IMPACT OF BUS RAPID TRANSIT SYSTEM (BRT) ON PASSENGERS' SATISFACTION IN LAGOS METROPOLIS, NIGERIA

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ABSTRACT

As cities attempt to address their urban mobility problems, the alternative transportation options emerge. In recent years, one of these options is the Bus Rapid Transit System (BRT). It is in the light of this, that the paper examined the impact of BRT on passengers' satisfaction in Lagos Metropolis. Data were collected through the use of questionnaire that was administered using simple random sampling technique. Also, secondary data were used. Findings revealed that less than average of the passengers were satisfied with the BRT system while some were fully dissatisfied. The paper concluded that BRT can be a practical and technical alternative to highway reconstruction. Therefore there is need to: ensure greater coordination with local planning and operating agencies for the purpose of identifying BRT potentials; conduct research, develop operational techniques and promote the use of Intelligent Transport System (ITS) technology to enable safe and efficient deployment of BRT.

Keywords: *Rapid transit, satisfaction, mobility transportation, accessibility*

INTRODUCTION

Cities all over the world are characterized with high level of accumulation and concentration of economic activities and are complex spatial structures that are supported by transport systems. In Nigeria, there is a great predominance of buses over rail-based technologies in the provision of transit services. The operation of bus transit systems is mostly private, with fares covering vehicle capital and operating costs. As cities attempt to address their urban mobility problems ranging from traffic congestion to road safety and environmental issues, the alternative transportation options have grown in recent years to include Bus Rapid Transit System which combines the most popular features of rail with the flexibility and cost advantages of roadway transit. Hence, in a bid to tackle such problems, the Lagos State Government introduced the BRT through private partnership.

The difference between a bus system and BRT is that, BRT operates longer buses on dedicated bus lanes thereby making passengers get a regular, faster and congestion-free drive. It is pertinent to stress here that, BRT has been adjudged by transport planners and policy makers all over the world at providing quality urban transportation services as it will help in tackling the huge public transport and pollution predicaments that besiege the city, thereby, enhancing good transportation quality and an improvement in the standard of living of the commuters. Because BRT system is a relatively new mode of public transit in Lagos, and despite a gap in literature and a lack of documented case studies on transit impact, the emergence of BRT provides a unique opportunity to change negative perceptions regarding public transit in Lagos State.

An enhanced BRT system that reflects full rapid transit objectives would include all of the features stated above while a low cost, basic BRT system would have some of the features. However, the challenge now lies in the fact of developing a BRT system that meets transit objectives without sacrificing the quality of any of these features. Hence Mobereola, (2009) stated that the Lagos BRT was launched with the goal of developing a BRT system with the following characteristics:

- Efficient service (low cost, high frequency, high speed, high occupation, high safety, low emissions)
- Adequate institutional and regulatory framework

- Significant socioeconomic benefits, especially for the low-income population
- Maximum private expenditures and liability
- Minimum public expenditures and liability
- Adequate mitigation of environmental and social impacts of the BRT system

Other options include the light rail, heavy rail, subway metro and traditional bus systems. The light and heavy rails as well as the subway metro systems are appropriate, but very expensive to construct and operate. The traditional bus service is highly patronized because it is flexible and inexpensive. But it has the problems of negative public image, air and noise pollution, slow speed and ramshackle state of the buses (Mobereola, 2009). A significant advantage of BRT over regular bus service is that BRT vehicles can carry more passengers than an ordinary bus. The marketing campaign for BR T has helped to detach itself from the common stigmatism of "dirty, bumpy" buses, and is beginning to pay off with increases in ridership in Lagos Metropolis.

However, this task is challenging, without reliable, quantifiable methods that measures performance. It is in the light of this that the paper to examine the impact of BRT on passengers' satisfaction in Lagos metropolis. In a related manner, hypothesis stated for the paper is that BRT has no significant impact on passengers' satisfaction in Lagos metropolis.

METHODOLOGY

The study was conducted in the metropolitan area of Lagos State. Lagos Metropolis is made up of 16 LGAs which includes both the Islands of the former municipality of Lagos and the Mainland suburbs. The population of Lagos Metropolis as at 2006 population census was 7,937,932 with a density of 7,941 (inh. per km^2) and a land area of 999.6 km^2 (Wikipedia, 2010). In terms of transportation, Lagos area is naturally endowed with navigable creeks, lagoons and water body that are suitable for urban transit services. It also has rail line that links the commercial southern part of the city with the dormitory settlement of the North. As a result, Lagos has the potential of benefiting from a seamless transportation

system. Ironically, road transport dominates more than 90 percent of all intra-urban movement (Oni, 2004).

Taiwo, (2005) stated that there are about 2,600 km of roads in Lagos. These roads are frequently congested with over 1 million vehicles on a daily basis. Lagos has about the highest national vehicular density of over 222 vehicles/km against country average of 11/km. The major identified corridors with predominant heavy vehicular traffic are Lagos-Badagry road axis and the Ikorodu road. The first phase of the Lagos BRT which runs from Mile 12 through Ikorodu road and Funsho Williams Avenue up to Church Missionary Society (CMS) Road began operations on March 17, 2008. It was expected to operate on eight routes on special BRT lanes running through the city but will expand its operation. The BRT corridor is about 22 kilometres in length and the system was projected to carry about 10,000 passengers per direction per hour during peak travel hours. The Lagos BRT runs 16-hour operation running from 6.00 a.m to 10.00 p.m while the bus has a maximum seating capacity of 47.

In the light of this the study employed both primary and secondary sources of data. Primary data was collected using questionnaire survey method. A total of 100 questionnaires were administered to the respondents which cut across the various groups of trip makers in Lagos Metropolis which uses the BRT using a simple random sampling method. The questionnaire was divided into two sections in which the first section elicits information on the socio-economic characteristics of the respondents while the second section elicits information on some explanatory variables that is relevant to the impact of BRT on passengers' satisfaction in Lagos Metropolis. A comparison of passengers' perception of the impact of BRT on passengers' satisfaction was done; using eight variables on a five point Likert Scale, ranging from strongly agree to strongly disagree. The questionnaire was designed in such a way that the same sets of variables that include reliability, safety, fare structure and comfortability, speed, ease of use, waiting time and journey time were measured among passengers of BRT scheme. Data generated was analyzed using Special Package for Social Sciences (SPSS) with a view to testing the hypothesis that BRT has no impact on passengers' satisfaction in Lagos Metropolis and to obtain the output of the chi-square and t-test statistics.

The variables as contained in the questionnaire are: ***reliability***

(the extent to which passengers can rely on the BRT system to make trips), *safety* (this is about safe arrival and the rate of incidents and/or accidents of the buses relatively to other local bus service), *fare structure* (the rate charged for a particular trip along the corridor in relation to that of a local transport system), *comfortability* (indicates the level of comfort before, and during the trip with respect to the facilities provided such as the stations, fare collection system etc.); *speed* (how fast is the system in relation to other public transport buses), *waiting time* (do the buses arrive on time and how long does it take for the buses to arrive?), *journey time* (indicates the time to transit along the corridor) and *ease of use* (this relates to the availability and accessibility of the scheme). All these variables were evaluated and assessed relatively to services provided by other public transport system.

RESULTS AND DISCUSSION

Table 1: Public Transport in Lagos - Issues and Causes

Issues	Causes
Inadequate institutional structure	Unbalanced supply and demand,Government lack of control of the operations, Dispersed ownership of public transport fleet, Dispersed transport fleet, In-the-market competition for passengers ownership of public
Poor quality of public transport	Inadequate vehicles, Old vehicles, Low maintenance standards
Long journeys	Excessive total travel time, Excessive waiting times in terminals,Low speed due to congestion, Too many and time consuming vehicle interchanges
High capital and operational costs	Inadequate infrastructure (lane surface, stop bays), Excessive fleet and vehicle-km/pax due to long dwell times, High cost of maintenance and spare parts, High vehicle replacement cost
Inadequate facilities for operators	Lack of toilets and poor sanitation, Lack of shelters and congestion at access points to terminals, Congestion within the terminal
High accident rates and low levels of security	Conflict with hawkers and pedestrians, Driver's indiscipline
High pollution levels	Old vehicles, bad quality diesel
Lack of accessibility to the urban poor	Service does not cover low income areas due to lack of infrastructure or small motorized trip rates, fares charged by, distance exclude poor users in the periphery from using public transport services.

Source: LASMATA (2007)

Table 2: Objective/Priority of BRT System

Objective /Priority	Impact of BRT System
Tackling Congestion	Critical for providing high quality public transport as an alternative to car delivers high quality bus services to existing commuters and planned developments including continuing in-migration; and will introduce traffic management control measures to allow optimization of traffic flows at busy junctions to give benefits to buses and at the same time improving general traffic flows or at least making general conditions no worse.
Improving accessibility	Improved bus service frequencies, interchange facilities to support 'feeder' services. Improved passenger and information, waiting environments and improved accessibility to key employment, education, health, retail and leisure destinations.
Improving road safety	Improved facilities for all road users; and improved control of traffic flow, especially on busy intersections.
Improving air	By providing real opportunities for modal shift on the key corridors; and quality Significant reduction in the average vehicle age (and emissions) through private participation in bus fleet renewal programmes.
Improving quality of	Reduced fear of crime and through quality infrastructure and life reliable services and improved confidence in reliable services allows; users to spend less time traveling and waiting.

Source: LASMATA (2007)

Features of the Bus Rapid Transit (BRT) System: BRT is an alternative transportation option that relies on the use of dedicated free lanes to ensure fast and reliable bus travel. The Lagos BRT - 'Lite system is Africa's first Bus Rapid Transit Scheme. The project draws from best practice examples of Bogota (Columbia) and Curitiba (Brazil) but adapts the concept of African context, as BRT 'Lite' (i.e. a high quality bus system that is affordable in the local context while retaining as many of the most desirable BRT characteristics as possible) (Mobereola, 2009).

Table 3: Basic Features and Attributes of Full BRT

Running way	Dedicated running ways; exclusive bus lane and distinctive pavement treatment.
Stations	Level boarding and alighting "Branded" consistently with appearance of BRT vehicles, high quality, attractive functional amenities.
Vehicles	* Easy-to-board (level with platform) * Multiple-door boarding and alighting * "Branded" exteriors that are distinctive and consistent with appearance of stations * High capacity * Pleasant interior conveniences * Quiet * Low or zero emissions
Service	* All-day service * Short headways (10 min. or better) * Wide station stop spacing
Route structure	* Simple route layout * Convenient transfer * Stations locations coordinated with land use plans * Service to major activity centres
Fare Intelligent Transportation Systems (ITS)	* Off-vehicle fare collection collection *Emphasis on prepaid fares* ITS technologies (for example, real-time "next bus-stop arrivalinformation signs at stations, "next board buses, smart fare paymentstop" signs on media and technology, trafficsignal prioritization traffic managementand Technology

* Automated guidance features for precision operations
Source: Bus Rapid Transit. Volume II (2003): Implementation Guidelines. TCRP Report 90 (Washington, D.C.: TRB.)

Table 4: Characteristics Comparisons among Regular Bus, Bus Rapid Transit, and Light Rail Modes

Characteristics	Mode		
	RB	BRT	LRT
System Components			
ROW	Mixed Traffic Exclusive	Mixed Traffic Traffic)	Exclusive (Mixed
Support	Road	Road	Rail
Guidance	Steered	Steered	Guided
Propulsion	ICE	ICE	Electric
Max TU Size	Single vehicle	Single vehicle	1-4 car trains
TU Capacity	120	180	4x180 = 720
Lines/operational element			
Lines	Many	Few	Few
Headways on each line	Long/ medium	Long/ Medium	Short
Stop spaing (meters)	80-250	200-400	250-600
Transfers	Few	Some/many	Many
Systems characteristics			
Investment costs/km	Low	High	very high
Operating costs/space	Medium	Medium	Low
System Image	Poor	Good	Excellent
Impacts on Land use	None	Some	Strong
Passenger Attraction	Poor	Good	Strong
Vehicle performance passengers cmmfort	Poor	Good	Excellent
Implementation time	Short	Short	Medim
Air Pollution Niose	High	considerable	None
Legend	ICE	Internal	Combustible Engine
	Row	Righ-of-way	
	TU	Transit Unit	

N/B: RB = Regular bus, BRT = Bus rapid transit, LRT = Light rail transit

Travel Impacts: Where the Bus Rapid Transit (BRT) system is effectively implemented, it can significantly improve transit service and increase transit ridership, especially under congested urban conditions. The daily ridership volume of the BRT Lite system already places it as one of the largest bus systems in the world in terms of passenger numbers. Although the system does not approach the ridership of the Trans/Milenio system in Bogota, Colombia, which employs dual lanes and an extensive network of local

end express services across the city, the BRT-Lite patronage is comparable to that of many of the individual lines in Curitiba, Brazil, and approaches that of the Metrobus in Quito, Ecuador. The BRT-Lite system currently carries over a quarter of all the trips recorded along its corridor (or 37 percent of public transport trips), even though BRT-Lite vehicles represent just 4 percent of vehicles on the route. The system carries nearly a tenth of all trips inbound to Lagos Island, the commercial heartland of Lagos and a main destination on the route. The level of demand is currently constrained by the capacity in peak periods. Thus by increasing its capacity, the BRT-Lite system could tap the demand currently being served by other transport modes (Mobereola, 2009).

**Table 5:** Comparison of 10 Urban Transport Systems in Length and Rider ship

Name	City	Country	Length (km)	Popul. (mils)	Peak hour one-way	Daily two-way
Transmilenio	Bogota	Columbia	84	7	45,000	1,300,000
Assis Brasil Busway	Porto	Brazil Alegre	4.9	3.7	28,000	290,000
Metrobus! EI Trole	Quito	Ecuador	16.1	1.8	7,000	240,000
9 de Julho Busway	Sao Paulo	Brazil	7	10	35,000	196,000
BRT Lite	LAGOS	NIGERIA	22	15+	10,000	195,000
SuI Busway	Curitiba	Brazil	10.1	2.7	13,000	156,200
Blok M Kota Line 1	Jakarta	Indonesia	12.9	9.8	6,500	100,000
SE Busway	Brisbane	Australia	17	1.7	18,000	150,000
Megabus	Pereira	Columbia	16.7	0.7		45,000
Adelaide	Adelaide	Australia	3	1.1	4,000	30,000

Source: Mobereola (2009) SSATP Discussion Paper No.9

BRT and Passenger's Satisfaction: Many researchers and marketers have focused their attention on customer evaluations of services in an effort to find ways to improve service quality (Fisk et. al., 1993). The dominant theoretical model employed in research into customer satisfaction is the expectancy/disconfirmation model in which customers are satisfied (dissatisfied) if their experience and perceptions of the service they receive exceed (fail short of) their expectations (Payne and Holt, 2001; Donovan, et. al., 2001). Within this framework, therefore, there are two

key elements to consider in analyzing satisfaction, as shown in figure 3.5.1: on the one hand people's expectations of the service and, on the other hand, attributes of the service that influence people's experience and perceptions.
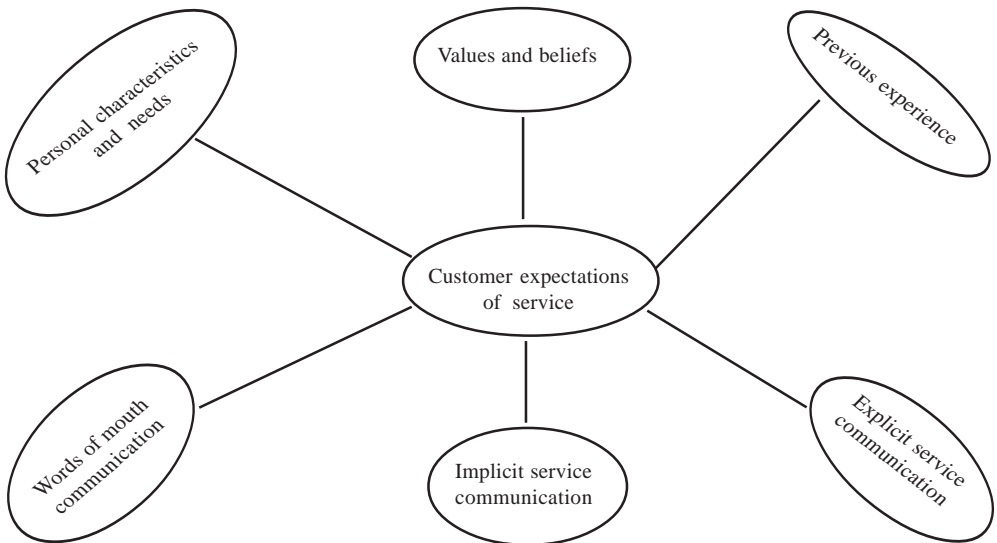
Fig 1: The "Expectancy/Disconfirmation Model" of Satisfaction.

| Experience | — | Experience of the service | — | Degree of Satisfaction |
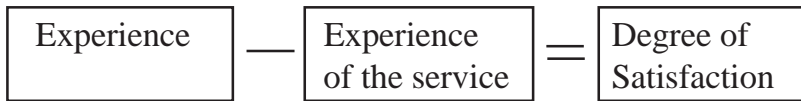
Source: Based on Accounts Commission (1999) and Mori (2002)

It is pertinent to stress that there are some variables that influence customer expectations and these are represented in Fig 1.

Fig 2: Factors Influencing Customer Expectations

Source: Based on Accounts Commission (1999) and MORI (2002)

Based on the above analysis, it is obvious that extensive research has been conducted in the field of service quality (Parasuraman, et. al., 1985, 1988, 1991), developed a service quality measure, called SERVQUAL which state that the customer's assessment of overall service quality is determined by the degree and direction of the gap between their expectations and perceptions of actual performance levels. They also identified five essentials for service quality; tangibles, reliability, responsiveness, assurance, and empathy. They proposed that perceived service quality could

be estimated by calculating the difference between expectations and perceptions of actual service performance. The SERVQUAL scale has been criticized for its validity and reliability. Buttle (1996) pointed out that including all 44 items (22 items of service expectations and a duplicated of 22 items of service performance) in one study often makes the survey task too difficult for respondents. Cronin and Taylor (1992, 1994) have empirically proved that the measures of service performance or SERVPERF, is more effective than SERVQUAL, which includes expectations as well as performance. SERVPERF is now widely used in measuring customer evaluations of service quality (Cunningham and Young, 2004).

Measurement and management of service quality is the fundamental issue for the survival and growth of service companies (Cunningham, et. al., 2002). For instance, the study conducted by Cunningham, et. aI., (2002) is interesting as it has measured service quality based on SERVPERF which is a set of multi-dimensional measures of customer evaluation of service quality. It is important to stress that, while all these models have been adopted in airline industries that have not been adapted to transport. Similarly, Natalisa and Subroto (2003) combined the variables of products quality and service quality into variable of service quality and studied the customers' perception of service quality in the domestic airline services of Indonesia. The study, therefore attempts to examine the satisfaction level of service quality of BRT scheme in Lagos as suggested by Wen Li and Chen (1998) which are modified to suit the Nigerian standard. This perhaps will pioneer the application of these models in transport infrastructure, like BR T scheme that is new in Sub-Saharan Africa as initially established.

New Technology in Bus Rapid Transit: A BRT system that is fully integrated with Intelligent Transportation Systems (ITS) can have an effect on bus operations, service level and ridership. This however, corroborated Kain et. al., (1992) assertion that new ITS or Advanced Public Transportation Systems (APTS) applications could contribute to improved bus service and increased bus operating speeds. Some ITS and APTS applications that a Bus Rapid Transit system might employ are described below, but this list is by no means exhaustive:

"   Smart card fare collection methods

"   Automated vehicle location (AVL) systems
"   Computer aided dispatching and advanced communications
"   Precision docking at bus stops
"   Tight terminal guidance
"   Warning systems
"   Passenger information systems
"   Automated enforcement systems for exclusive bus lanes

Challenges of the Bus Rapid Transit (BRT) System: There are some challenges to the implementation of the BRT system such as the lack of support by some of the operators in the public transport industry towards the project or not wanting to change to the new operations, time factor in the construction of the corridors as well as educating the current users and the potential users. Also, Mobereola, (2009) stated that the central challenges in implementing the BRT system in Lagos were accommodating the high levels of demand in the face of a dilapidated infrastructure of limited capacity, ensuring that operations were sustainable by means of the appropriate delivery structures, establishing the appropriate regulations and ensuring compliance, and winning the support of the people of Lagos.

Table 6: Level of Satisfaction Derived by BRT User

	F Sat	Sat	Indif.	Dissat	FDsat	Total
Speed	20	49	7	15	9	100
Com.	20	49	10	8	13	100
RT	19	52	8	11	10	100
Safety	40	45	9	3	3	100
Waiting	7	30	13	30	20	100
Fare	22	53	5	10	10	100
JT	21	40	13	15	11	100
EOU	15	53	10	10	12	100
Total	21	46	9	13	11	100

Source: Authors Survey, (2009). FSat = Fully satisfied, Indf = Indifferent, Dissat = Dissatisfied, FDsat = Fully disatisfied, EOU = Ease of use

From Table 6, on the aggregate, the passengers are satisfied with the level of service derived from the scheme, however, some were fully dissatisfied in which about 4% has to do with ease of waiting time. This indicates that buses are not available at the expected time which in

turn has a negative influence on the part of the service enjoyed by the passengers. In a related manner, the result of nonparametric statistical technique employed revealed as shown.

Table7: Test Statistics

	Chi-Square	df	Asymp. Sig.
Speed	.000[a]	4	1.000
Comfortability	.000[a]	4	1.000
Reliability	.000[a]	4	1.000
Safety	.600[b]	3	.896
Waiting	.600[b]	3	.896
Fare	.600[b]	3	.896
Travel Time	.000[a]	4	1.000
Ease of use	.600	3	.891

Source: Survey, (2009)

a.   5 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 1.0.

b.   4 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 1.3.

The table above indicates that the observed distribution does not conform to the hypothesized distribution, consequently, the hypothesis that BR T has no impact on passengers' satisfaction is rejected, implying that BRT has a significant impact on passengers' satisfaction in Lagos Metropolis is accepted. This in essence suggests that the use of BRT as a transport option to combat congestion in Lagos Metropolis has significantly improved the quality of life of its users as well as their accessibility. This finding is supported by evidence from other researchers (Ogunkoya, 2008) which revealed that there is a significant impact of BRT to the passengers' satisfaction in Lagos metropolis. Hence, it confirms that BRT users are saving travel time, has fewer transfers, are traveling cheaper, and feel safer. Suffice it to stress that businesses along the system's corridor are positive; the new system improved accessibility, staff found it easier to get to work and to travel on company business.

Table 8: One-sample

	N	Mean	Std.Dev.	Std. Error Mean
Speed	5	20.00	17.000	7.603
Comfortability	5	20.00	16.837	7.530
Reliability	5	20.00	18.371	8.216
Safety	5	20.00	20.761	9.284
Waiting time	5	20.00	10.223	4.572
Fare	5	20.00	19.481	8.712
Travel time	5	20.00	11.790	5.273
Ease of use	5	20.00	18.561	8.301

Source: Survey, 2009

Table 9: One-sample.

	t	df	Sig.	MD	Lower	Upper
Speed	2.631	4	.058	20.000	19.49	20.51
Com	2.656	4	.057	20.000	19.50	20.50
Rty	2.434	4	.072	20.000	19.45	20.55
Safety	2.154	4	.098	20.000	19.38	20.62
WT	4.375	4	.012	20.000	19.69	20.31
Fare	2.296	4	.083	20.000	19.42	20.58
JT	3.793	4	.019	20.000	19.65	20.35
EOU	2.409	4	.074	20.000	19.45	20.55

Source: Survey, 2009. Test Value = 0 5% confidence interval of the difference

Table 9 shows an equal mean of 20 with a standard deviation ranging from 11.790 to 20.761. However, Table 9 also revealed that all the other variables are significant except the waiting time and travel time. The import of this is that, the buses do not arrive on time at the bus stop which is at variance with some of the expected benefits of the BRT scheme because waiting time at bus stops is an element of journey.

CONCLUSION AND RECOMMENDATIONS

The BRT 'Lite' is the first organized mass transit in Lagos metropolis and it stands as a potential to improved bus services to address mobility problems in the metropolitan area and can be a practical alternative to highway

reconstruction. Because buses travel on urban roadways, infrastructure investments needed to support bus service can be substantially lower than the capital costs required for rail systems. As a result, bus service can be implemented cost-effectively on routes where ridership may not be sufficient. An integration of the various ITS technologies to the current BRT system in Lagos will increase service frequency and reliability. While BRT may offer some benefits for some communities, it should be considered as an alternative only in the context of other transportation options, such as light rail. Depending on the needs of a given community in terms of capital cost, implementation time, level of service and long term viability, BRT may or may not be an appropriate choice.

The study revealed that BRT has a significant impact on passengers' satisfaction in Lagos metropolis. It has helped to improve the quality of life of not only its users but also those that travel along the corridor using other modes as well as those who choose to locate their businesses there. Even though BRT systems are not the final solution to public transport problems in Lagos, it will help form an integrated system of different modes. Despite the fact that BRT has helped to reform the existing transport system in Lagos Metropolis by providing a more competitive service rather than competing for passengers, the system requires that bus transit be given increased respect and priority in transportation planning decisions, including investments, roadway management and land use development.

There is need to ensure greater coordination with local planning and operating agencies for the purpose of identifying BRT potential, the need to conduct research, develop operational techniques and promote the use of ITS technology to enable safe and efficient deployment of BRT. BRT implementation also may require policy and institutional reforms, such as changes in transportation planning and roadway management practices (to give buses priority in traffic); vehicle purchasing; transit regulations and contacting (to maintain a high quality of service); and urban design (to increase development near BRT routes). Also, in an attempt to achieve an increased ridership of the BRT system, the widely-held perception that buses are primarily for second-class citizens must be overcome.

Figure 1: Map showing the 16 LGAs making up Metropolitan Lagos
Source: Wikipedia

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