of transformation within societies. Modernization refers to a model of a progressive transition from a 'pre-modern' or 'traditional' to a 'modern' society. Modernization theory both attempts to identify the social variables that contribute to social progress and development of societies and seeks to explain the process of social evolution. Modernization theory stresses not only the process of change but also the responses to that change (Kendall, 2007).

Although there's a lot of different versions of modernization theory, according to Roxborough (2014), the fundamental implicit or explicit principle is that societies evolve over a series of evolutionary stages: ; these stages are based on different degrees and patterns of social

differentiation and reintegration of structural and cultural components that are functionally compatible for the maintenance of society; contemporary developing societies are at a premodern stage of evolution and they eventually This modernization will lead to economic growth and will take into account the social, political, and economic features of Western European and North American societies that have advanced to the highest level of social evolution; and it will lead to the importation of complex Western technology and the removal of traditional structural and cultural features that are incompatible with such development. The relevance of modernization theory to this study effect of road traffic management in the development of urban areas in Nigeria is that modernization theory shows that urban development is a continuous process evolving over different stages. It is not a once and for all development process, it changes in a progressive manner with urban growth, technological advancement and infrastructural and structural upgrading and maintenance etc. Traffic management must take cognizance of the urban growth which strictly refers to the growing number of people living in urban areas. As a growing number of people migrate to the urban areas, there is a need for matching expansion and improvement in traffic control mechanisms. Otherwise traffic congestion will become a regular challenge in most strategic places like market, T-junction and so on.

3.0 METHODOLOGY

The study adopted survey research design. Survey research is a type of research design whereby a small number of people or items are considered or used to represent a large group (population or universe) for data collection and analysis. The study was conducted with total population of 968,300 people of the three local governments in Enugu Urban (i.e. Enugu North 326,900; Enugu South 267,300; Enugu East 374,100). The sample size is 625, while the purposive sampling technique was used to select the sample for the study. The instrument used for the study was a structured questionnaire. The researcher ensured the validity of the instrument by having two research experts from the Department of Public Administration and Local Government (PALG) and one from Measurement and Evaluation all from the University of Nigeria, Nsukka study the instrument items. The definitive instrument has been made using their corrections and recommendations. The instrument reliability was tested using a test retest method. The reliability coefficient was 0.86 using Cronbach Alpha formula. A total of 514 copies of the questionnaire were properly completed and returned for the study (i.e. Enugu North 173; Enugu South 145; Enugu East 196). Data were presented in a tabular form using frequencies and percentages in the five-point Likert scale format. The hypotheses were tested using Chi-square (χ^2) analysis at the significant level of 0.05, when the computed value of chi-square (χ^2) is greater than ($>$) the table value of chi-square (χ^2), the null hypothesis is rejected.

4.0 DATA PRESENTATION AND ANALYSIS

In this section, the results of data collected are presented and analysed according to the research questions posed for the study. The hypotheses were also tested using Chi-square (χ^2) analysis at the significant level of 0.05 and the appropriate degree of freedom (DF).

Research Question One: How have the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets helped in the management of traffic flow in Enugu urban?

Table 1: How the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets helped in the management of traffic flow

Options	Strongly Agree	Agree	undecided	Disagree	Strongly Disagree	Total
Apprehending one-way drivers result in orderly flow of traffic in Enugu urban	310 60%	105 20%	32 6%	43 8%	24 5%	514 100%
Apprehending drivers that violate traffic light improved traffic flow during the peak period	271 53%	139 27%	26 5%	58 11%	22 4%	514 100%
Apprehending wrong parking on major Enugu urban roads clear the roads	293 57%	108 21%	23 4%	56 11%	34 7%	514 100%
Traffic control and passage of vehicles in busy areas by MOT officers enhance traffic flow	301 59%	77 15%	34 7%	48 9%	54 11%	514 100%
Relocation and removal of commercial activities and unauthorised structures on urban routes enhance traffic flow	244 47%	83 16%	34 7%	78 15%	75 15%	514 100%
Arrange for pay parking spaces to ease congestion and obstruction through illegal parking	312 61%	87 17%	40 8%	48 9%	27 5%	514 100%
Maintaining road signs and enforcing compliance to road use rules enhance traffic flow	293 57%	108 21%	23 4%	56 11%	34 7%	514 100%

Source: Field Survey, 2024

Table 1 reveals how the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets helped in the management of traffic flow in Enugu urban. The table showed that the frequency of the respondents that strongly agree was above average in all the items. This pattern of responses indicates that the respondents accepted all the items as how the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT

cadets helped in the management of traffic flow in Enugu urban. The items include: apprehending one-way drivers result in orderly flow of traffic in Enugu urban, apprehending drivers that violate traffic light improved traffic flow during the peak period, apprehending wrong parking on major Enugu urban roads clear the roads, traffic control and passage of vehicles in busy areas by MOT officers enhance traffic flow, relocation and removal of commercial activities and unauthorised structures on urban routes enhance traffic flow, arrange for pay parking spaces to ease congestion and obstruction through illegal parking, and maintaining road signs and enforcing compliance to road rules enhance traffic flow in Enugu urban.

Research Question Two: How has the current traffic light in use at Enugu urban contributed to the management of traffic flow in Enugu urban?

Table 2: How the current traffic light in Enugu urban contributed to the management of traffic flow

Options	Strongly Agree	Agree	undecided	Disagree	Strongly Disagree	Total
Effective in controlling traffics in orderly manner during pick period	222 43%	194 38%	35 7%	22 4%	41 8%	514 100%
Intelligent in time allocation to routes in traffic points	68 13%	14 3%	23 4%	28 5%	381 74%	514 100%
Reduces traffic collision or car accident, or car crash at T-junctions and roundabouts	312 61%	87 17%	40 8%	48 9%	27 5%	514 100%
Ability to detect vehicles that violate traffic light for punishment	48 9%	39 8%	22 4%	291 57%	114 22%	514 100%
Enhances free traffic flow in queuing method rather than blocking the roads	226 44%	169 33%	29 6%	61 12%	29 6%	514 100%
•	•	•	•	•	•	•

Source: Field Survey 2024

Table 2 reveals how the current traffic light in Enugu urban contributed to the management of traffic flow. The pattern of responses presented above shows that the frequency of the respondents that strongly agree are above average in three items indicating that the traffic light is effective in controlling traffics in orderly manner during pick period, reduces traffic collision or car accident, or car crash at T-junctions and roundabouts, and enhances free traffic flow in queuing method rather than blocking the roads. The analysis also shows that the frequency of the respondents that disagreed and strongly disagreed are above average in two

items indicating that traffic lights are not intelligent in the traffic control system in terms of time allocation to routes in traffic points and lack the ability to detect vehicles that violate traffic light for punishment.

Test of Hypothesis One: The approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets have significantly helped in the management of traffic flow in Enugu urban.

Calculation of Degree of Freedom (DF)

$$DF = (R-1) (C-1)$$

Where R = Number of Row in the contingency table

C = Number of columns in the contingency table

$$DF = (3-1) (5-1)$$

$$= 2 \times 4$$

$$= 8$$

At 0.05 significance level and 8 degree of freedom the table value of chi-square = **15.51**

Table 3: Observed Frequency for hypothesis One

Location of Respondents	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Enugu North Local Government Area	46	55	21	33	18	173
Enugu South Local Government Area	81	36	6	5	17	145
Enugu East Local government Area	35	90	20	47	4	196
Total	162	181	47	85	39	514

Source: Field Survey, 2024

Table 4: Chi-Square (χ^2) Contingency Table for Hypothesis One

Observed Frequency (o)	Expected Frequency (e)	(o-e)	(o-e) ²	$\frac{(o-e)^2}{e}$
46	54.53	-8.53	-72.7609	1.33
55	60.92	-5.92	35.0464	0.58
21	15.82	5.18	26.8324	1.70

33	28.61	4.39	19.2721	0.67
18	13.13	4.87	23.7169	1.81
81	45.70	35.30	1246.0900	27.27
36	51.06	-15.06	226.8036	4.44
6	13.26	-7.26	52.7076	3.97
5	23.98	-18.98	360.2404	15.02
17	11.00	6.00	36.0000	3.27
35	62.91	-27.91	778.9681	12.38
90	69.02	20.98	440.1604	6.38
20	17.92	2.08	4.3264	0.24
47	32.41	14.59	212.8681	6.57
4	14.87	-10.87	118.1569	7.95
				$\chi^2 = \frac{\sum(o-e)^2}{e} = 93.58$

Source: Field Survey, 2024

Decision

Since the computed value of chi-square (χ^2) of 93.58 is greater than (>) the table value of chi-square of 15.51, hypothesis one was accepted. The statistical test therefore affirmed that the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets have significantly helped in the management of traffic flow in Enugu urban.

Test of Hypothesis Two: The current traffic light in use at Enugu urban has positively contributed to the management of traffic flow in Enugu urban.

Table 5: Observed Frequency for hypothesis Two

Location of Respondents	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Enugu North Local Government Area	56	35	11	40	31	173
Enugu South Local Government Area	34	67	6	21	17	145
Enugu East Local government Area	65	26	24	37	44	196
Total	155	128	41	98	92	514

Source: Field Survey, 2024

Table 6: Chi-Square (χ^2) Contingency Table for Hypothesis Two

Observed Frequency (o)	Expected Frequency (e)	(o-e)	(o-e) ²	$\frac{(o-e)^2}{e}$
56	52.17	3.83	14.6689	0.28
35	43.08	-8.08	65.2864	1.52
11	13.10	-2.10	4.4100	0.34
40	32.98	7.02	49.2804	1.49
31	30.96	0.04	0.0016	0.00.
34	43.73	-9.73	94.6729	2.16
67	36.11	30.89	954.1921	26.42
6	11.57	-5.57	31.0249	2.68
21	27.65	-6.65	44.2225	1.60
17	25.95	-8.95	80.1025	3.09
65	59.11	5.89	34.6921	0.59
26	48.81	-22.81	520.2961	10.66
24	15.63	8.37	70.0569	4.48
37	37.37	-0.37	0.1369	0.00
44	35.08	8.92	79.5664	2.27
				$\chi^2 = \frac{\sum(o-e)^2}{e} = 57.59$

Source: Field Survey, 2024

Decision

Since the computed value of chi-square (χ^2) of 57.59 is greater than (>) the table value of chi-square (χ^2) of 9.49, hypothesis two is rejected. The statistical analysis therefore indicated that the current traffic light in use at Enugu urban has positively contributed to the management of traffic flow in Enugu urban.

Discussion of Results

The result of the first hypothesis revealed that the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets have significantly helped in the management of traffic flow in Enugu urban. The result is in agreement with the finding of

Anierobi, Ugwuanyi & Kanu (2017) asserted that despite great achievement on the control of traffic congestion, urban motorists' perception of the activities of ECTDA and MOT cadets was negative.

The analysis of Eze, Ugwoke & Ugwoke (2018) revealed that the time road users spent on the Enugu urban roads, especially intra-urban bus passengers, has reduced since the introduction of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets. The time spent on Enugu road varied from one area to another, indicating variations in the level of traffic congestion. Table 7 gives the calculated mean time road users spent on the Enugu urban roads for the 20 major centres as a result of the introduction of Enugu Capital Territory Development Authority (ECTDA), MOT cadets and traffic lights.

Table 7: Calculated mean time road users spent on the Enugu urban major traffic areas before and after the introduction of and traffic light, ECTDA and MOT cadets

Centre Number	Name of Major Centre	Mean Time Spent by Road Users in Various Enugu Urban Roads in Minutes	
		Before	After
1	Abakpa Nike	35.53	42.61
2	New Heaven	10.10	4.08
3	Emene	26.12	21.72
4	Obiagu	22.07	16.02
5	Abakpa Junction	18.11	15.11
6	Ogui Junction	11.22	7.01
7	Camp Colliery	14.71	12.15
8	Polo Park Shopping Mall	13.20	4.92
9	Trans Ekulu	20.51	9.05
10	Government Secretariat	7.11	3.41
11	Artisan Market Road	16.81	10.17
12	Old Park (Ogbete)	31.17	26.77
13	New Layout	11.91	7.14
14	Kenyatta/Uwani	17.51	11.31
15	Mayo Market/Agbani Road/Achara I	24.12	19.63
16	Amechi Junction	18.66	12.51
17	Gariki (Awkunanaw)	28.41	21.66

18	MaryLand/Timber/Ugwuaji Road	14.13	9.01
19	Asata/Ogui Road	9.10	3.03
20	Iva Valley/New Market Road	12.19	8.11

Source: Field Survey, 2024

The average road users waiting time as a result of traffic, the world over as devised by the World Health Organization (WHO), World Bank (WB) cited in Ali (2010), ranges from 5-10 minutes indicating high quality of traffic services and the maximum time passengers are expected to wait for the arrival of buses at bus stops, ranges from 10-15 minutes indicating moderate quality of traffic services. Any time above 15 minutes indicates poor quality of traffic services and can lead to stress and cause health problems. Aligning to the table 7 above before these measures and in line with the World Health Organization (WHO), World Bank (WB) declaration is the result of the study by Echendu, Okeke & Okeke (2020) which indicated that major travel mode within Enugu metropolis by passengers is mini buses and tricycles while commuters undergo stress during their trips regardless of the good condition of roads within the metropolis as a result of poor traffic services. As we can see, the users waiting time is reduced even to the prescribed time in most areas as a result of traffic measures under study. While some other areas still need urgent attention such as Abakpa Nike, Emene, Gariki (Awkunanaw), and Old Park (Ogbete) etc.

In total disagreement the first finding is the assertion of Nwokoro (2020) who described the activities of MOT cadets as “thuggery in Enugu State transport ministry”. The assertion states that “there is a popular traffic enforcement cadet known as MOT operating majorly in Enugu Metropolis whose relationship with vehicle and tricycle operators in the state is taking an unusual dimension”. Explaining that these cadets before their inauguration had an intensive orientation course to prepare them for the job, the idea was simply to help in traffic management and nothing more. But sadly, some members of the organisation, going by their recent conducts, leave one asking the question of whether thuggery has found its place in Enugu urban. But the first finding of this study revealed that the activities of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets have helped in decongesting traffic flow in Enugu urban through apprehending one-way drivers in major Enugu Urban roads, apprehending drivers that violate traffic light, apprehending vehicles parked on major Enugu urban roads during the peak period of the working days , traffic control and passage of vehicles in busy areas and when traffic lights are off, relocation and removal of commercial activities and/or unauthorised structures on urban transportation routes, and maintaining road signs and enforcing compliance to road use rules in Enugu urban.

Our second hypothesis revealed that the current traffic light in use at Enugu urban has positively contributed to the management of traffic flow in Enugu urban. The finding agreed with the results of Ilo, Ibekwe & Nwobodo (2017) who discovered that the current traffic

lights in use at Enugu urban have limitations such as, poor time allocation to traffics, lack of intelligent in the control system, difficulty to manage and control traffic during peak period. The performance of the Intelligent Traffic Light Controller was compared with the current mode Conventional Traffic Light Controller in use in Enugu urban which uses microprocessors or microcontroller for its operation by Ilo, Ibekwe & Nwobodo (2017), from the results, it was observed that the Intelligent Traffic Light Controller is more efficient than the conventional traffic light controller in the area of time allocations to traffics. It was also observed that intelligent traffic light controllers manage traffic better during peak periods.

5.0 FINDINGS, CONCLUSION & RECOMMENDATIONS

Findings

This study dealt with Traffic Management Strategies and Traffic Flow in Enugu Urban Areas of Enugu State, Nigeria. After presentation and analysis of the various data gathered in the course of the study, the following findings were made.

1. The study revealed that the approaches of Enugu Capital Territory Development Authority (ECTDA) activities of Enugu Capital Territory Development Authority (ECTDA) and MOT cadets have helped in decongesting traffic flow in Enugu urban through apprehending one-way drivers in major Enugu Urban roads, apprehending drivers that violate traffic light, apprehending vehicles parked on major Enugu urban roads during the peak period of the working days , traffic control and passage of vehicles in busy areas and when traffic lights are off, relocation and removal of commercial activities and/or unauthorised structures on urban transportation routes, and maintaining road signs and enforcing compliance to road use rules in Enugu urban and MOT cadets have significantly helped in the management of traffic flow in Enugu urban.
2. It was discovered that current traffic lights in use at Enugu urban have positively contributed to the management of traffic flow in Enugu urban. The study shows that traffic light is effective in controlling traffics in orderly manner during pick period, reduces traffic collision or car accident, or car crash at T-junctions and roundabouts, and enhances free traffic flow in queuing method rather than blocking the roads, but the traffic light is not intelligent in the traffic control system in terms of time allocation to routes in traffic points and lack the ability to detect vehicles that violate traffic light for punishment.

Conclusion

This study has brought into focus the issue of traffic management strategies and traffic flow in Enugu Urban Areas of Enugu State, Nigeria. The effects of traffic congestion on daily activities of the people have been unveiled. This study has shown that the approaches of Enugu Capital Territory Development Authority (ECTDA) and MOT have significantly helped in the management of traffic flow in Enugu urban. The study also showed that the current traffic light in Enugu city is having a positive impact on traffic management, although

it has limitations such as poor time allocation to movements, lack of intelligent control system and difficulties with controlling movement during periods of peak hour.

In conclusion therefore, the significance of alternative ways to solve hold ups increase since infrastructural extensions and adjustments require large investments and also takes time is very important. New traffic management measures are required in Enugu Urban, as well as smart software that can enable a specific traffic surplus route allowing green light longer or more often and improvement to other existing measures.

Recommendations

Based on the findings and conclusion of the study, the following recommendations were made.

1. There is great need to integrate transportation and land use planning. Land use and transport form a closed loop system and interact very much. Land use planning will involve relocation of major land users that attract and generate traffic enormously to elsewhere.
2. All the markets that are not food item markets and some institutions should be relocated; food item markets along the Enugu Urban roads should be relocated to alternative sites. This site consists of privately owned plots but can be acquired by the state government on the basis of overriding public interests.
3. The MOT cadets and other traffic personnel should be carefully sanitised to fish out the corrupt ones and replace them with more honest and integrityful people.
4. There is also a need for traffic education. Traffic education here is the conscious training of all road users, most especially the vehicle operators including the Keke-Napep operators in proper and lawful behaviour in Enugu urban routes.
5. To make traffic light control more efficient, the modern traffic light is called "Intelligent Traffic Light Controller". This makes the use of sensor networks along with embedded technology. The timings of red, green lights at each crossing of road will be intelligently decided based on the total traffic on all adjacent roads. Thus, optimization of traffic light switching increases road capacity and traffic flow, and can prevent traffic congestions more intelligently.
6. There is a need to improve the arrangement for pay parking spaces to ease congestion and obstruction through illegal parking.

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