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### RESEARCH ARTICLE

## EVALUATION OF OFF-STREET PARKING IN CENTRAL BUSINESS DISTRICT OF SOUTHWESTERN NIGERIA – A CASE STUDY OF AKURE.

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#### Abstract

The policies and management practices regarding parking have been known to directly affect land use, air quality, traffic congestion, travel behavior, and economic development. Nevertheless, having an effective system for managing off-street park remains a major challenge in large central cities of the Southwestern parts of Nigeria. In this study, parking surveys were conducted to evaluate the efficiencies of using both close and open-ended questionnaires. Three different parking areas, namely CBP1, CBP2, and CBP3 and four road areas, namely CBR1, CBR2, CBR3 and CBR4, were utilize for five main parts of the Central Business District in Akure, Ondo State, Nigeria. The data collected were analysed to determine demand and supply of parking facilities with a view to formulate strategies for better and efficient management of off-street parking in the study area, and their efficiency were obtained as 42.5 %, 69.52 %, 74.88 % and 26.66 %, respectively. The study shows that CBP1 operated below the maximum capacity at parking index lower than 50%, while CBP2 and CBP3 operated above the maximum capacity when compared with Policy 7 of the Parking Space Requirements in Parking Code Guidance 2012 of San Francisco Department of Transportation. The study shows that there is inadequate parking signage and deficiency in enforced by the City's Management; and thus, effective communication, parking enforcement, operational efficiency and provision of parking signage should be adopted in the study area.

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#### Introduction:-

Parking is an essential component of the transportation system because vehicles must park at every destination such that a typical automobile can be parked for up to twenty-three hours on a daily basis (Oyedepo, 2016). Parking facilities are, therefore, a major cost to society and parking conflicts are among the most common problems in most cities. Such problems can be often defined either in terms of supply: when the available spaces are (very) few; or in terms of management: when the available facilities are used inefficiently. Management solutions tend to be better than expanding supply because they support more strategic planning (Subramani, 2012). Parking studies may be restricted to a particular traffic producer or encompass an entire region, such as a central business district (CBD).

Parking is one of the problems that confront the CBD as it is to both the traffic and transportation engineers. The policies and management practices affecting parking leads to outcomes that can affect land use, air quality, traffic

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congestion, travel behavior, safety, and economic development (Barter, 2010). Yet, effectively managing parking is an ongoing struggle for the large central cities as they faced with an ever increasing demand for space and too little parking makes good businesses less viable. In order to improve the conditions of the parks, data pertaining to the availability of parking space, extent of its usage and parking demand are important. Surveys concerning the use of parking lots in urban areas are an essential part of the parking policy studies and usually require a large amount of effort (Sander et al., 2002). Parking problems are very common in the CBD of Nigeria Cities as a result of the growing concentration of population, rapid urbanization and economic activities of certain point of the world. The increasing population and expanding urban centers has been accompanied by increasing car ownership rate and increasing demand for parking for various purposes.

Parking management refers to policies and programs that results in more efficient use of parking resources. Parking management includes several specific strategies such as changes in the provision of parking and its cost affect the overall cost of travel; changes in parking can alter urban density levels (since parking requires land that could otherwise be used for residential or commercial buildings); and, parking can directly generate revenue as an economic activity. (Still et al., 2000). Studies on traffic impact analysis are conducted to determine the number, movements, and characteristics of vehicles at given location. The study assesses the effects that a particular development's traffic will have on the transportation network in the community's CBD (Shoup, 2002). A properly developed traffic impact study should provide factual basis for good decision making and facilitate a timely implementation of necessary improvements. Also, it can help in identifying critical flow time periods, and can be used to determine the influence of vehicles on vehicular traffic flow or volume trends (Geoff, 2010).

Traffic impact analysis is a sub-component of the larger transportation network which is needed by larger communities, such as CBD, to determine appropriate mixes of transportation modes. Furthermore, traffic impact analysis may provide information relevant to broader plans and decisions. Thus, the aim of this study is to carry out parking studies and traffic impact analysis in Nigeria. The specific objectives of the study are to conduct off street parking studies around the CBD areas in Southwestern parts of Nigeria. A case study of five major areas in Akure, capital city of Ondo State, was observed. The remaining of this paper is reported such that. Section 2 highlights the important contribution in the study area as found in existing literature; Section 3 presents an overview of the parking policy and the study area along with the procedures observed; Section 4 presents the results of the study; while the discussion and remarks about the results are presented in Section 5; finally, conclusion of the study is in Section 6.

#### **Literature Review:-**

The demand for parking in the CBD depends on how many people want to drive there (Voith, 1998). A successful CBD combines large amount of labor and capital on a small area of land and must not just receive a critical mass of people every day but do so without clogging itself to the point of paralysis. One way to do this is to require off-street parking spaces which, invariably, can reduce parking densities that often strangles the streets of CBDs. Moreover, CBDs thrive on high density because of proximity, which is a prime advantage they offer in metropolitan areas, that enhances availability of wide varieties of activities. This makes parking an important factor for planning CBD area.

Earlier works includes the study of Orquina et al., (2001) which was focused on parking facilities in order to determine how certain supply factors influence the occupancy in the study area of Philippines. They analysed factors affecting the supply of parking facilities to include; building size, development density, development mix, policy requirements, location, and cost of parking slot. And evaluation on how these factors affect parking occupancy rates was undertaken using data gathered from the parking occupancy survey. Likewise, Marsden (2006) who reviewed the impact of parking in the CBD discovered that drivers make leisure and shopping trip to the CBD in United Kingdom, and have a greater range of options available to them to respond to parking. Palmer et al., (2010) discovered that parking spaces in United Kingdom are almost never filled, that parking facility costs should be incorporated into the costs of buildings or be subsidized by local government, and that every destination should satisfy its own parking needs. He suggested that CBD should strive to use parking facilities efficiently.

In Nigeria, some of the earlier works in this study area includes the study of Olayiwola (1985) where the study of parking analysis of CBD in Lagos was carried out. The author observed that the parking lots are always full during the peak hours of the day especially between 12 P.M and 2 P.M. For the case of car parks which are allocated to offices, it was observed that the turnover is usually low because parking within such area are strictly reserved for employees of the companies that own these parking lots. He made some recommendation on how to improve the parking lots for those who wish to transact business within the core area of the CBD by constructing a multi-storey

car park or provision of surface parking lots in the area to cater for more vehicles that might be willing to make use of the parking lots. According to Simmon (1996), in Routledge, London discovered that parking is a complex and long term problem which cannot be totally eradicated but managed. Buses and trucks have to load and unload passengers and goods. They all need space to park and this pose a problem if required spaces are not available. The usage of vehicle has a direct linkage with parking.

Wilbur (2011) in his analysis for parking studies in California, Los Angeles, recommended the use of management of parking demand which will include programs that are used to manage the demand for parking and should be considered a first step before undertaking additional parking management measures. Osoba (2012) identified the adequacy of parking facilities of the CBD in Lagos, 76.5% of the respondents to his questionnaire; believe that they are fairly adequate. On-Street Parking is being practiced in the business districts. The Local Government also designated some spaces within the business districts for On-Street parking. However, the spaces are provided for the use of private cars only. Similarly, Chaturvedi (2012) address the problems relating to parking policy inventions of Enschede, The Netherland, by making a justifiable choice of parking demands and ascertained the assessment criteria of economic efficiency relating to parking studies and the impact of parking policies measures. He considered the dynamics of parking location choice decisions and competition between parking locations. Furthermore, Stuart et al., (2013) concluded that minimum parking requirements in Auckland, New Zealand can be understood as a regulatory intervention (i.e. public policy) that seeks to increase the supply of parking above what would normally be provided by new developments if they were free to choose themselves.

Later on, McCahill et al., (2014) revealed that the physical impacts of minimum parking requirements in urban centers of Buffalo, New York, through estimation of area wide parking supply ratios and visualization of parking supplies and built environment around the CBD in their research work “Visualizing Urban Parking Supply Ratios”. Their work demonstrates that parking requirements can only be met through drastic changes to the urban built environment. However, buildings generally also become more sparsely distributed and parking becomes a more dominant feature of the built environment. Similarly, the study made by Olorunfemi et al., (2014) appraised the menace of on-street parking in Lokoja (Nigeria) and it has been seen that parking problems are due to its land use pattern coupled with inadequate parking spaces or facilities and ineffective of the traffic devices in the area. Ogundare & Ogunbodede (2015) have studied traffic congestion and parking difficulties in Akure metropolis (Nigeria). However, since the study area is imbedded with a lot of commercial activities causing scores of vehicular and pedestrian traffic, demand for parking spaces and other facilities are high. Thus, there is need to investigate how inability of the existing situation has yielded a way survive the demand for high parking lots and traffic problems.

### Study Area and Methodology:-

The study was carried out for cities in the Southwest of Nigeria, using a case study of Central Business District in Akure, Ondo State, Nigeria. The city was chosen as a result of the urgent need to conduct a survey on the parking spaces in the CBD areas of the city

#### The Study Area

Akure is one of the important cities in terms of economy and commercial profile in the Southwest of Nigeria. Despite being one of the more densely populated cities of the country (Figure 1), Akure connects to several popular and larger cities such as: Ibadan, Lagos, Benin, Port Harcourt, Abuja and Kaduna; thus, the city does not lag behind in terms of development. It has an area of 331 km<sup>2</sup> with a population of approximately 420,594 at the 2012 census. The city is located on latitude 70 20’N and longitude 50’E, while the natural pattern of development is linear along its main roads viz Oyemekun-Oba Adesida road and Arakale-Oda road. The existing land use is characterized by a medium density of structure within the inner core areas.

**Table 1:-Park Use Characteristics**

No	Park Name	Code	No. of Bays	Parking Layout	Park Use Characteristics'
1	Democracy Park	CBP1	400	Parallel and angle parking	Commercial, truck parks, and residential
2	Arakale Park 1	CBP2	370	Parallel and 90o parking	Commercial and residential
3	Arakale Park 2	CBP3	300	90o and angle parking	Commercial, truck parks, residential
4	Oyemekun Road 1	CBR1	10	Parallel and 90o parking	Commercial
5	Oyemekun Road 2	CBR2	103	90o parking	Commercial and residential
6	Adegbola Road	CBR3	30	90o parking	Commercial and residential
7	Ondo Road	CBR4	100	Parallel and 90o parking	Commercial

Akure is mostly residential areas forming over 90% of the developed area but additional activities such as warehousing, manufacturing, workshops and other commercial uses are commonly located within the residential neighborhoods. At present the traffic composition of Akure is dominated by taxis, motorcycles and minivans. Traffic impact analysis and parking studies in the CBD of Akure is part of the cities that has the CBD's operations at its peak. With all the activities going on in the CBD, this study is of the view of conducting a parking study to help find the problems facing parks and also to determine the causes of parking irregularities in the selected area of study.

**Methodology:-**

Parking studies are conducted to make survey for information that is required about the demand for parking and as well as the capacity and use of existing parking facilities. Before parking studies can be initiated, a study area must be defined, that is drawing cordon line to designate a particular area under investigation. Following the delineation of the study area which extends from Ilesha garage through Oyemekun Road to Oja Oba via the modern market, Arakale, and Ondo Road of Akure, three different parking areas and four road areas around the CBD shown in Figure 2 were selected for detailed study. Analysis was carried out for the CBD areas. The use characteristics of the parks, along with their coded given to them during this study, are shown in Table 1.

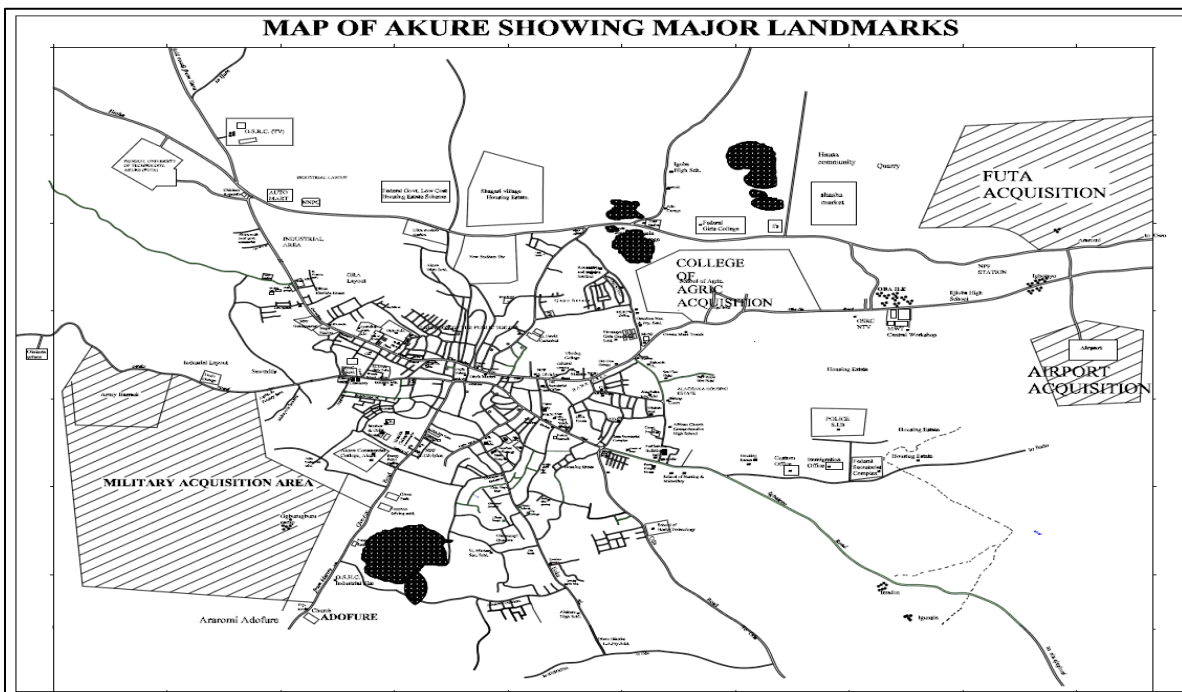


Figure 1:-Map of Akure (Source: Department of Urban and Regional Planning, FUTA. ©2015)

Table 2:-Parking Accumulation for Monday 30th June, 2014

Time of day	stalls available	vehicles parked within parking lot	Percentage (%)
Before 8a.m	400	27	6.75
8-10a.m	400	93	23.25
10-12a.m	400	152	38.00
12-1p.m		BREAK	
1-3p.m	400	171	42.75
3-5p.m	400	68	17.00

Arakale Park 2 and Oyemekun Road 2 are made up of many parks and roads, respectively, but in a closer CBD area. Thus, for clarity, they are mapped as one. The primary data were obtained from well-structured questionnaires and personal interview while the parking surveys were conducted between 08:00 and 17:00 every day for twenty-four days in a time period spanning 30th of June 2014 to 23th August 2014. License plate method of survey was adopted, so in this case of survey, every parking stall was monitored at a continuous interval of 15 minutes or so and the license plate number was noted. This gave the data regarding the duration for which a particular vehicle was using the parking bay. Both close-ended and open-ended questionnaires were administered to 800 users representing 75%

of the total population. The calculation for sample size was based on the consideration to examine at least half (50%) of the total parking bay; 680 questionnaires were retrieved for data analysis, which represent 85% of the total population.

**Study Results:-**

Data about the parking accumulation and arrival - departure survey acquired for each of the parks and the road areas were analyzed. For instance, for the CBP1: Democracy Park (Figure 3), the data are summarized as presented in Table 2 and Table 3, respectively. The parking duration, turnover, and efficiency were computed, using Eq. 1-3, respectively, based on the data that were collected for each of the CBD areas.

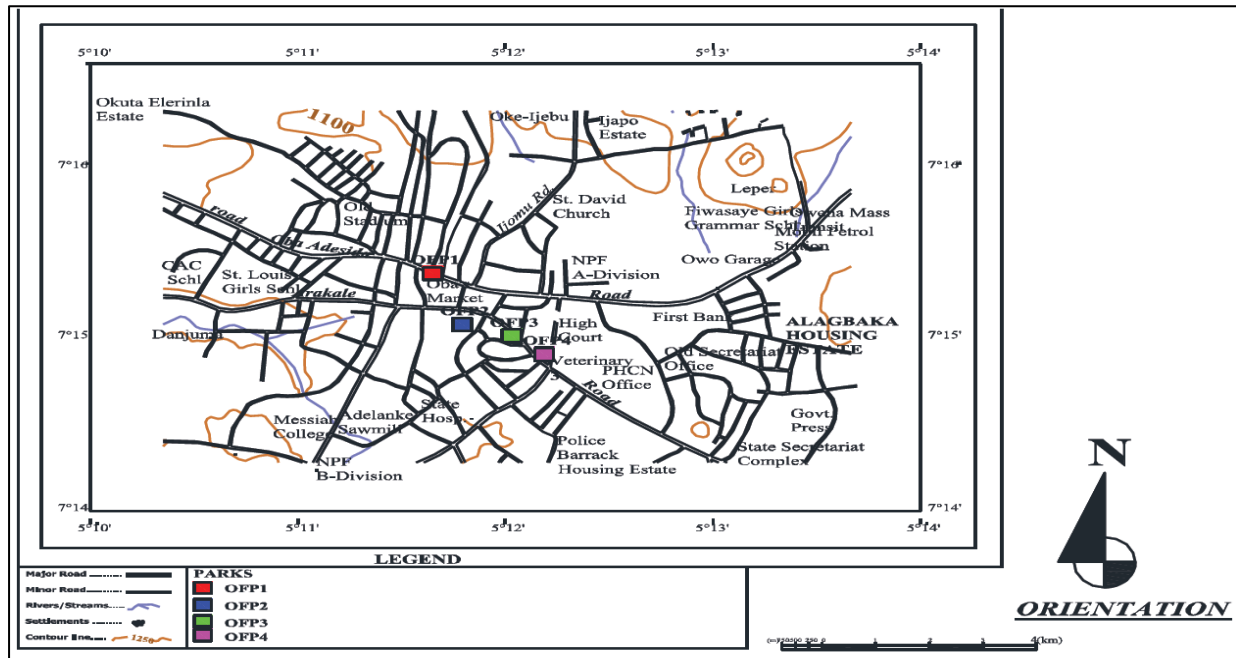


Figure 2:-Map of Akure (Source: Department of Urban and Regional Planning, FUTA © 2015)

Table 3:-Parking Accumulation for Wednesday 2nd July, 2014

Time of day	stalls available	vehicles parked within parking lot	Percentage (%)
Before 8a.m	400	29	7.25
8-10a.m	400	101	25.25
10-12a.m	400	196	49.00
12-1p.m		BREAK	
1-3p.m	400	168	42.00
3-5p.m	400	54	13.50

$$\text{Parking duration} = \frac{\text{parking load}}{\text{parking volume}} \quad \text{Eq. (1)}$$

$$\text{Parking turnover} = \frac{\text{parking volume}}{\text{no of bays available}} \quad \text{Eq. (2)}$$

$$\text{Efficiency} = \frac{\text{parking load}}{\text{parking capacity}} \times 100 \quad \text{Eq. (3)}$$

Sequel to the computations of Eq. 1-2, accumulation can be found out as initial count plus number of vehicles that entered the parking lot during the time interval minus the number of vehicles that just exited for that particular time interval. For the first time interval of 5 minutes, where the initial count is 137, accumulation can be found out as 137 +8 -7 =138, as presented in Table 4. Then, the parking index, otherwise known as the parking efficiency, was calculated using Eq. 3. For instance, the first time interval of five minutes yielded a parking index of 34.5 %.

to these, the average occupancy in terms of the efficiency and parking load (vehicle minutes) are derived with Eq. 4 and Eq. 5, respectively. The results obtained for the whole computations are given in Table 5.

$$\text{Average parking index} = \frac{\sum_{i=1}^n \text{Efficiency}}{n} \times 100 \quad \text{Eq. (4)}$$

$$\text{Parking load} = \frac{\text{Accumulation}}{\text{Time Interval}^{-1}} \quad \text{Eq. (5)}$$

Parking load for certain time interval can be modeled as multiplication of the accumulation value with the time interval. Thus, the Total parking load can be computed as summation of all the vehicles in a study period across all time intervals. Figure 4 shows the parking accumulation curve for the CBP1, CBP2, CBR1, and CBR4, respectively; while Eqs. 1-5 were used to evaluate the parking statistics.



Figure 3:-Views of the areas in Table 1; a) CBP1; b) CBP1; c) CBP2; d) CBR1; e) CBR3 and (f) CBR4

Table 4:-Arrival - Departure parking survey solution

Time Interval	Arrival	Departure	Accumulation	Occupancy (%)	Parking Load
5	8	7	138	34.50	690
10	13	6	145	36.25	725
15	11	6	150	37.50	750
20	16	7	159	39.75	795
25	11	4	166	41.50	830
30	9	7	168	42.00	840
35	10	3	175	43.75	875
40	10	5	180	45.00	900
45	15	8	187	46.75	935
50	8	8	187	46.75	935
55	13	7	193	48.25	965
60	9	9	193	48.25	965
				510.25	10,235

**Discussions:-**

The maximum capacity of CBP1 park is above average as revealed from the studies carried out hence, the park has a low volume capacity if compared with its use. Therefore, Policy 7 of the Parking Space Requirements in Parking Code Guidance which states that support shared parking between multiple uses to the extent possible, and allow private property owners to share their underutilized off-street parking resources with the general public (Knepper,

2012), is recommended so as not to choke the park. Similarly, Arakale park 1 (CBP2) has a medium volume capacity as compared to its use. From the studies carried out, its maximum capacity, especially in the busiest period is above average. Thus, its demand can be in line with the capacity if its volume is properly managed. On the other hand, although CBP3 has high volume capacity, its use is not as efficient as it should be when comparing with the activities surrounding it. The study carried out on the park shows that its maximum capacity is below average even during the busiest period of the day.

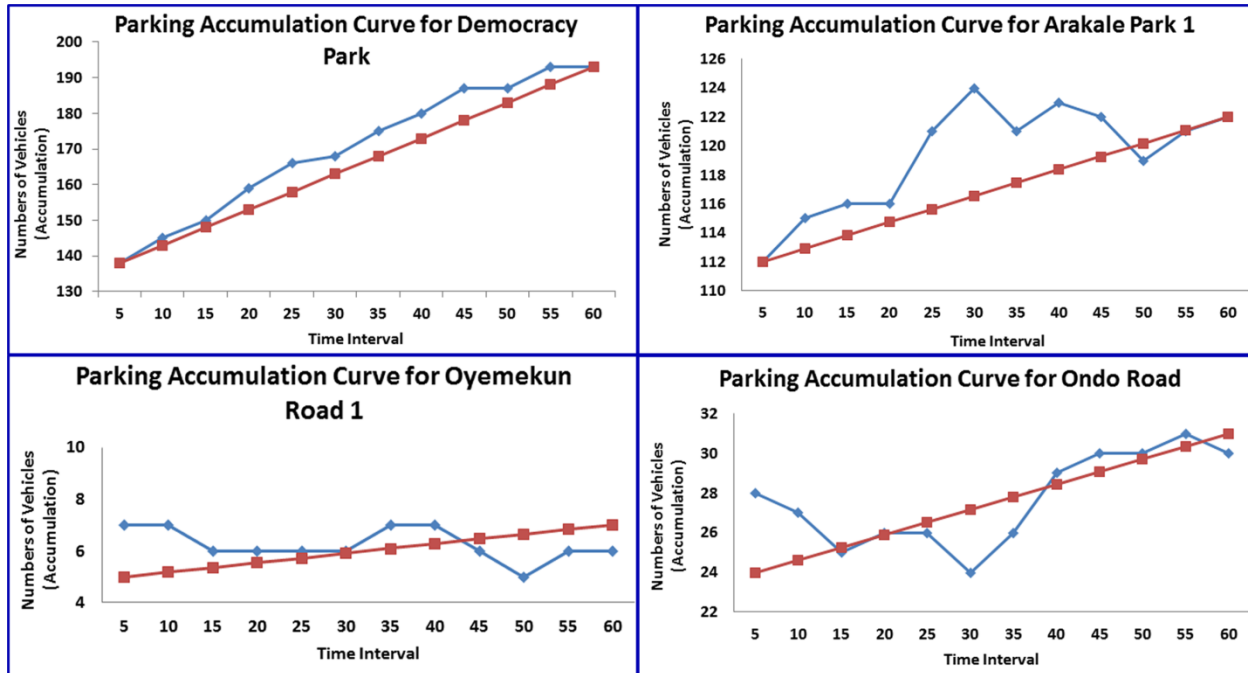


Figure 4:-Parking Accumulation Curve for two Parking areas and two road areas in Akure CBD

Exceptional diverse cases are found in the roads of the CBD area. For instance, the major areas of the roads in CBR1, including the Oyemekun Road 1, have medium volume capacity as compared to its use, especially in the busiest period is above average. However, the other parks mainly the CBR2 area has a low volume capacity if compared with its use. Similar to CBR1, Adegbola Road and the Ondo Road has a medium volume capacity as compared to its use. From the studies carried out, its maximum capacity, especially in the busiest period is above average.

### Conclusion:-

Despite the fact that studies relating to parking have been described by many standards, understanding the impact is necessary to the transportation engineers. This project identifies the impact of parking to traffic, analyses the problems associated with parking, intends to find appropriate solution to the fundamental question relating to causes of parking problems, and proffers measures to correct the inadequacies. The research conducted off street parking studies around the CBD in the study area by collect relevant data such as: existing parking conditions, capacity, use, and parking requirements of the CBD. The data gathered were analysed to determine demand and supply of parking facilities with a view to formulate strategies for better and efficient management of off-street parking in the study area.

The study shows how analysis of traffic impact of certain areas can be used to measure the efficiency of such parks in the area. The study shows that some parks like Arakale Park 2, has medium volume parking capacity when compared to its usage. Although the studies showed that its maximum capacity, especially during the busiest period, is above average hence its volume is evenly distributed. However, parks like Democracy Park and Oyemekun Park 2 are respectively above and below average. Thus, this study demonstrates that demand can only be observed in areas where parking is free. The provision of, usually free, parking spaces is very important in determining the travel behavior of commuting parking generation rates as the demand for parking increases.

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