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The Lagos Bus Rapid Transit: Review of Users' Perception

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SUMMARY*:* The Lagos BRT Lite system which was implemented in 2008 has been extended and upgraded to BRT classic. It has successfully delivered high-quality services especially in the first two years of operation with high ridership. To determine users' preferences, a customer satisfaction survey was carried out. The study aimed explicitly at investigating commuters' preferences and perception of the BRT services. Consequently, the study identified certain attributes comprising long waiting time, inadequate bus frequency, poor ticketing systems amongst others requiring improvements. However, over 60% of the commuters still remain repeat users, thereby signalling the role that the BRT operations is playing in the movement of people within the city.

KEY WORDS: *BRT; Customer; Satisfaction*

I. BACKGROUND

Bus Rapid Transit is now widely accepted as a sustainable mass transit option that can compete and complement rail systems in delivering high-quality services. It is a high quality bus-based transit system that delivers fast, comfortable, and cost effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellent in marketing and customer service (ITDP, 2007). The notable advantages over metro systems include lower operating and capital cost, higher flexibility and shorter implementation time. These benefits have made Bus Rapid Transit prevalent in developing countries, where there are paucities of funds.

The introduction of the BRT system in Lagos Metropolitan owes its present state to decades of concerted efforts and initiatives in bus planning, restructuring, adaptation and government intervention. The BRT Scheme demonstrated a unique public transport progression which started from bus operations of unfettered market to one with planned approach with restricted players and the transition to government contracting model. The BRT scheme implemented on Ikorodu-TBS corridor in Lagos metropolis is regarded as one of the busiest and most important routes with high passenger traffic. The corridor cuts across seven local government areas and leads to the major Central Business District (CBD). The carriage way is divided by a median and has several intersections which are traffic signalized. The carriage way from Ikorodu provides one of the main arterial links within Lagos State, linking the peripheral settlement of Ikorodu to Lagos Island and intermediate settlements.

The 1st phase of Lagos BRT scheme became operational on 17th March 2008 after a 14-month period of planning and design. The System commenced with a 22 km bilateral station arrangement running from Mile 12 to CMS. The route connects Mile 12 to the north of Lagos terminating at Marina/TBS. LAMATA was actively involved in the provision of infrastructure - physically segregated lanes, 29 bus shelters and lay byes, 3 terminal facilities at Mile 12, Moshalahi and CMS, a bus depot/ garage, service lane repairs, lightning, fencing, traffic signs and road marking. Following the successful operations and the need for BRT expansion and upgrade, a 13.5 km extension of the BRT lane was approved by the Lagos State Government for implementation.

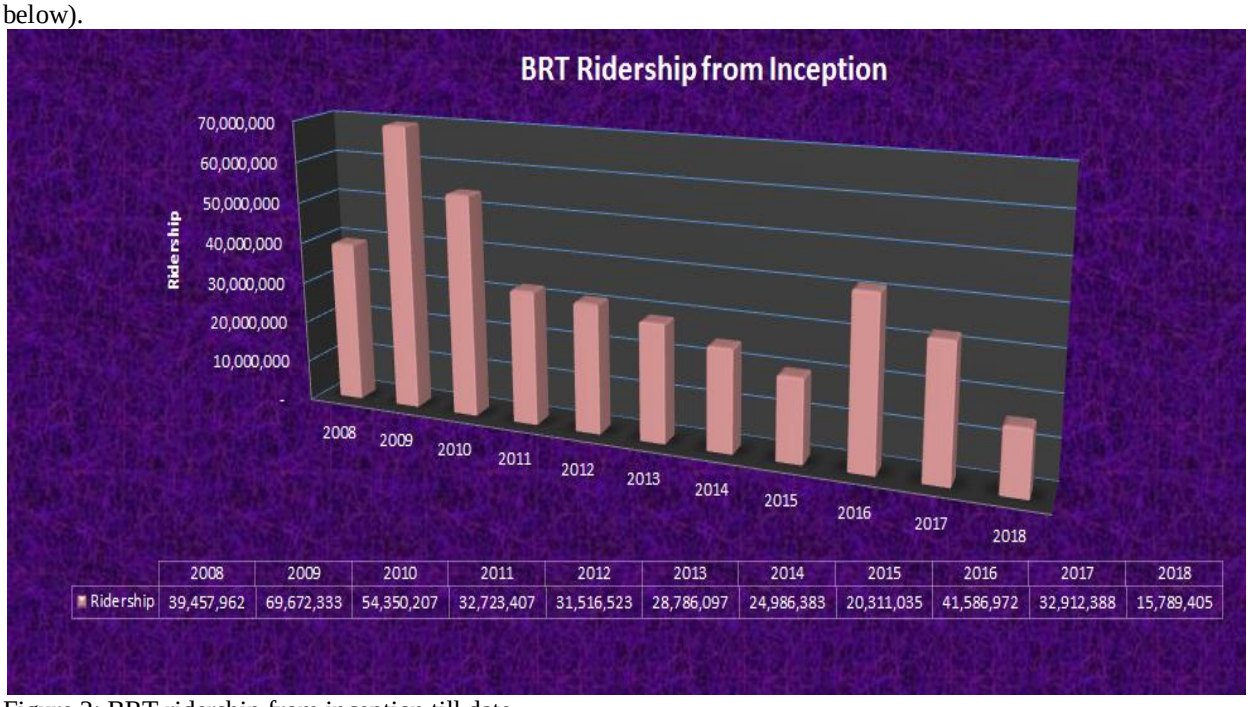
Between Mile 12 and Ikorodu, the carriageway is a dual two-lane road 15m wide and 3.3m BRT median. The BRT extension has 15 bus shelters, 3 terminals and a modern bus depot built on five hectares of land at Majidun. The 3 terminals are located at Mile 12, Agric and Ikorodu. The corridor is also equipped with 6 pedestrian bridges located at Owode, Irawo, Awori, Majidun-Ogolonto, Agric and Haruna, 12 'U-turn' points (6 in each direction), at grade crossing provisions, street lighting and 3 signalized junctions at Ikorodu, Agric and Ogolonto. The BRT extension connects with the BRT Lite corridor at Mile 12. To ensure sameness of infrastructure, the BRT Lite infrastructure have been upgraded to align with the BRT classic infrastructure.

The entire BRT Scheme (both BRT Lite and BRT Extension) is 35.5km in length running from Ikorodu to TBS (see map in figure 1). The system has also been upgraded to BRT Classic System with the introduction of Electronic Ticketing and Intelligent Transport System. The BRT currently have 44 bus shelters in both direction, 5 terminals, 19 intersection and 2 bus depots which house a maintenance bay, a fuel dump, an automatic washing bay, administrative offices and other appurtenances for the smooth operation of the system.

Figure 1: Ikorodu – TBS BRT Route

1.1 BRT OPERATIONS

The BRT scheme is currently operated by Primero Transport Services Limited (PTSL), a private sector operator that took over the operations in November 2015 after the termination of the 1st BRT Cooperative Society contract (initial operator of the BRT scheme). PTSL has injected 434 buses to service the operations from Ikorodu to TBS and has conveyed over 101 million passengers from November 2015 to date. The BRT scheme therefore (both 1st and 2nd phase) has conveyed over 400 million passengers from inception till date (see figure 2 below).



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Ridership	39,457,962	69,672,333	54,350,207	32,723,407	31,516,523	28,786,097	24,986,383	20,311,035	41,586,972	32,912,388	15,789,405

Figure 2: BRT ridership from inception till date

The operation is guided by a set of regulations approved by the Lagos State House of Assembly (LAHA) and signed into law in 2008. The regulations restrict all yellow buses and other articulated and heavy-duty buses to the service lanes. The same regulations guides all the current and the proposed BRT corridors. The BRT Operates 16 hours from 6:00am to 10:00pm. The operations schedule are divided into 2 shifts with 8 hours driving time per shift (AM & PM).

The Ikorodu – TBS BRT scheme features specific attributes which include dedicated right-of-way, enhanced station with shelters, pre-board fare collection systems; brand new air-conditioned high capacity buses and the use of Intelligence Transport System. These attributes played an important role in creating a positive image thereby causing the scheme to receive accolade from customers along the corridor. However, in the last few months the scheme has suffered from underuse, with poor quality service and inefficiency. Passengers have become increasingly frustrated by consistently long wait times for buses. Therefore, to reduce waiting time, riders had the choice of making use of the alternative transport along the corridor.

1.2 BRT DEFINITION MATRIX

The BRT has many definitions but the quick approach is apply a definition matrix as shown in the table below.

Table 1: BRT Definition Matrix

	Initial BRT	**Intermediate BRT**		**Full BRT**
Components	**Stage I**	**Stage II**	**Stage III**	**Stage IV**
Running ways	ared lanes in mixed traffic/some preferential treatment	Designated lanes/ HOV lanes/ queue jumper segments	licated lanes and segregated facilities	ive alignment with full grade separation
Stations	oved shelters, signage and amenities	Additional passenger information, safety and security amenities	ced station services and fare collection	ed docking, loading and land use features
Service	e service frequency and reliability	Extended distances, skip-stop and express services	l coordination, high frequency and reliability	f alignment operations and convenient transfer options
Route structure	le route with transfer connections	Multiple route operations with transfer facilities and unique identity	ation with regional network/direct transfer options	cible route options to increase seat ride and reduce transfer
Fare collection	sed pre-paid fare sales	luce proof of payment fare systems	ze electronic fare collection systems	nent multi-modal smart card systems
Vehicles	terior aesthetic and ride/comfort features	nproved boarding, accessibility and information features	ified vehicle sizes, material and capacities	Guidiance propulsion alternative fuel features
ligent Transport System	Signal preference enhancement to improve travel time and schedule adherence	enger information to increase convenience and ridership	g enhancements to boarding time	Vehicle loactionand surveillance to improve system coordinationand safety/security

Source: Integrated Transport Planner, 2009

1.3 PURPOSE OF STUDY

When a programme that have the public as the strategic users is implemented, it is imperative to carry out an evaluation. Determining how well a BRT programme is operating is a useful form of evaluation known as programme process evaluation. There could retrospective or prospective evaluation, whichever one, the

evaluation may be social, economic, environmental, technological or political. Since the public forms the fulcrum of providing or investing in BRT, it is important to gauge their perception. This study therefore aims to review the Lagos BRT operations to determine commuter's perception and identify areas for improvement. In transit services, particularly where there are cheaper alternatives, customers' satisfaction is the ultimate test for efficiency and it is a significant determinant of patronage which subsequently affects revenue and sustainability.

1.4 SIGNIFICANCE OF STUDY

Growing competition, tighter financial margins and increased quality awareness have led to customer orientation in transport sector in recent years. Like all other market-oriented service organisations, transport companies have to tailor their service supply to the wants and needs of their customers. Customer satisfaction surveys are an increasingly popular instrument for identifying the expectations of both existing and potential customers.

Fornell et al. (1996) explain that customer satisfaction is an important marketing construct. As an important marketing factor, the high level of customer satisfaction would result to high level of customer loyalty. The higher the quality of public transport offered, the higher the satisfaction of passenger. In the field of service marketing, satisfied customer is likely to be more loyal then unsatisfied customer. Therefore, it is important that BRT operator provide high quality of services which can satisfy the passenger and retain them to use the BRT buses. In a bid to achieve the objective, a quarterly customer satisfaction study has been designed to be carried out yearly to measure users' perception of the BRT-Classic and provides data for planning for future BRT and improve the services of the current BRT.

1.5 BRT PERFORMANCE INDICATORS

The provision of an effective bus transit service is the basic premise upon which transit service is developed and the goal that all public transportations agencies strive to achieve. To attain this goal, the regulator of the BRT (LAMATA) has designed the services around clear and defined principles, as well as process to monitor the results achieved and to respond accordingly using the key performance indicators. Performance indicators are powerful tools for monitoring and improving transit service. While there are many possible indicators that could be used, typically a small subset is used on a regular basis to monitor the important aspects of transit system performance.

The Customer Satisfaction Survey exercise is a typical approach aimed at assessing BRT services from the perspective of the actual BRT users. The outcomes of relevant attributes are measured in line with the stipulations of the KPI to determine the Operator's compliance levels. The BRT services and performance are evaluated using the indicators as stated in table 1 below

Table 2: Monthly Performance Measurement Chart

	Bus Reform Service Evaluator Sheet	**Month ……**			
	Performance Indicators	**Indicator**	**Actual**	**Deviation**	**Remarks**
1	**Financial Indicators**				
	Total Operating Cost (N)				
	Total Administrative Cost (N)				
	Total Maintenance Cost				
	Total Cost of Fuel Consumption				
	Total Revenue (N)				
	Total Fare Revenue (N)				
	Total Revenue from other sources (e.g. Advert)				
2	**Ridership**				
	Total Passengers Carried				
	Total Elderly Passengers carried				
	Total Disabled passengers Carried				
	Population of Service Area				
3	**Service Quality**				

	Number of Complaints about Drivers				
	Number of Complaints about Ticketing staff				
	Number of Complaints about Inspectors				
	Total Numbers of Complaints				
4	**Personnel**				
	Number of Drivers				
	Number of Ticketing Staff				
	Number of Inspectors				
	Number of other support staff				
5	**Level of Service**				
	Total Vehicle Kilometre covered				
	Total Operating Hours				
5	**Safety / Accident Rate**				
	Total Number of Accident				
	Number of Avoidable Accident				
	Number of Near Accident				
	Fatal Accidents/ month				
	Major Accidents / month				
	Minor Accidents / month				
6	**Maintenance**				
	Number of Breakdowns				
	Number of downtimes				
	Number of Damaged rollouts				
	Number of Dirty Buses				
7	**BusAvailability**				
	Total fleet size				
	Total Available Fleet				
	Number of Buses Deployed during weekdays				
	Number of Buses Deployed during weekends				
	Number of Routes Covered				
	Average waiting Time				
	Average Bus Headway				
8	**Report Rendition**	**1st week**			

1.6 RELATED STUDIES ON TRANSIT CUSTOMER SATISFACTION SURVEY

Several studies reported a link between customer perception and service outcomes such as loyalty, positive word-of-mouth and purchase intentions.

Previous studies have identified a variety of service attributes related to service quality of transit. They include, but are not limited to service availability, reliability, travel time, safety and security, appearance and comfort (TCRP 2003). However, few have investigated service attributes that specifically influence BRT's quality of service. Baltes (2003) conducts user surveys on South Miami-Dade BRT and Orlando BRT. He asks respondents to report their satisfactions with service attributes and overall satisfaction with BRT. Then he develops regression models to assess which attributes help improve the overall satisfaction. He concludes that comfort, travel time, reliability, and safety are important attributes for Orlando BRT, while service frequency, travel time, seat availability, convenience, hours of service, safety on bus, and dependability are influential factors for South Miami-Dade BRT.

J. Cao et al (2015) conducted a study using Guangzhou BRT as a case, the study explores transit riders' satisfaction with BRT and compares BRT with conventional bus and metro service. A trivariate ordered probit model was developed to examine the effects of various service attributes on riders' overall satisfactions with the three types of transit. Among the 14 service attributes tested, riders are most satisfied with travel cost, ease of use, and travel time of the BRT, and least satisfied with other riders, customer service, and comfort while riding. Perceived ease of use, safety while riding, and comfort while waiting are the most important among attributes that contribute to the overall satisfaction with BRT. Based on the findings, they proposed that planners should prioritize the three attributes when developing a new BRT service, subject to an assessment of the relative cost effectiveness of their implementation. Specifically, to improve ease of use, transit agencies can provide up-to-date timetables and maps, implement at-stop and on-board real-time information systems, offer stop announcement systems, and develop apps to allow smartphone access to traveller information. The study concludes that Guangzhou BRT does offer a better quality of service than conventional bus. The study recommends that to reduce the gap, transit agencies should improve BRT service alongthese dimensions, also subject to an assessment of the relative cost effectiveness of their implementation.

LAMATA carried out a study on passenger's preference to determine the level of service offered by BRT and other buses along Ikorodu road in 2017.The study compared the quality of service between the BRT buses and conventional buses operating along the corridor. The study provided details on passenger travel behaviour and their overall preferences in terms of demographics such as age, gender, employment status, passenger's travel characteristics and bus provider. The survey covered a large and representative sample of people using buses within the corridor i.e. Primero BRT, Tata Bus, LT, SE-Red, LAGBUS, K-Red, E-Red, L-Red, Danfo, Nationwide, Cape trust, Owolowo K, Adonis K, Labour and A-Red. The parameters evaluated in the passenger satisfaction survey include – price satisfaction, cleanliness of the bus, satisfaction with travel time, driver attitude, driver attitude, comfort and waiting time.

The results from the survey revealed significant evidence of interest regarding the preference of users with respect to BRT and Danfo buses (see table 2 below).

Table 3: Percentage of Commuters satisfied with the BRT & Danfo service attributes

		BRT		**DANFO**	
S/N	SERVICE ATTRIBUTES	STRONGLY SATISFIED (%)	SATISFIED (%)	STRONGLY SATISFIED (%)	SATISFIED (%)
1	PRICE SATISFACTION	5	48	3	27
2	BUS CLEANLINESS	13	44	9	23
3	TRAVEL TIME	11	49	4	26
4	DRIVER'S ATTITUDE	9	44	4	24
5	DRIVER'S CAREFULNESS	16	38	2	26
6	COMFORT	25	54	10	18
7	WAITING TIME	3	24	6	32

Source: Field work, 2018

These figures provide clear evidence that on six out of the seven parameters being measured, the BRT bus outperformed the danfo, and by significant margins in most cases. The performances of the BRT with respect to the six parameters suggest significant improvements in public transport system pioneered by LASG. However, on the seventh parameter (waiting time), the danfo came out ahead.

Liu Xiyuan (2014) conducted a study on Bus Rapid Transit Service Quality. His work is aimed at developing a new research framework of BRT system quality from subjective and objective approaches. His focus was on the Hefei BRT Route 1 in, which is one of the 20 BRT services running in over 20 cities in China. A total of 116 respondents were interviewed, the outcome showed the mean value of overall satisfaction levels coming to 3.13, an indication that satisfaction level is slightly higher than the neutral level.
The detailed Satisfaction Levels analysis that incorporates all 17 parameters indicates the following:

Table 4: Indicators and Customer Satisfaction Level

INDICATORS	MEAN VOLUME	SATISFACTION LEVEL
Bus fare level	3.89	BASICALLY SATISFIED
Service level	3.6	
In-vehicle journey time	3.58	
Travel speed	3.57	
Service frequency	3.54	NEUTRAL SATISFIED
Route coverage	3.47	
Waiting time	3.41	
On-time route	3.36	
Safety and Security	3.28	
Information provision	3.24	
Vehicle environment	3.12	NEUTRAL
Driver kindness	2.99	
Seats availability	2.95	
Walking distance	2.93	NEUTRAL OR UNSATISFIED
Station environment	2.91	
Interchange accessibility	2.81	
Degree of crowding	2.74	

Source: Field work, 2018

This table summarizes detailed indicators' satisfaction levels. The satisfaction values of 17 indicators range from 2.74 (poorer than neutral) to 3.89 (close to satisfied) and it should be noted that no indicator achieved average satisfied level. He categorized the satisfaction level into: neutral to unsatisfied, neutral, neutral to satisfied and basically satisfied. Based on the higher standards for BRT project, except category of "basically satisfied", other three categories with 13 indicators are defined as unsatisfactory.
Among 17 indicators, walking distance, station environment, interchange accessibility and degree of crowding imposed inferior impression to passengers. Conversely, cheap bus fare level received uniformly high satisfaction. Owing to the right-of-way given to BRT Route 1, service speed and in vehicle journey time also obtained relatively high perception.
Moreover, the overall trend of indicators' satisfaction is time and speed related issues are viewed better performance than environment and service related issues. Except for travel speed, other special features of BRT system such as service frequency, on time rate, information provision and inner vehicle service received mediocre evaluations that are lower than expectation.

1.7 METHODOLOGY

1.7.1 Data and Sampling Techniques

The BRT data were collected from riders at 6 stations (i.e. Ikorodu, Agric, Mile 12, Ojota, Fadeyi and TBS) along the corridor using the random sampling techniques. The questionnaire was administered to the BRT-Classic passengers along the corridor within a period spanning the third and fourth week of November, 2017. A total of four hundred and twenty-five questionnaires (425) were administered.
Fourteen service attributes that are widely known to affect customer satisfaction were investigated using a Likert scale. Socio-demographics, travel characteristics, customer loyalty and overall satisfaction were also examined. The survey was carried out at stations using paper questionnaires and respondents were selected randomly. The questionnaires were administered to commuters at both peak and off peak periods. This was done with the intent of capturing accurate and frank opinions of the commuters.

The two-page questionnaire was designed to include three sections. Section one contains commuter's trip characteristics including purpose, number of trips, benefit of using BRT and information related to their origin and destination. In section two respondents were asked to rate the attributes and to indicate their overall opinion

of BRT service on a six-point scale ranging from ‘‘very dissatisfied’’ (1) to ‘‘very satisfied’’ (6). The 14 attributes cover different dimensions of quality of service, which include comfort, cleanliness, fare level, safety, ventilation ease of getting information, waiting time, frequency of buses overcrowding etc. While section three contains a list of socio-demographics including gender, age, education, driver’s license, employment status, income, household size, and car ownership.

1.7.2 Analytical method

Based on international best practice, four reinforcing methods were selected for a holistic analysis. Firstly, the Quadrant Analysis visualised the averages of the satisfaction and importance ratings of each service attribute. Secondly, the Heterogeneous Customer Satisfaction Index analysed for the variability in users’ ratings of each service attribute and produced an overall index score. Thirdly, the Customer Loyalty Index classified commuters into various loyalty segments. Lastly, the overall satisfaction level was segmented by socio-demographic data to identify the variability between different users’ satisfaction level. The results were also tested for significant statistical differences. A customer satisfaction questionnaire was designed to collect primary data from BRT-Classic users along the corridor (Ikorodu - TBS). 14 service attributes that are widely known to affect customer satisfaction were investigated using a Likert scale. Socio-demographics, travel characteristics, customer loyalty and overall satisfaction were also examined. A total of 425 paper questionnaires were administered at the four major terminals and two major bus stops. Commuters were selected using the random sampling technique within a sample frame of 7:00 a.m. and 6:00 p.m. throughout the week.

1.6.3 Identifications and Outcomes

Based on international best practice, three reinforcing methods were selected for a holistic analysis. Firstly, the Quadrant Analysis visualised the averages of the satisfaction ratings of each service attribute. Secondly, the Heterogeneous Customer Satisfaction Index analysed for the variability in users’ ratings of each service attribute and it produced an overall index score. Lastly, the overall satisfaction level was segmented by socio-demographic data to identify the variability between different users’ satisfaction level. The results were also tested for significant statistical differences.

This study revealed that the overall Commuters’ perception of the BRT-Classic service quality was moderately above average (62%). The commuters are generally satisfied with the service quality of the BRT-Classic. Although, they are also dissatisfied with the service level of some service attributes. The top-five attributes that contributed to the overall satisfaction are: comfort, value for money, cleanliness, ventilation, resolving complaints. While the attributes that least contributed are: frequency of the buses, waiting time, ticket purchasing, overcrowding at the station, disseminating of passenger information and overloading in the buses.

This study recommends a shorter headway and deployment of more buses to reduce waiting time and overcrowding of passengers. Also, publicising information channels and disseminating real time passenger information should be maximised to ensure commuters are kept updated.

II. ANALYSIS, RESULTS AND INTEPRETATION

2.0 ANALYSIS, RESULTS AND INTEPRETATION

This section outlines the analysis and results from the Customer Satisfaction Survey (CSS) carried out on Ikorodu – TBS corridor. 425 respondents were surveyed using an intercept survey technique (before boarding) and simple random sampling technique (Table of Random Digits). The socio-demographic and travel characteristics are summarised in section one and two respectively. Subsequently, each analysis and their results are presented and then interpreted below. The overall satisfaction of the BRT-Classic is evaluated in section 3.

2.1 SOCIO-DEMOGRAPHIC PROFILE OF THE BRT-CLASSIC RESPONDENTS

The gender, age group, occupation and car ownership distributions of the sample population will be analysed in this section to understand the profile of the BRT-Classic respondents. This pattern is used in stratifying and understanding the perception of different BRT-Classic users.

2.1.1 Gender

There were more male (243) respondents than females (182) (see Figure 3). The male-female ratio of respondents (1.33) is higher than the male-female ratio of Lagos population (1.11) (Knoema, 2017). This result indicates males use the BRT-Classic more than females.

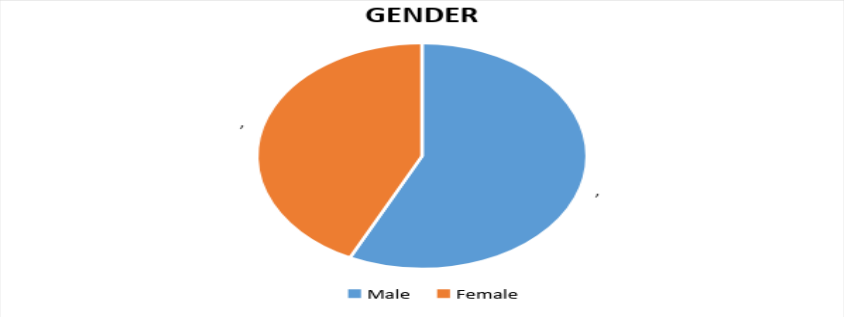


Figure 3: Gender Distribution of Respondents
Source: Field Survey, 2017

2.1.2 Age Group

The majority (83%) are aged between 25 and 60, and these are the typical working class age group who often require distant travel to access opportunities in the metropolis. Followed by those (14%) aged between 17 and 25, the typical higher education age group. Seniors (over 60) and minors' (17 or less) were minimal (see Figure 4). In Lagos, this is expected because children typically enrol in community schools within walking distance to their residents and most seniors are retired, therefore reducing the need for regular distant travel.

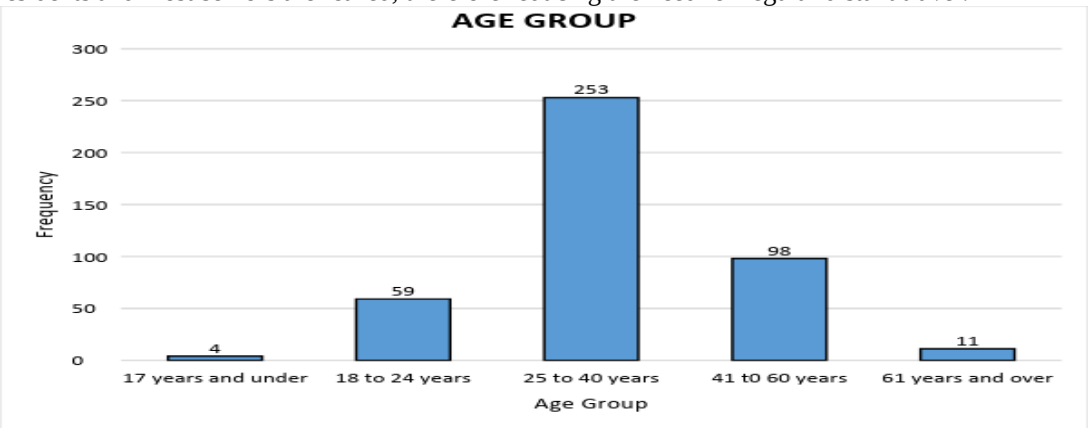


Figure 34 Age Group Distribution of Respondents
Source: Field Survey, 2017

2.1.3 Occupation

The majority (83%) are working as - an employee, self-employed, trader or part-time worker; followed by students. Small percentages were accounted for by those unemployed and retirees. (See Figure 5).This split is consistent with ITDP's study which found that the Lagos-BRT users are mostly workers, followed by students (LAMATA, 2009).

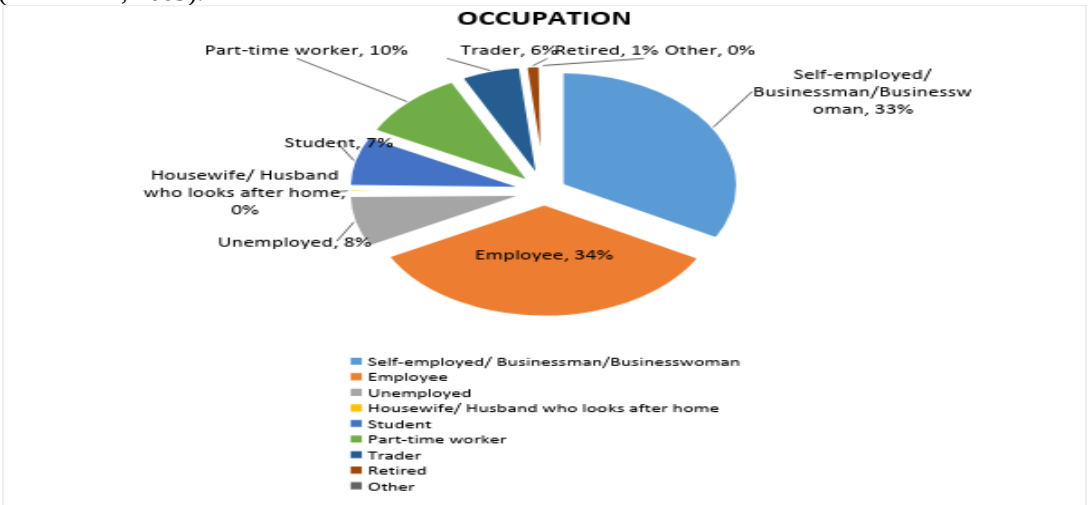


Figure 5: Occupation Distribution of Respondents
Source: Field Survey, 2017

2.1.4 Car Ownership

The majority (60%) are captive users - who do not have a car alternative for this journey and others are choice users who either have a car or two (see Figure 6). Also, most of the choice users are males who use personal vehicles less; compared to females in Lagos (LASTMA, 2016).

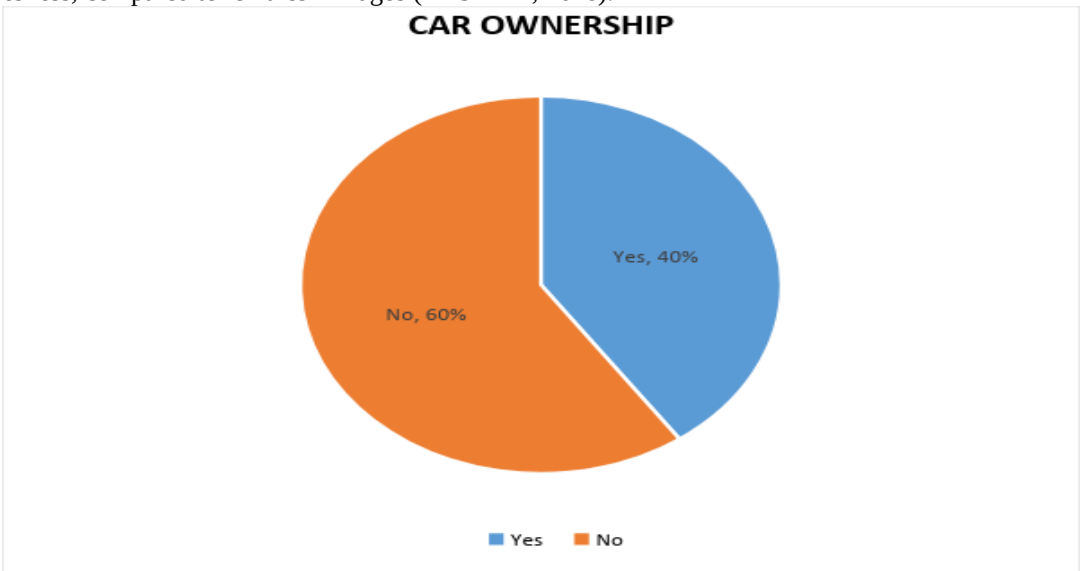


Figure 6: Car Ownership Distribution of Respondents
Source: Field Survey, 2017

2.2 TRAVEL CHARACTERISTICS OF THE BRT-CLASSIC RESPONDENTS

This aspect of the analysis deals with respondent's trip purposes, travel frequency and the benefits commuters have gained by switching to the BRT-Classic. This aids in understanding the trip characteristics of the BRT-Classic users.

2.2.1 Trip Purpose

The majority were travelling to work (see Figure 7), and this is consistent with ITDP's study which reported that majority use the BRT- Classic to commute to their places of work (LAMATA, 2009). This split reflects the importance of the BRT-Classic to the commercial sector in Lagos. Others were either returning home or headed for shopping, educational and recreational activities. Also, small percentages were accounted for by other purposes such as religious and health purposes as shown in Figure 6. Supporting moderate non-work related trips recognises` BRT-Classic integration into several societal activities.

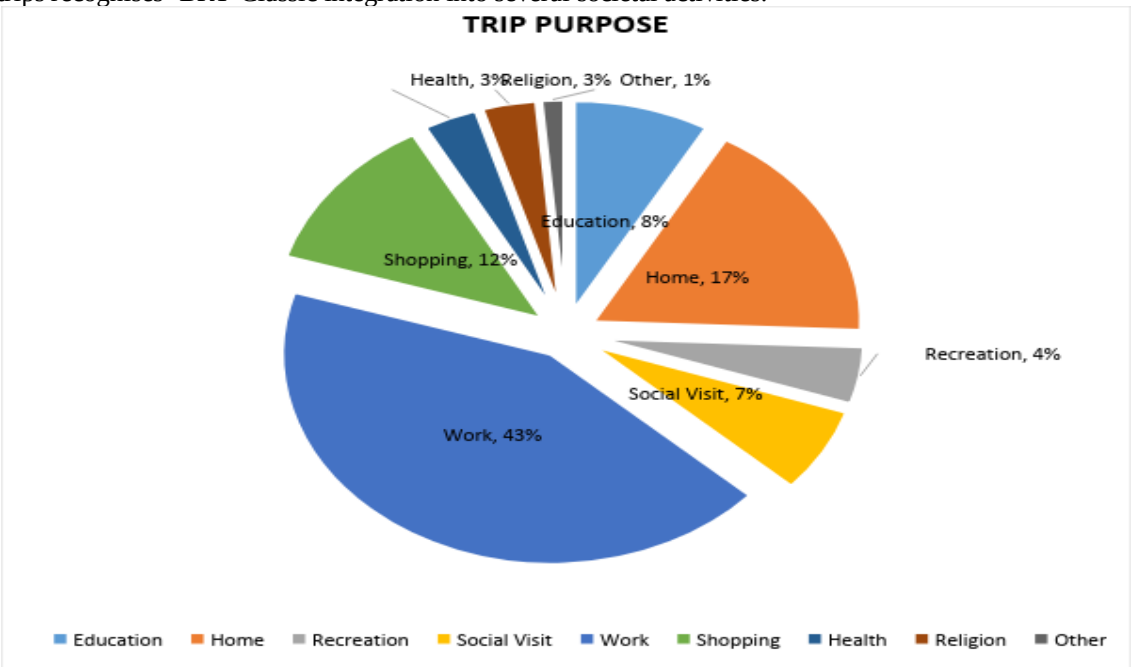


Figure 7: Trip Purpose of Respondents
Source: Field Survey, 2017

2.2.2 Frequency of Travel

The majority (92%) use the BRT-Classic often and others either rarely use it (see Figure 8). This result indicates that most of the respondents are conversant with the BRT-Classic services, thus increases the significance of their perception.

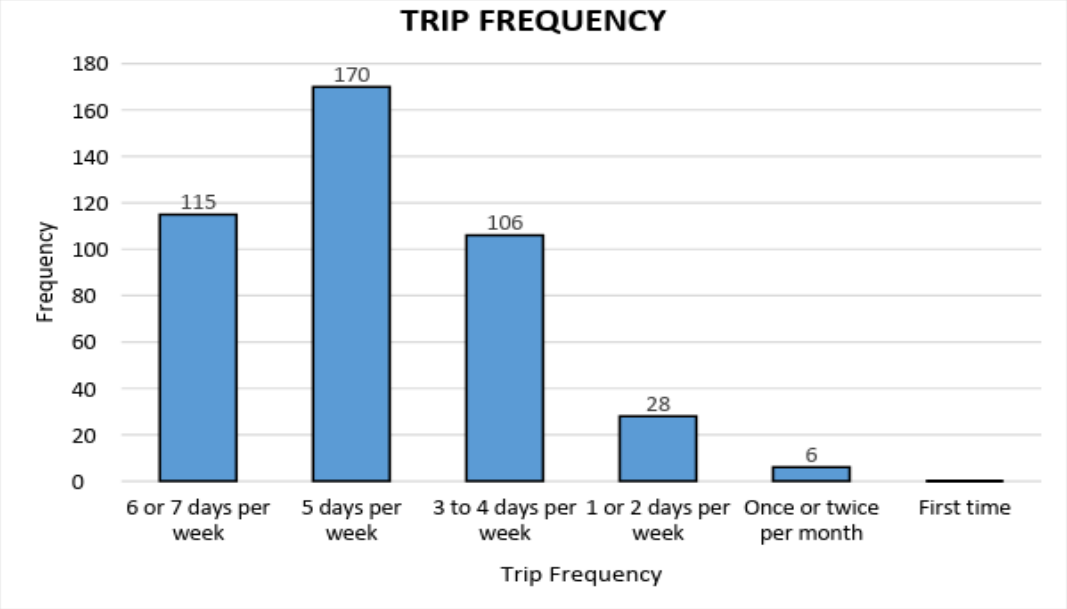


Figure 8: Frequency of Travel
Source: Field Survey, 2017

2.2.3 Benefits Gained Compared to the Previous Mode

All respondents reported having benefited from the switch to the BRT-Classic. It was found that the BRT-Classic vehicles are more comfortable, faster, more reliable, safer, and has better ambience. Small percentages accounted for free Wi-Fi and affordability as part of the services derived (see Figure 9). In light of comparing the benefits gained by captive and choice users, a Pearson's chi-square was used to test for significant statistical differences in their responses (see figure 10).

The null hypothesis: "No difference between both sample groups" was tested against the alternative hypothesis "There are differences between both sample groups" at 99% significant level using Pearson's Chi-Square test. A Pearson coefficient (χ^2) of **0.99** was derived. Therefore, the null hypothesis is accepted. This result indicates both captive and choice users enjoy the same benefits while using the BRT-Classic.

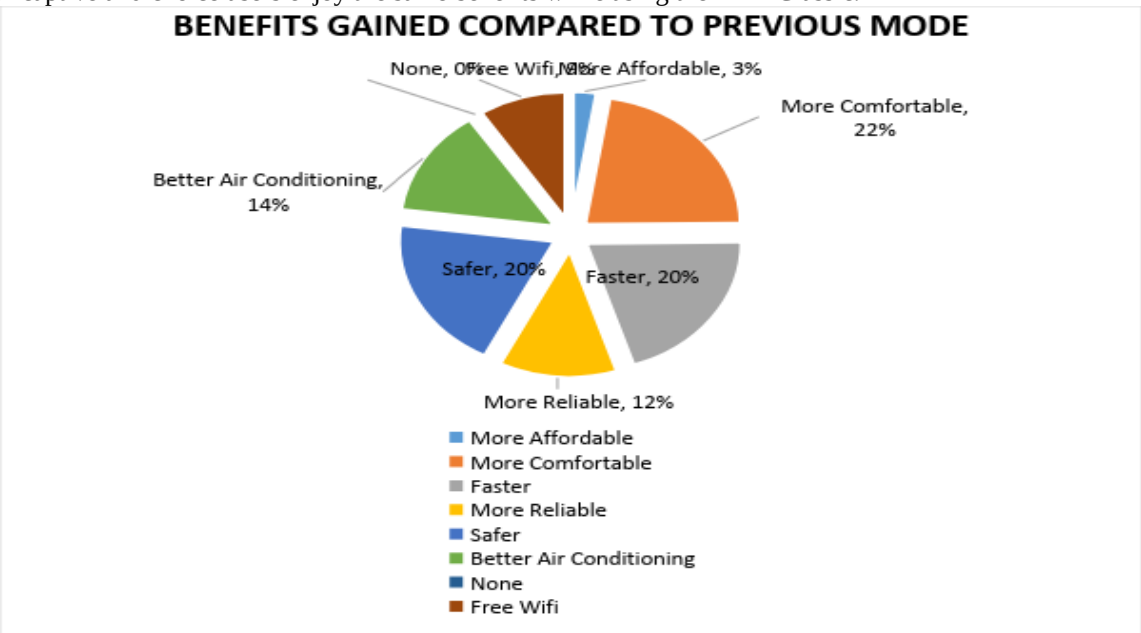


Figure 9: Benefits Gained by Respondents Compared to Previous Mode of Travel
Source: Field Survey, 2017

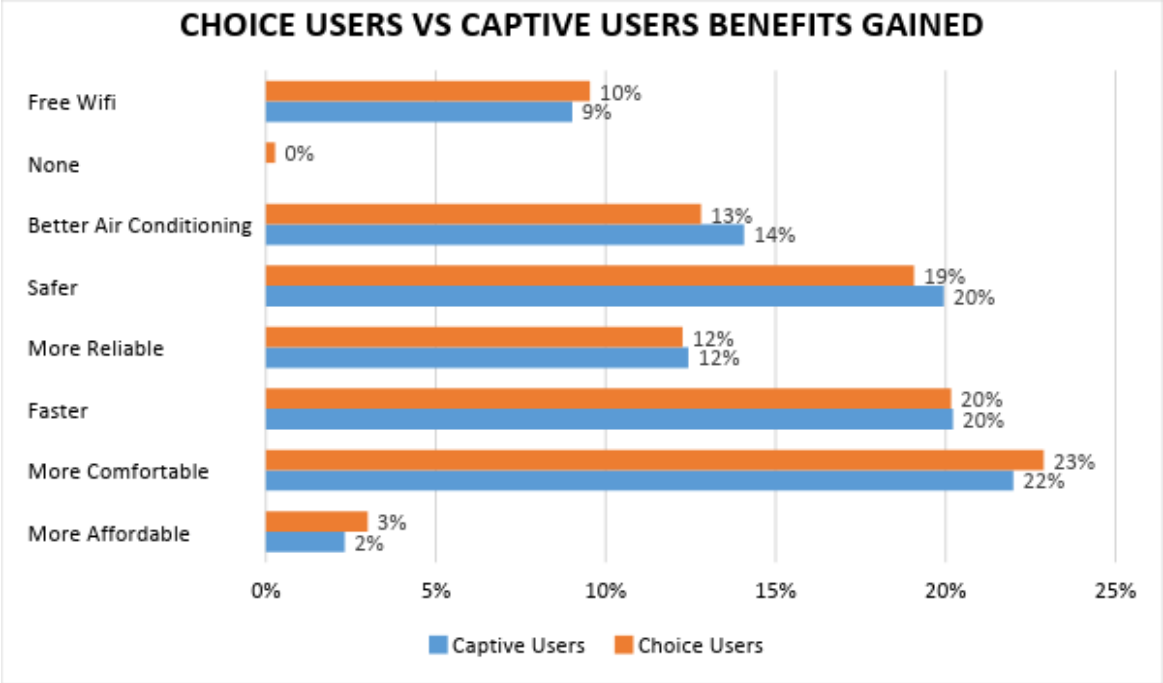


Figure 10: Captive VS Choice User Benefits Gained
Source: Field Survey, 2017

2.3 QUADRANT ANALYSIS (QA)

QA visualises respondents' mean important ratings of each service attributes against their mean satisfaction ratings into various quadrants in a chart. The ultimate goal is to identify service attributes that are in the "Target issue" quadrant – which implies that such service attribute is vital to commuters but unsatisfactory, therefore, needs urgent improvement. The BRT-Classic QA result is shown in Figure 11 below.

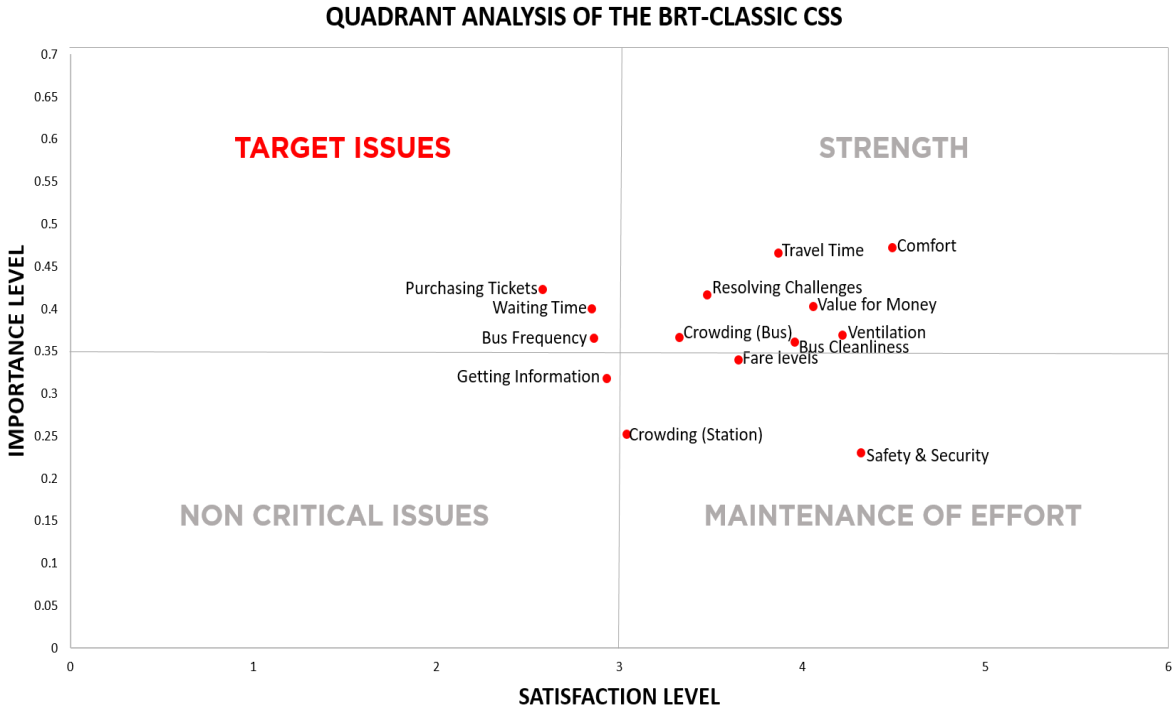


Figure 11: Quadrant Analysis Chart

The majority (11) of the service attributes are in the "strength" and "maintenance of effort" quadrant while waiting time and crowding in the buses are in the "target" quadrant. From the QA, the waiting time for buses and crowding in the bus needs urgent decrement because commuters are not satisfied with the current service

level and they are deemed very important to them. Also, crowding at the station and the frequency of buses require improvement to increase satisfaction levels. Other service attributes are essential and very satisfactory to the BRT-Classic users; thus - only needs consistent maintenance of present service quality.

Now that the socio-demographic and travel characteristics of the BRT-Classic respondents are established, the selected analytical methods - QA, HSCI and CLI will be used to investigate the BRT-Classic's service quality.

QA visualises respondents' mean important ratings of each service attributes against their mean satisfaction ratings into various quadrants in a chart. The ultimate goal is to identify service attributes that are in the "Target issue" quadrant – which implies that such service attribute is vital to commuters but unsatisfactory, therefore, needs urgent improvement. The BRT-Classic QA result is shown in Figure 11.

2.4 HETEROGENEOUS CUSTOMER SATISFACTION INDEX (HCSI)

The HSCI accounts for the heterogeneity in respondents' satisfaction and importance ratings, unlike other analysis. More weight is given to service attributes with similar commuter perception and less weight to those with different commuter perception. It provides an overall satisfaction index and identifies the effect of each service attribute (weighted score) on the index. The BRT-Classic HCSI result is presented in Table 3.

Table 5: BRT-Classic Heterogeneous Customer Satisfaction Index

S/N	Service Attributes	Satisfaction		Importance		Corrected Satisfaction	Corrected Importance Weight	Weighted Score
		Mean	Variance	Mean	Variance			
1	Comfort	4.5	1.5	0.5	1.0	6.5	0.07	0.48
2	Cleanliness	4.0	1.9	0.4	1.0	4.0	0.09	0.38
3	Value for money	4.1	1.8	0.4	1.0	4.6	0.07	0.33
4	Fare Levels	3.7	1.6	0.3	1.0	4.2	0.08	0.32
5	Safety and Security	4.3	1.9	0.2	1.0	4.8	0.07	0.32
6	Ventilation	4.2	1.7	0.4	1.0	5.2	0.06	0.29
7	Ease of resolving challenges	3.5	1.5	0.4	1.0	3.9	0.07	0.29
8	Crowding (bus)	3.3	1.9	0.4	1.0	3.0	0.08	0.24
9	Trip Time	3.9	1.9	0.5	1.0	3.9	0.05	0.20
10	Ease of getting information etc.	2.9	2.2	0.3	1.0	2.0	0.09	0.18
11	Crowding (station)	3.0	1.9	0.3	1.0	2.4	0.07	0.17
12	**Waiting Time**	**2.9**	**2.1**	**0.3**	**1.0**	**1.9**	**0.06**	**0.12**
13	**Frequency**	**2.9**	**1.8**	**0.4**	**1.0**	**2.2**	**0.05**	**0.10**
14	Ease of purchasing ticket	2.58	3.2	0.4	1.0	3.2	0.08	0.08
							HSCI	**3.69**

Shaded cells are below the average weighted score (0.26)

Source: Field work 2018

The percentage score of the BRT-Classic HCSI is **62%** (3.69 over 6). Service attributes such as comfort and cleanliness of buses have relatively high weighted scores. Value for money, fare levels, safety and security, ventilation inside the bus, ease of resolving challenges and ease of purchasing tickets have average weighted scores. Crowding in the bus, trip time, getting information about services and crowding at the station have low weighted scores below average. Waiting time, frequency and ticket purchasing have very minimal weighted scores (see Figure 12).

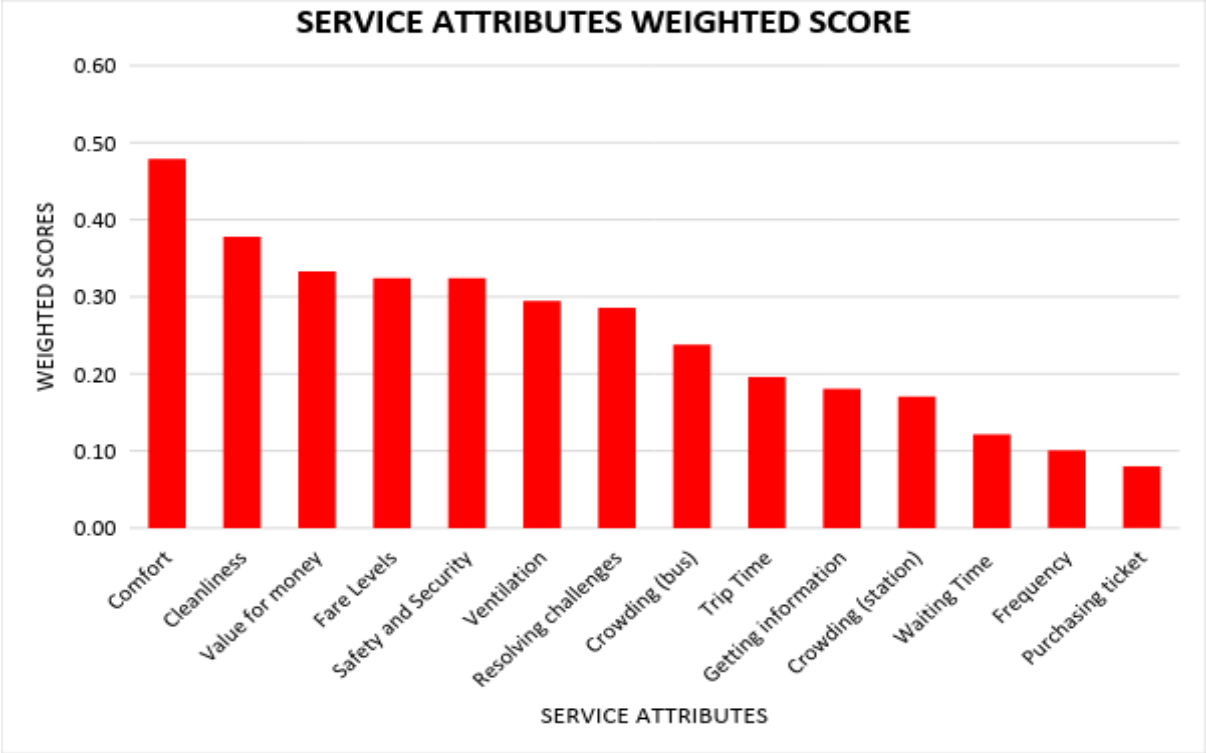


Figure 12: Weighted Scores of Service Attributes

This result implies that commuters are least satisfied with the frequency of buses, waiting time at stations, purchasing ticket, and they do not contribute significantly to the HCSI, thus needs necessary improvements to increase the HCSI. Also, overcrowding, trip time and passenger information dissemination marginally contribute to the HCSI, hence need to be considered for improvements. Other service attributes contribute moderately to the HCSI and only require maintenance of present service quality. The HCSI is relatively okay, indicating commuters are slightly satisfied with the BRT-Classic service quality.

2.5 CUSTOMER LOYALTY INDEX

Now that the service quality of the BRT-Classic has been identified, its effect on customer loyalty is shown in this analysis. This analysis aims at classifying commuters into different customer loyalty segments. The BRT-Classic's customer loyalty chart and customer loyalty segmentation are shown in Figure 13 and 14 respectively.

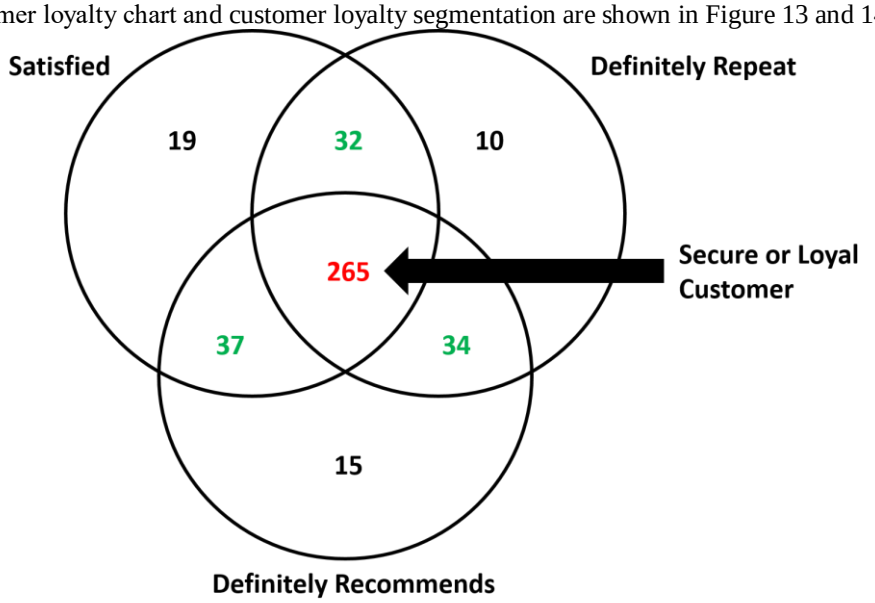


Figure 13: Customer Loyalty Chart

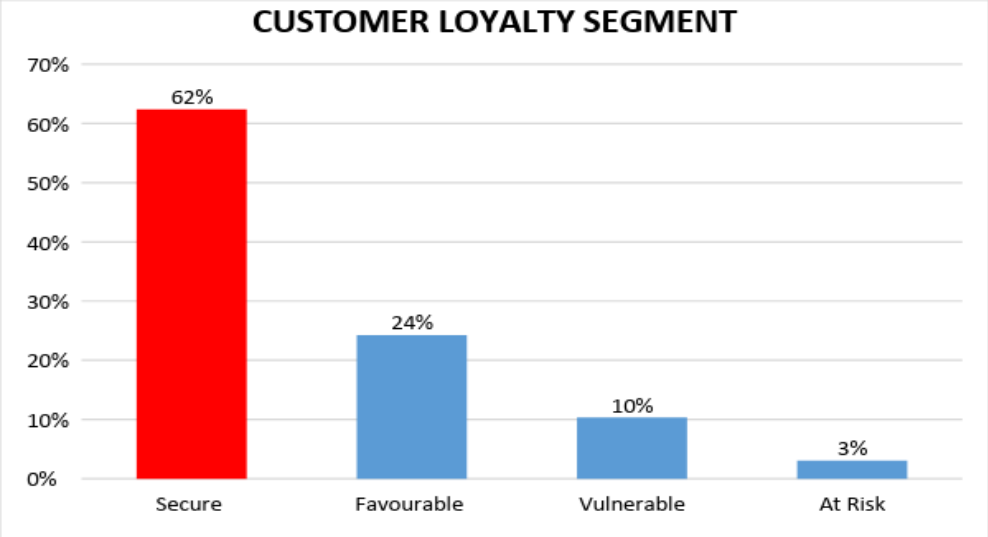


Figure 14: BRT-Classic Customer Loyalty Segmentation

The respondents are regular user of the BRT services and are very satisfied with the BRT-Classic's services. They can recommend the services to friends and family, and whoever care to use the services. One-fourth are favourable customers who gave a second-best response on all three measures of satisfaction and loyalty. The minority are vulnerable, and at-risk customers who are somewhat satisfied/have or have not recommended it/ will or will not continue to use it. This result indicates that few customers are at risk to shifting to other forms of transportation or reducing travel frequency using the BRT-Classic. Most customers will continue to use BRT-Classic and keep recommending to others as shown in figure 15. Thus, there's need for significant improvement in service quality to make others secured.

Figure 15: Passengers on board during survey

III. BRT- CLASSIC OVERALL SATISFACTION

The respondents' overall satisfaction with the BRT-Classic is reported in this section. It aims at analysing customer satisfaction of the system. 53% of the respondent are satisfied" with the BRT-Classic services while about 47% are dissatisfied" with the services. Furthermore, the overall satisfaction of various socio-demographic groups was compared to discern if it varies amongst the groups. It was also observed that males have higher satisfaction mean score than females; captive users have higher mean score than choice users; commuters above 40 years have higher mean score than those below 40 years; commuters travelling during the off-peak period have higher mean score than those travelling during the peak period (see Table 3). In identifying if overall satisfaction mean scores are significantly statistically different amongst the groups, an independent-sample T-test was conducted to compare the groups mentioned above at 95% significant level (See Table 4).

Table 6: Comparison of Mean Satisfaction Score

Respondents characteristics		**Mean**	**SD**	**Mean Difference**	**t-values**	**df**	**Sig. (2-tailed)** $p = 0.05$
Gender	Males	4.38	1.000	.182	1.628	423	.104
	Females	4.20	1.231				
Car Ownership	Choice users	4.22	1.118	-.126	1.122	423	.262
	Captive users	4.35	1.171				
Age	≤40 years old	4.26	1.159	-.049	-.389	423	.698
	•40 years old	4.31	1.086				
Period	Peak period	4.22	1.156	-.172	-1.449	423	.148
	Off - peak	4.39	1.100				

**Indicates significance level < 0.05*

The satisfaction mean scores were not found to be significantly statistically different between the groups of users as indicated in Table 3. This result indicates that all groups are equally satisfied with the BRT-Classic. Following the preceding, the discussion of findings will be done in the succeeding chapter.

IV. DISCUSSION OF FINDINGS

4.0 DISCUSSION OF FINDINGS

With a clear interpretation of the results and analyses of the Customer Satisfaction Survey (CSS) carried out at the BRT-Classic stations, Lagos; the findings from the survey will now be discussed. Section four synthesises commuters' perception of the BRT-Classic and highlights the service attributes that need urgent improvement. Section three already addressed the BRT-Classic overall satisfaction level.

4.1 COMMUTERS' PERCEPTION OF THE BRT-CLASSIC

A holistic approach was used in identifying customer judgement of the BRT-Classic service quality. By combining the Quadrant Analysis (QA), Heterogeneous Customer Satisfaction Index (HCSI), Customer Loyalty Index (CLI) and overall satisfaction averages, commuters' perception were measured. The outcome of this survey is discussed below.

4.1.1 Quadrant Analysis (QA)

QA visualised the average mean rating of each service attribute. This model found that customers were dissatisfied with the frequency of buses, waiting time at stations and the method of disseminating passenger information. Also, overcrowding at stations is on the verge, thus a little increase in the level of overcrowding will make commuters dissatisfied. This displeasure is consistent with the HSCI models findings, thus makes it prominent. However, customers are satisfied with the other service attributes in the QA model.

4.1.2 Heterogeneous Customer Satisfaction Index (HSCI)

Accounting for the variability in each service attribute ratings, commuters' perception of the BRT-Classic service quality has an average rating of 62%. This model found that customers were dissatisfied with the frequency of the buses, waiting time at bus stops, overcrowding at the station, the method of disseminating passenger information, travel time in buses and overcrowding in the buses.

By combining the results from each analysis, each service attributes and their improvement status are shown in Table 5.

Table 7: The BRT-Classic Service Attributes Improvement Status

S/N	Service Attributes	Improvement Status
1	Comfort	Maintenance of Effort
2	Value for money	Maintenance of Effort
3	Cleanliness	Maintenance of Effort
4	Ventilation	Maintenance of Effort
5	Resolving complaints	Maintenance of Effort
6	Safety and security	Maintenance of Effort
7	Resolving complaints	Maintenance of Effort
8	Fare levels	Maintenance of Effort
9	Ease of purchasing tickets	Need Improvement
10	Over-Crowding in the bus	Need Improvement
11	**Ease of getting information**	Need Improvement
12	Over-Crowding at the station	Need Urgent Improvement
13	Waiting time	Need Urgent Improvement
14	Bus Frequency	Need Urgent Improvement

The service attributes highlighted for improvement in table 4 are highly correlated. For example, if the frequency of buses increases, it will reduce the waiting time of commuters at the station as well as the overcrowding at the stations and in the buses.

These findings are also supported by the 15% drop in the monthly average buses deployed by the operator (from 270 in August 2017 to 230 in November 2017). The satisfactory customer index of 62% is less than LAMATA's benchmark of 90%. Therefore, it is paramount buses are deployed more frequently to eradicate commuter's displeasures and improve service quality. Also, passenger information directories should be disseminated adequately in real time.

The next chapter concludes this study and provides recommendations to improve customer satisfaction.

V. CONCLUSION AND RECOMMENDATIONS

Assessing the performance of BRT-Classic is necessary to ensure high-quality service is delivered regularly. Several BRT systems have been improved by always identifying gaps in their performance, either from a customers' perception, authority's outlook or operators' viewpoint, or combined. The BRT-Lite, Lagos, has fallen victim of waned service quality which resulted in a significant drop in ridership.

To ensure the performance of BRT-Classic does not also depreciate; a customer satisfaction survey was conducted on-board the corridor to measure the current service quality of the system. It was observed that 53% of the respondents are satisfied with the BRT-Classic service quality and they have a relatively positive perception about the system. However, 47% of the respondents also reported dissatisfaction with some service attributes such as the frequency of the buses, waiting time at bus stops, overcrowding at the station, disseminating of passenger information, travel time in buses and overcrowding in the buses. In improving the observed service quality, practical solutions have been suggested in the next section.

5.1 RECOMMENDATIONS TO IMPROVE BRT-CLASSIC SERVICE QUALITY

The suggestions on how the BRT-Classic can be enhanced is based on the findings from the CSS results, international standard and local conditions. The recommendations are outlined below:

5.1.1 Increase Bus Frequency

Following passengers demand for increased bus frequencies, we needed to show that Primero operations are currently facing a myriad of challenges that have seriously affected the effective dispatch and distribution of buses on the BRT-Classic corridor, some of the observed issues and recommendations are:

1. **Maintenance**: Currently the operator deploy between 170 and 200 buses daily. A staggering of over 200 buses are on down time and about half of the buses are grounded. The inadequate maintenance capacity has resulted to low deployment of buses as against the number of buses mandated in the SLA. In view of the identified issues with maintenance, we recommend the following:

- An overhaul of the current maintenance unit, this will involve the Introduction of a carefully designed maintenance process flow whereby each aspect of maintenance is broken down according to expected work durations that will bring about standardized lead times. This will make for easy tracking and timing of all aspects of maintenance, this will in turn reduce the number of buses on down time.
- A system of planned replacement of spares should be adopted for all categories of spare parts, especially critically important and high consumable parts like tyres, batteries, bearings, brake linings, filters amongst others.
- The operator can also consider outsourcing the maintenance of the buses to a reputable fleet maintenance service provider; this arrangement allows the operator concentrate on their core operational functions. It also makes for cost savings as the operator is not saddled with paying for services not rendered because an SLA contract will be put in place to monitor the performance of the service provider. Some notable Service Providers are Lanre Shittu Motors and Fix Factor Automobile.

2. **Spare parts**: There are observed unavailability of critical spare parts like tyres and batteries especially. We therefore recommend thus:

   - There should be in place a detailed chart of all the vehicle spare parts requirements according to different categories and importance. Each bus should have a comprehensive maintenance log book that details the history of all maintenance carried out on the bus whether in the past, currently as well as details of future maintenance works or replacements as necessary.
   - The spare parts store or warehouse should be run in a professional manner. In this regards, all the vehicle consumable parts and other critically required parts must be available, for this to work well, proper records must be kept of spares supplies and their usage. Depending on nature of spares, stock out levels must be determined and adhered to. In addition, a periodic Inventory audit should be conducted to determine average monthly usage.

3. **Financial constraints**: As a result of the inefficient output in maintenance and operations, the operator is facing challenges in meeting with critical financial obligations to the Bank in relation to loans repayment. This development has in turn affected the prompt payment for diesel supplies, salaries for drivers, mechanics and other categories of workers, payment for spare parts amongst other issues. We recommend thus:

   - The operator should also consider a restructuring of their current loan portfolio. On one hand, operator can explore other financial options like involving the Infrastructure Bank or Bank of Industries to buy out their obligations, while also spreading their exposure. On the other hand, they can consider working with some other financial institutions that can take over some of their overheads like diesel purchases, salaries payments, spares purchases etc.

4. **Skills gap:** There is an obvious gap in the professional deliverables of the workshop crew and the operations personnel. There appears to be an absence of process flow designs tailored to ensure speedy processes at the workshop. Also missing is proper synergy amongst the workshop, operations and Primero monitoring personnel. We recommend thus:

   - A properly designed process flow should be introduced in order for the workshop crew to be more proactive and responsive in the discharge of their duties.

   - The workshop crew needs to undergo technical training on current methods of carrying out their roles. They also need to be equipped with modern workshop tools that aid the speedy dispatch of their functions.

   - Effective work flow communication channels should be enhanced between the workshop and other operations units. This will allow for up-to-date and real time information on the state of the buses as necessary for efficient scheduling and deployments.

5. **Traffic bottlenecks:** Peak period trafficcongestion has continued to dog the effective distribution and return of buses. Traffic build ups are becoming a near daily occurrence at places like Ketu, Maryland, Fadeyi, Western Avenue, Costain and Eko Bridge. We therefore recommend thus:

- The Regulator and the Operator should adopt a radical approach by creating a Traffic Monitoring Task Force. This body would be working closely with the officers of the State Traffic Management Authority and the police to ensure that all bottlenecks are collapsed for free movements of the buses for improved turn around.
- The Regulator can also support the Operator by conducting a study of the peak hour traffic situation, with a view to providing traffic Interventions. This may involve the adjustment of observed disruptions occasioned by existing road conditions, it may also involve the redirection of traffic to pave way for BRT movements at the affected periods or any other measures as may be suggested following the outcome of the peak period traffic survey.

6. **Ticketing challenges:** The current ticketing system is not flexible, the situation is such that passengers have to endure long waiting times to procure tickets before eventually boarding the bus, and this is often the case when network issues disrupt the issuance of tickets to passengers. Again, the non-availability of alternative ticketing channels constrains passengers to using the hand held ticket dispensing methods and the card system, which is still on test run. We recommend as follows:

- Waiting time at the point of ticket purchase will be greatly reduced if there are other options of purchasing tickets apart from the Terminals/Shelters. By this arrangement, passengers shall be offered options of purchasing their tickets using various other means whether through Bank ATMs, on-line purchases via phones or computers and other kiosks distributed around Lagos.
- Though electronic ticketing system has been introduced, it has not performed optimally in addressing commuters' need at purchasing tickets to board BRT buses. It is recommended that the current electronic smart card should be enhanced with all existing challenges of black-listing, users' top-up, accessibility amongst others resolved.

7 Reduce Information Gap

Ensuring commuters get information about the BRT-Classic services that can allow them to make travel decisions is essential to customers.

The Operator should liaise with LAMATA, to ensure that passengers are maximizing the use of Information channels i.e. Passenger Information System display screen at Shelter and Terminals, BRT mobile application and the online portal. Disseminating real time trip information on these channels as well as educating commuters about these channels will help reduce information gap.

Overall, BRT-Classic can do better in the delivery of high-quality services to meet the needs of the commuting public of Lagos state.

It is important to note that the untimely implementation of the above recommendation with affect the sustainability of this project.

5.2 ABULE – EGBA – OSHODI BRT SCHEME

The affirmative benefits and positive experience of the users of the BRT-Classic have inspired the implementation of the third BRT in Lagos named '*Oshodi - Abule-Egba BRT'*. The Oshodi - Abule-Egba BRT is an upgrade of the BRT-Classic, which is a Bronze Standard BRT system (Using ITDP's BRT Standard Rating, 2016). The construction of the BRT is about 40% completed and it is due by December 2018.

The Oshodi - Abule-Egba BRT is a 14Km two-way median-aligned busway in the central verge of a two-way road and it is over 97% physically segregated by curbs. It will use a central station to serve both directions. They will be equipped with off-board payment infrastructures and operated with contemporary Intelligent Transport Systems (ITS). Each station will be universally accessible by pedestrian bridges, and they will all have passing lanes and level boarding platform with the buses.

Approximately 300 sophisticated high capacity buses with ultra-low emission will be used to operate several services along the corridor. The BRT will be integrated with the Lagos Bus Reform Project, the Red Rail Project and other transport projects. The estimated demand is about 350,000 commuters daily and 15,000 Peak Passenger per Hour per Direction (PPHPD). However, the estimated passenger capacity of the corridor is more than double the current demand.

The Oshodi - Abule-Egba BRT will potentially be the first Gold Standard BRT System in Africa (Using ITDP's BRT Standard Rating, 2016). The projected benefits of the system include:

- Reduced travel time by at least 40% along the corridor
- 50% reduction in average waiting time
- Man-hour cost savings of about ₦360,000,000 ($1,000,000) daily
- 15% modal shift from private vehicles to the BRT
- 30% reduction in total accidents and about 90% in public transport fatal accidents

- About 35% reduction in traffic pollution
- Over 10,000 direct and indirect job employment
- Increased commuter travel satisfaction to at least 80%

Other benefits include:

- Improved accessibility and mobility
- High Public Transport Service Quality
- Regeneration of communities along the corridor
- Increased land value of adjacent lands
- Promotion of Non-Motorised Transport (NMT)
- Projection of Lagos as a world-class society

The extension of the BRT network to the Oshodi /Abule-Egba environ will contribute immensely to the quality of public transport infrastructures and services experienced by the commuters. It will enhance passenger's mobility and travelling experience.

5.3 NEW CONCEPT FOR THE OSHODI – ABULE EGBA BRT SCHEME

Based on the outcome and experiences of the users of the current BRT, LAMATA is using evidence based theory to implement the Oshodi – Abule-Egba BRT with a counterfactual concept. This concept is to ensure the challenges observed on the current BRT are eradicated and service quality is improved. The essential lessons to improve the service quality includes:

- Outsourcing the maintenance of the buses to the fleet manufacturer from inception. This concept is to minimize the fleet downtimes, breakdowns and ensure the bus frequency is consistent. Thus, reducing passenger waiting time at the stations.
- A spare-part supply contract with the fleet manufacturer from inception. This concept is to guarantee genuine spare parts are used to replace the damaged ones timely. It will also reduce fleet downtime and increase bus deployment.
- Secure financial loan in local currency. This concept is to avoid increase in loan repayment due to exchange rate fluctuation. It will also support financial stability.
- A loan interest rate of about 5%-10% will be recommended to ensure the CAPEX repayment is viable.
- The use of sophisticated Intelligent Transport Systems, Passenger Information Systems and off-board payment systems will be embedded in the operation of the BRT from inception. This will increase the efficiency of the operations, secure revenue and increase public awareness.
- Adaptive traffic signals will be implemented at intersections to reduce bottleneck. This infrastructure will reduce passengers travel time and delays.

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