Geo-Spatial Analysis of Zebra Crossings and Bus-Stop Shelters on Road Networks in Akure Metropolis Ondo State, Nigeria

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Abstract: **The study examined the distribution patterns of Zebra Crossing and Bus-stop shelter in the area. It also assessed the compliance of the people to the use of these life-saving facilities within the area. These were with the view to determining adherences to traffic regulations in the area. Primary and secondary data were used for the study. The primary data were derived through extensive field work/ground truthing with the use of a Global Positioning System (GPS) receiver used to capture the coordinates of locations of these life-saving facilities on the roads. This was in order to locate the ground verification points on the satellite image and for further incorporation of the life-saving facilities on the ground. One hundred and fifty (150) copies of questionnaire were administered in five motor parks selected within the metropolis using simple random sampling technique. Secondary data were Google Earth imageries and relevant information from published books/articles. Questionnaire data were analysed using frequency distribution and spatial data were analysed using spatial query. The study identified various locations of zebra crossing, bus-stop shelters, and distribution pattern as well as compliance rate of the people in the study area. The study therefore recommended among others on how to enforce compliance and concluded that distributions of Zebra Crossing and Bus-stop shelter and its compliance are not in adherence with traffic regulations in the study area.**

Keywords: **Geo-spatial Analysis, Zebra Crossings, Bus-stop shelter.**

I. INTRODUCTION

The need to improve road safety is an increasingly and continually important objective for road infrastructure planners in all developing economies. Amongst the other means of transportation, road and humans are like siamese twins inseparable, no human day to day activity can be achieved successfully without the use of road(s). However, important as this infrastructure can be the safety of humans on them cannot be overemphasized. Greater number of urban centers in developing countries, particularly Nigeria are experiencing rapid development and growth through the expansion of built up areas and socioeconomic activities. For instance, the increasing population of Ibadan made the city to increase in size from about 101.95km^2 in 1972 to about 240 km^2 in 1988, (Ayeni, 1994). Onibokun and Faniran (1963) reported that Enugu witnessed an average annual physical expansion of 57.8 hectares between 1963 and 1983. The work of Adedibu (1998) revealed that Ilorin with 45 hectares rose to about 223 hectares in 1973, making the town to witness astronomical rate of expansion. This situation does not only give rise to greater demand for road life-saving facilities but equally influence the choice of modes of transport which in most cases depends on journey length, speed of vehicle, conveniences as well as the reliability of alternative modes.

Rapid growth of cities anywhere in the world has impact not only for the land use but also for the spatial expansion. Ikya (1993) for example, stated that the commuting distance of Lagos increased from 20km in 1970 to 35km in 1995 while that of Kaduna increased from 6km to 10km during the same period. In Akure, the commuting distance increased from 5.2km in 1966 to 6.4km in 1976, 10.5km in 1986, 13km in 1996 and 19km in 2006, Ogunbodede (2006). The increase in commuting distance has impact on trip attraction, thus, a number of factors have been found to influence trip generation,

attraction and distribution in any urban environment. As a matter of fact, many metropolitans and intermediate cities across the country experienced varieties of chronic transportation problems of road life-saving facilities such as poor road networks, and complete absence of bus-stops, road signs, pedestrian crossings, street lights, and road mobile clinics. A survey conducted in major cities across the country confirmed that urban road networks is terribly in severe state of disrepair with over 55 percent of them to be totally unpaved. Out of the remaining 45 percent considered tarred only 10 percent is completely in good condition while about 20 percent are fairly good and the rest are in poor state of maintenance, (Oyesiku, 2003).

In order to alleviate urban transport problems, life-saving facilities options appeared to meet the growing demand for safety on the roads in developing countries. Transportation is key both to the economic success and to the quality of life in urban and rural areas. However, the rapid growth of city populations and corresponding vehicle kilometer of travel, commerce, and transportation infrastructure has generated negative effects, visibly such as motor vehicle crashes. An accident is an unpleasant, undesirable damage that happens unexpectedly or by chance. Road accidents has been a threat to the safety of humans on the use of roads and are associated with numerous problems each of which needed to be addressed separately; human, vehicle, life-saving facilities and environmental factors play important roles, before, during and after trauma event. According to Tandoh (2003), road accidents are becoming very common and are robbing the nation of its valuable human resources, he noted that the implications of these lead to both social and economic trauma. He emphasized that road accidents can be curbed by mainly educating drivers on defensive driving skills and also the enforcement of traffic laws.

Life-saving facilities such as Zebra Crossings and bus-stop shelters help to provide safety on roads. Studies have shown that cases of intra-urban accidents have increased despite the number of these life-saving facilities on the roads. Studies also show that part of the reasons for the increased cases of accidents is inadequate distribution of these facilities in urban centers in Nigeria, specifically in Akure metropolis, which therefore requires urgent attention; hence this study. According to WHO (2004), every year more than 1.17million people die in road crashes around the world, 70% of these occur in developing countries; globally, every 10million people are crippled or injured each year, 65% of deaths involved pedestrians, 35% pedestrians are children, worldwide. WHO (2004) also estimates road accident costs (including vehicle and other damage, health expenditure and wasted production) at 518 billion dollars. Public authorities have been active in improving road safety out-comes by providing new or better infrastructure and enforcing public measures (regulation).

II. AIM

The aim of the study is to examine the distribution pattern of Zebra Crossings and Bus-stop shelters on the road networks within Akure metropolis with a view to providing a framework for traffic management in the study area.

III. OBJECTIVES OF THE STUDY

The following are the set objectives;

i. Examine the distribution pattern of life-saving facilities in the area.

ii. Assess the compliance rate of people to the existing life-saving facilities within the metropolis.

iii. Proffer solutions to the problems identified.

IV. RELEVANT LITRATURE

The role of transport in our daily activities cannot be over-emphasized and without it the necessities of life would be difficult to achieve. As wonderful as the role of transport maybe in our daily activities, it has been noted to possess myriads of negative effects. This is why Clark (1958) described transport as the maker and breaker of cities. In year 2002, Ogunsanya also reiterated what Clark observed and confirmed how transport had built cities over the years in some urban areas in Nigeria and how it has gradually destroyed them. Generally, transportation system could be seen as a set of facilities and institutions organized to distribute qualitative accessibility and mobility in urban area. According to Okoko (2003), the Transport System Management (TSM) is a package of short term measures for the most productive and cost effective use of existing transportation facilities, services and modes. However, the Transport System Management (TSM) came into being in 1975 when the Federal Highway Administration and Urban Mass Transport Administration in USA jointly advocated for the adoption of short term and intermediate term plans as against the long range transportation plans

which were no longer effective. The concept was designed to improve the management and operation of highway and transport system, (Adesanya, 1998). In order words, TSM is partly concerned with how to improve problems associated with each mode of transport and effective management of traffic flow in urban centres' with the bid to ensuring safety of road users on the roads. Many metropolitans and intermediate cities across the country experienced varieties of chronic transportation problems which include inadequate transportation infrastructure, poor road networks, complete absence of bus-stop, inadequate facilities such as legible road sign, pedestrian crossing, street lightings, inadequate vehicles for public transport services, low-level of motorization and lack of coordination of the transportation system. A survey conducted in major cities across the country confirmed that urban road networks is terribly in severe state of disrepair with over 55 percent of them to be totally unpaved out of the remaining 45 percent considered tarred only 10 percent is completely in good condition while about 20 percent is fairly good and the rest are in poor state of maintenance, (Oyesiku, 2003). In order to alleviate urban transport problems, new passengers' transport options appeared to meet the growing demand for movement in developing countries. Wright (1993) pointed out that developing countries such as Brazil, India, Singapore, Mexico, and Turkey have introduced new transport options like bus-way transit and several types of rail system to reduce congestion. However, in Nigeria the poor economic situation popularized the non-motorized transport options, particularly the use of motorcycle (Okada) as mode of transport in our cities. According to Oyesiku (2003), the steady decline in level of motorization by over 50 percent between 1990 and 1998 popularized the use of motorcycle that increased from 4000 in 1990 to 25000 in 1995 in major cities in the country.

Road transportation remains the main mode of transportation among other modes of transportation in developing countries which Nigeria carries the status. The importance of life-saving facilities on Nigeria roads in achieving safety on the road and efficient transport delivery cannot be overemphasized as the consequences of neglect are enormous and costly. The age of the roads, the continuous use of the roads coupled with untimely maintenance or sometimes near neglect manifest as rough surfaces and black spots with resultant human casualties and loss of lives. The level of availability of the Life-saving facilities on roads which includes the Zebra Crossing and Bus-stop shelters amongst others and their functionality varied within and between the roads in Nigeria. The discovery of oil in Nigeria came with its own problems. Prior to the 'Oil boom' in Nigeria, road accidents were rather rare. The oil boom brought along with it an increase in disposable income of the people which in turn increased vehicle ownership and brought about 'rapid' industrialization. This undoubtedly calls for improved road networks accessibility, roads were therefore built albeit without dire attentions to standard. These developments were not matched by adequate measures, control and provision of life-saving facilities.

In Nigeria today, hardly a day goes by without the occurrence of a road traffic accident leading to generally increasing incidence of morbidity and mortality rates as well as financial cost to both society and the individual involved. Information on some of these traffic accidents get to the news rooms of media houses and are aired while majority goes unreported. Nigeria has the highest road accidents rate as well as the largest number of death per 10,000 vehicles Sheriff (2009). One may be tempted to believe that the level of awareness on the causes of road traffic accidents is very low among Nigerians.

Travellers heave a sigh of relief if they make their destinations Eze (2012). According to Ogunyemi (2015), Zebra Crossings and Bus-stop shelters plays a crucial role in road safety, for it helps people use roads safely and minimise the risk that a crash or accident will occur. When a crash or accident does happen, protective road infrastructure can mean the difference between life and death. People depend on roads in their daily life to get to school, to work, or to the health centre. Roads underpin the businesses, agriculture and trade which provide the jobs that lift nations out of poverty. Major roads are generally the roads where the majority of people are killed and in their greatest concentrations and therefore the safety of the users of these major roads and the conflicts between different road users resulting from the heavy use of these roads by motorised transport will have to do with types of life-saving facilities on this roads. Recent figures estimate conservatively that some 1.3million people are killed each year in road crashes and a further 50 million people are injured. These numbers likely to almost double by 2030 unless action is taken. And a prevalence of under reporting of serious crashes, notably in low-income and middle income countries means that the actual number of deaths is likely to be much higher than that reported in individual countries, WHO (2009). Road death and injury is not inevitable, road trauma is a preventable public health challenge as well and therefore road systems can be developed such that it will reduce the likelihood of a crash and/or accident occurring and minimise the severity if does occur. This can be achieved with the provisions (where they are not) of life-saving facilities, road users understanding the risks they impose on themselves when they fail to use them and together with appropriate enforcement.

Spatial database is the heart of GIS technology. Kufoniyi (1998) described GIS data modelling as process by which the real world entities and their interrelationship are analyzed and modelled in such a way that maximum benefits are derived while utilizing a minimum number of data. Database creation in GIS environment has two main stages; Design Phase and Construction Phase. Geographical Information System (GIS) is defined as a computer based system that allows the capturing, modeling, manipulating, retrieval, analysis, and storage of geographically referenced data. However, GIS includes some types of software program that runs on personal computers and similar to database program (it analysis and relate information stored as records) but with one crucial difference each record in a GIS database contain information on a point, a line, or polygon that represents a unique place on the earth surface to which the data is geo-referenced, Harder (1997) cited in Nsikak (2003). This implies that a record in a GIS file describing life-saving facilities on urban road network in Akure metropolis would include not only text and numerical information, but also field of spatial data enabling computer to locate the position of each life-saving facilities on road networks map of the study area.

V. STUDY AREA

 Akure, a typical traditional city in the South Western geo-political zone of Nigeria is bounded within latitude 7^0 $14^{'}$ and 7^0 $20^{'}$ North and Longitude 5^0 $06^{'}$ and 5^0 $23^{'}$ East of the Greenwich Meridian, about 370km south west of Abuja the Federal Capital and at a height of about 370m above the sea level. The area towards Ado-Ekiti and Idanre are hilly and studded with large granite formation, rising to 410metres and 496 metres above sea level respectively. In 1991, the provisional population for Akure was put at 239,124 (1991 census). Although, the city accommodated a population of 38,852 in 1952, 71,000 in 1961, 109,000 in 1980, and 112,000 in 1981; 114,000 in 1982; 117,000 in 1983; 120,000 in 1984; 123,000 in 1985(WHO/UNICEF 2010). In 2016, the city has been projected to a population of 465,462 at a growth rate of 2.7 (Ogunyemi, 2016).

VI. METHODS OF DATA COLLECTION AND ANALYSIS
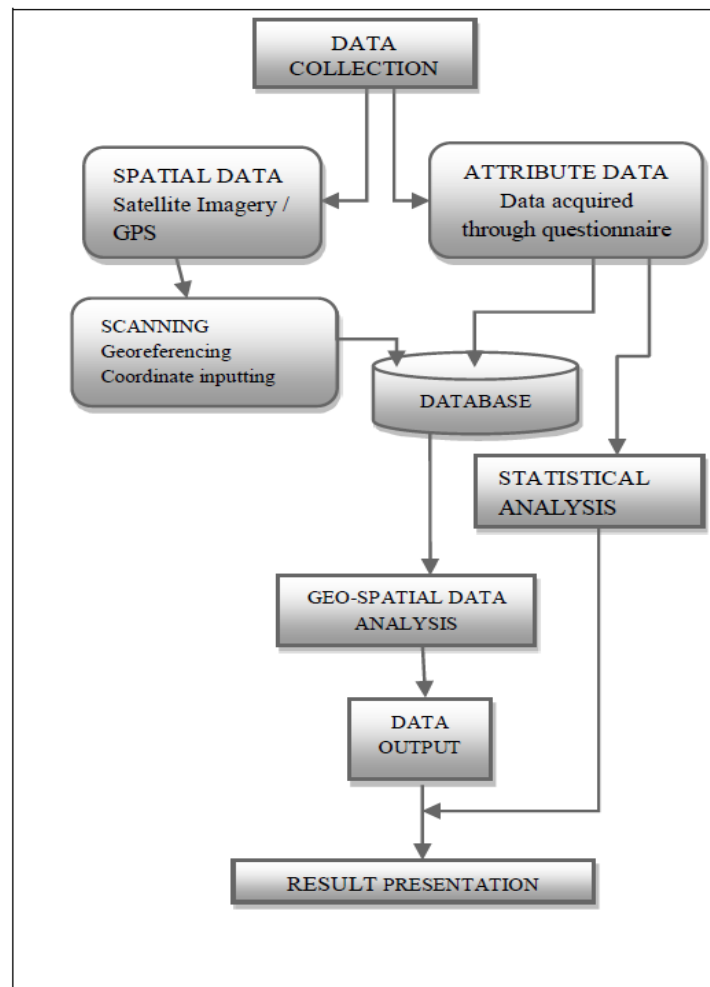
Figure 1: Methodology Flowchart

VII.   ANALYSIS AND DISCUSSION

Figure 1 and Figure 2 below shows the identified zebra crossings and bus-stop shelters on the road networks in Akure metropolis. The zebra crossings were twenty (20) and mainly located along Oyemekun and Oba-Adesida roads, zebra crossings were however not on some major roads such as Arakale and Ondo roads. Bus-stop shelters were thirty three (33) located along the roads within the metropolis, with Oyemekun road having eight (8) functional bus-stops while all the four (4) bus-stops along Arakale road are still under construction. However, one (1) bus-stop namely Oloko bus-stop along Ilesha - Akure road is not an approved bus-stop, Oba – Adesida road has eight (8) bus-stop functioning, while Ondo road is having two (2) functioning bus-stop. Oke-Ijebu Street, Sijuwade Street and Hospital road all have two (2) functioning bus-stop each. College of Agric road has three (3) functioning bus-stop while only one (1) bus-stop, still undergoing construction is spotted along Oba – Ile road.
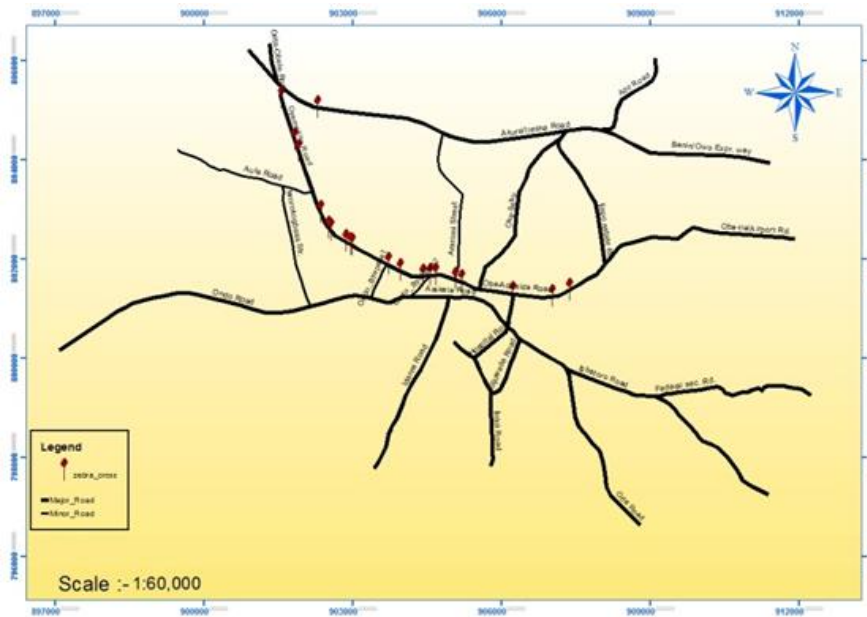

Figure 2: Major and Minor roads within the metropolis showing Zebra crossings. (Field work 2016)
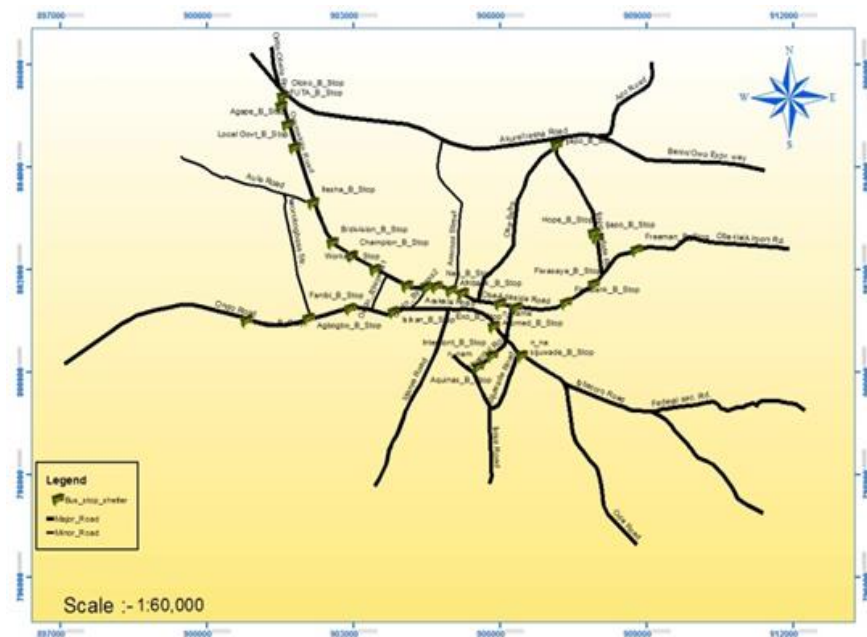

Figure 3: Major and Minor roads within the metropolis showing Bus-stop Shelters. (Field work 2016)

In general, 25% and 35% of major roads has zebra crossing and bus stop shelters respectively 1% and 0% on minor roads respectively has none.(Tables 1 and 2).

**Table 1: Major roads with Zebra Crossings and Bus-stop Shelter**

S/N	Road Name	Zebra crossing	Bus-stop Shelter
1	Oyemekun Road	y	y
2	Oba-Adesida Road	y	y
3	Oba-Ile/Airport Rd.	n	n
4	Ijapo estate Rd.	n	y
5	Oke-Ijebu	y	y
6	Igbatoro Road	n	n
7	Adekunle Ajasin Road	y	n
8	Oda Road	n	n
9	Arakale Road	n	y
10	Ondo Road	n	y
11	Idanre Road	n	n
12	Hospital Road	n	y
13	Oluwatuyi Road	n	n
14	Ijoka Road	n	n
15	Sijuwade Road	n	n
16	Orita-Obele Road	n	n
17	Akure/Ilesha Road	y	n
18	Ado Road	n	n
19	Benin/Owo Expr. way	n	n
20	Federal sec. Road	n	n
Total	**Roads with zebra crossing and Bus-stop shelters**	5	7
%	" "	25	35

*** y = available; n = not available. (field work 2016)

Table 2: Minor Roads with Zebra Crossings and Busstop Shelter

S/N	Road Name	Zebra crossing	Bus-stop Shelter
1	Aule Road	n	n
2	Iworokogbas Str.	n	n
3	Araromi Street	n	n
4	Ondo ByPass2	y	n
5	Ondo Bypass1	n	n
6	Sijuwade streets	n	n
Total	**Roads with zebra crossing and Bus-stop shelters**	1	0
%	" "	17	0

*** y = available; n = not available. (field work 2016)
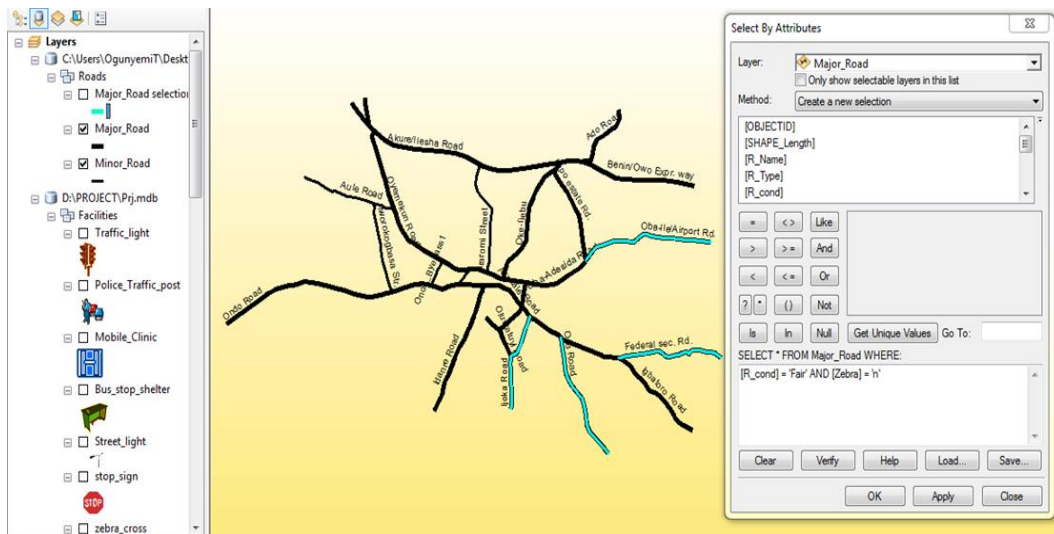
Figure 4: Query / Result for Roads (Tourmaline Green) where Road condition is fair and Zebra Crossings are not available

The distribution of Zebra Crossings and Bus-stop shelter is shown in figure 1 and 2. Most of the Zebra Crossings and Bus-stop shelters within the metropolis were however concentrated along Oyemekun – Oba-Adesida road. Only few of other roads (Fiwasaye – Oke-Ijebu roads, Hospital road, Oluwatuyi road and Igbatoro road) are equipped with them. In addition, six (6) out of the existing thirty three (33) bus-stops are not in use at the time of the study, five (5) were still under construction and one was not approved (table 1). Twenty (20) zebra crossings existed, and these were mainly along Oyemekun – Oba-Adesida roads.

From Table 3, 67.6% of the respondents are married, 4.7% of the respondents are separated while 27.7% are single. There are more male household heads in Akure metropolis as 66.2% of the respondents are men, this explains the extent to which people that head the household are men, whilst the remaining 33.8% are women. About 19.6% respondents are between 21-30 years of age, 29.7% between 31-40 years, while 31.1% are between the ages of 41-50 years and 14.2% are above 50 years, this shows that the household heads are mostly in the working age groups of 20-60 years old.

Most of the respondents are literate. 43.9% of sampled population had tertiary education while 6.1% of the sampled population had only primary education, 29.7% of the respondents went to secondary school with only 20.3% of the respondents had no formal education. The major means of livelihood of household heads in Akure metropolis is in the civil service. Civil servants make up 60.1% of the respondents, while 11.5% of the respondents engaged in one trading activity or the other, 4.1% of the respondents are teachers, 14.2% of the respondents are artisans, while the remaining respondents of 10.1% are students.

Largely, the compliance rate of the people to the use of Zebra Crossings and Bus-stop shelter is poor (Table 3). About 26.4% had 100% compliance rate, 31.1% had compliance rate of 80%, while 22.3% had 60% compliance rate, also is the compliance rate of 40% that goes to 38.4% respondents. From the survey as reflected on the table 3, the percentage of respondents who complied 100%, 80% and 60% is far below average hence the compliance rate of the people to the use of Zebra Crossings and Bus-stop shelter cannot be said to be one that puts sanity on the road networks in Akure metropolis.

Table 3: Socio-cultural, Socio-economic and Compliance Rate of respondents Field work 2016.

Variables	Options	Frequency	Percentage
Marital Status	Single	41	27.7
	Married	100	67.6
	Separated	7	4.7
Gender	Male	98	66.2
	Female	50	33.8
Age group (Years	0 – 20	8	5.4
	21 – 30	29	19.6
	31 – 40	44	29.7
	41 – 50	46	31.1

	Above 50	21	14.2
Educational Level	Tertiary	65	43.9
	Secondary	44	29.7
	Primary	9	6.1
	Others	30	20.3
Occupation	Civil servant	89	60.1
	Student	15	10.1
	Trader	17	11.5
	Teacher	6	4.1
	Artisan	21	14.2
COMPLIANCE RATE (percentage	100%	39	26.4
	80%	46	31.1
	60%	33	22.3
	40%	30	20.3
Total		**148**	**100**

VIII.   DISCUSSION OF RESULTS/FINDINGS

Results and findings in respect to the aim and objectives with the methodology adopted in this study geospatial analysis of Zebra Crossings and Bus-stop shelters on road networks in Akure metropolis, was most revealing.

Zebra crossings is fundamental to human safety on roads, the benefits of zebra crossings for society are numerous, including checking speed limit and average number of vehicles per hour applicable to vehicles at the crossings point during the periods when children walk to and from schools and market places Anderson (1997). Results, reveals the absence of zebra crossings on Ondo and Arakale roads where numerous human activities ranging from commercial to educational takes place, a situation that increases the chance of pedestrian crash and injury risk to pedestrians, shoppers and other pedestrians while crossing the road. Traditionally, the essence of zebra crossing on the road is primarily to maintain a peaceful and safe interaction between man and vehicle traffic, the absence of it however on Ondo – Arakale roads and others roads within the metropolis has not made it possible to maintain a perfect and complete segregation between these two important road users. More so, the attitude and activities of road users on zebra crossings in the metropolis render ineffectual the in-built safety benefit of this device even on the Oyemekun – Oba-Adesida roads. In general and notably so, the negative attitudes exhibited on zebra crossing by road users in the metropolis are, zebra crossings obstructed due to on-street parking, vehicles in traffic jam stand on zebra crossing, Pedestrian stand aloof from this safety device and motorists raced across the zebra crossing. Also, the poor road maintenance culture in the metropolitan further aggravate the unsafe state of this safety device. For example, the white paint on the zebra crossings often peel-off without instant replacement. According to Odeleye (2009), supplementary component of the road environment like special lighting for pedestrian crossing, steady and flashing beacon, overhead flood light, flashing road studs and traffic lights that give right of the way to pedestrians are to alert the road users of the need to use the zebra crossing, as well as the necessity to obey it. Ironically, these are virtually not available in the metropolis and zebra crossing points are abandoned, and paradoxically becomes a danger crossing point for the pedestrian at all time.

In the metropolis, thirty three (33) bus stops or bus shelters were located along the roads with some functional and others either non-functional or unapproved. However, bus stop shelters should be located where they are convenient to use and for the safety of passengers and other road users, hence in considering the suitability of a potential site, the prime considerations should be road and pedestrian safety. Factors like proximity to adjacent junctions, proximity to pedestrian crossings, bends or crests in the road, on-street parking, existing accesses to residential and business properties should influence the detailed location of a bus stop or bus shelter for road user safety and these formed the basis for other suggested locations in the metropolis for bus stop or bus shelter. Bus priority team, (2006) in Adebola (2012), posited that the concept of 'Total Journey Quality' recognizes that bus passengers are also pedestrians at each end of the bus trip and requires that all aspects of the journey are considered. So the convenience and comfort of bus stops must not be overlooked. The study of the area shows that the existing bus stops or bus shelters ironically are not of high impact on the entire traffic, ease of traffic and transport system of the area. Bus-stop shelters locations and their characteristics must be such that would make the interchange most appealing to the users. So when such interchanges are problematic and poorly situated, it becomes an impediment to public transport systems and safety on the roads. Essential priorities are needed to be given to this essential public transport infrastructure in terms of its location, characteristics and spacing.

In general, the study reveals that the distribution patterns of the Zebra-Crossings and Bus-stop shelters in the area are mostly concentrated along the Oyemekun - Oba Adesida road. Only few of the other roads (Fiwasaye – Oke-Ijebu roads,

hospital road, Oluwatuyi road, and Igbatoro roads) are equipped them. However, the compliance rate of the people to these life-saving facilities is poor.

IX.   SUMMARY

This work has examined the distribution pattern of Zebra-Crossings and Bus-stop shelters in the area. Assessed the compliance rate of people to the life-saving facilities within the area an indicator for safety protocols on the road networks in Akure metropolis. The findings shows that the compliance rate of the people to life-saving facilities rules and regulations is poor. Road infrastructures planners should make roads safer, make dangerous roads and highways easier to get across by constructing Pedestrian bridges appropriately where there are high volume of traffic or high traffic flow. The road networks is an important infrastructure in an urban setting, it allows connectivity and movement of people, traffic and goods both within and between urban centres. This makes it expedient to preserve urban road networks in good working condition and maintained safety. Satellite remote sensing and GIS are powerful new technologies used to update information about road transportation which is required for mapping, planning and maintenance of urban road networks. Therefore, road planners need to integrate land-use transportation models with Satellite Remote Sensing and GIS technique for effective planning and management of road networks.

X.   RECOMMENDATIONS

Arising from the study and in light of the study's findings and results, the following recommendations are made;

1. An increase in the penalties for violation of traffic laws and rules within the metropolis.

2. To have a daily news report through the television and radio stations about the daily traffic accidents.

3. More enlightenment programmes, seminars and jingles on television and radio on the importance of people to comply with rules of life-saving facilities on the roads.

4. To encourage drivers and road users who violate traffic laws to attend refreshers courses concerning traffic laws and regulations.

5. To start educating our children in schools about traffic safety rules and regulations and also encourage the students at tertiary institutions in the state to take traffic safety course.

6. To further achieve safety on the road networks in the study area, pedetsrian bridges should be constructed at the Araromi north end - shagari village roads, Oke-Ijebu north end - Ado roads and Akure – Ilesa roads / Orita-Obele roads due to the heavy traffic volume and higher vehicular flow.

7. Road safety audit should generally be considered as a valuable instrument to guarantee road safety in design plans for roads in the metropolis.

8. A mobile clinic should be stationed at defined locations and distances for emergency cases of road accidents, this will meet the first aid demands of road users' in the metropolis.

9. The result from the research shows that some of the roads in the study area are in a poor condition for example, Orita-Obele road. Therefore, it is recommended that roads in dire need of maintenance and reconstruction be attended to and invariably help to facilitate smooth, time saving, safety and comfortable ride.

10. That both the quality and quantity of traffic officer's surveillance need to be improved and surveillance be concentrated on three areas: drink-driving, the wearing of seatbelts and persuading drivers to keep to the speed limits. Provision of surveillance cameras at each crowded road in the metropolis will also help.

11. That roads be improved or reconstructed and the maintenance culture improved so as to keep the safety devices on road network in the metropolis in a safe state.

XI.   CONCLUSION

Improving compliance and maintenance of life-saving facilities on road networks in the metropolis will require commitment of all including the government resources in road infrastructure and road safety regulation enforcement systems. Unlike mandatory compliance, everyone must focus on achieving voluntary compliance levels so the pressure on road safety regulation enforcement can be minimized. While the effort and money being put into maintaining and

expanding life-saving facilities stagnated or decreased, the demand for transportation services increased with the growing population in the study area. So strategies such as use of consumer centered designs when designing road infrastructure will help government leverage on the amount of capital required for life-saving facilities on the roads within the metropolis.

More so, the research demonstrated the dynamic capabilities in the application of Geographic Information System in geospatial analysis of Zebra Crossings and Bus-stop shelters on road networks in the metropolis. It is concluded that, the recommendations made are targeted at strengthening current road safety approaches, while also proposing new initiatives capable of affecting drastic reduction in the carnage on the road networks in Akure metropolis.

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