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## BUS RAPID TRANSPORT OPERATION AND SAFETY IN LAGOS METROPOLIS OF NIGERIA

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*The hallmark of an ideal public transportation is in its high standard of safety of operation in the movement of passengers and goods. The public transport concept of BRT had been successfully implemented in Lagos metropolis in Nigeria-the largest urban conglomeration in the country as an innovation in public transport provision in Nigeria's, but the safety impact on commuters is not known. It is in this light that this study examines the operation impact of BRT buses on the safety of passenger's mobility. The methodology used in this study is the self completion survey method. Data were collected on variables of BRT operation; bearing on safety of the passengers as well as other road users .This is to evaluate the safety of BRT buses as a novel mode of public transportation in Lagos metropolis. The study was analysed through Pearson's moment correlation coefficient, analysis of variance and the multiple regression. The study revealed that there is a significant impact of BRT buses operation on the safety of passengers' mobility in Lagos metropolis. This is by providing a safe and convenient means of public transport, as well as other road users and highlights suggestions on ways to enhance sustainable BRT operation and safety of the passengers as well as other road users in Lagos Metropolis.*

**Keywords:** Safety, Public Transport, Bus Rapid Transit, Infrastructure, Traffic, Urban, Sustainability

### INTRODUCTION

Indeed, a good public transport system is invaluable to city socio-economic growth and livability (Bannister, 2005). In other words, the effective, efficient, reliable and safe operated public transport mode is considered a necessary desideratum to sustain urban economic growth. Moreso, safety is seen a part of the requirement to meeting the target of millennium development goals (MDGs), particularly in a developing country, whose public transport safety record is nothing to write home about.

However, in trying to achieve this feat, issues of safety of passengers' and their property should be considered utmost by public transport providers and planners. Though the varieties of public transport options and urban transit technology, as well as the safety operation significance available for urban and suburban mobility is extant in literature (Institute for Transportation and Development Policy, 2007;Vuchic,2007). More importantly, the reliable option of public transport in BRT recently adopted in Nigerian largest metropolitan area is considered a relief to the dearth of reliable formal public transport system in a highly urbanized developing country such as Nigeria. It was tailored to replicate the feat recorded in the adoption of BRT in Curitiba and Bogota, both the South American cities of Brazil and Columbia respectively. However, its safety in the movement of passengers and freight in Nigerian largest urban area is yet evaluated and studied.

Whilst studies have been carried out on public transport characteristics of informal public transport option in relation to passenger mobility in the Lagos metropolis

(Adeniji,1985;1987). Similarly, the study on the impact, the effectiveness and the reliability of TransMilenio and Integrated Transit Network(RIT) as adopted in Bogota, Columbia and Curitiba, Brazil in passenger movement in a developing country of South American cities compare well in meeting people's mobility needs to other public transport typologies such as tram, light rail and metro (Hidalgo,2003a;2003). Similarly, the impact of public transport innovation of a newly introduced formal public transport mode such as the BRT and its impact on passenger mobility in Lagos metropolis (Ogunkoya, 2008). Also, the studies on transport and the Nigerian environment, taking cursory view on the challenges of some transport externalities impact on the environment (Olokesusi and Asiyanbola,1997 and Oyesiku,2000).

Nevertheless, in Nigeria the use of BRT, a formal form of public transport typologies is novel and safety impact issues as related to its use as a form of public transport is lacking in literature. Meanwhile, in order to optimize BRT operation and benefits as well as enhanced public patronage and confidence to satisfy the daily trips demands, safety of BRT operations should be given a pride of place in the heart of policy makers and stakeholders alike. It is in this light that this study tends to contribute to literature in this regard by examining BRT operation and safety of BRT buses in Nigerian largest metropolitan area. The ratiocination for this study is to help policy makers, institution and different stakeholders involved in the provision of public transport system on the need to accord safety of operation of BRT as topmost priority to help achieve sustainability in policy issues as regards safety of public transport provision in Lagos metropolis.

### **CONCEPTUAL AND THEORETICAL FRAMEWORK**

The concept of safety seems to be inherent in the total understanding of the of the major causes of road traffic accident which provide understanding of why accident occurs in virtually all forms of modal transportation of which the use in BRT is no exception. To this end, understanding the conceptual framework of the cause of road traffic accident would help minimize and improve policy options in public transport intervention for cities of the world. These factors which constitute the conceptual underlay in road traffic safety are discussed below.

The human factor is an important concept in the cause of road traffic accident such as avoidable act which manifest in excessive speeding, overloading, dangerous overtaking, lack of consideration for other road users, influence of drugs or any other intoxicants, poor knowledge of traffic rules and loopholes in the regulation and issuance of driver's license. (Olson et al, 2002; Road Traffic Accident, 2005) in their studies on traffic safety identified human factor to road traffic accident prevention. The impulse of this concept on BRT operation and safety in Lagos metropolis is to ensure that BRT driver mental fitness and alacrity and good traffic education for safety of property and lives in Lagos metropolis.

The mechanical factor includes all factors associated with the mechanical constituents such as vehicle design, maintenance, operation, road design, speed cameras, and seat belt. Also included are well-designed intersections, road surfaces, visibility device, traffic control devices and signal system. The safe interactions with users are very important safety measure to ensure wellness of life and property. (Bekibele et al., 2007) in their studies revealed that mechanical defects in vehicle are major causes of road traffic accident. In this light BRT safety and operation in Lagos metropolis hinges on a good and well maintained BRT buses. The exclusive BRT lanes should be devoid of pothole and well paved. Similarly, proper alignment of median with guard rails to avoid conflict both with pedestrian and other road

users and where intersections with other road users is unavoidable, effective signals and control should be put in place to minimize conflicts as much as possible.

The environmental factor is a very important factor in the cause of road traffic accident that impact on safety of operation of public transportation services in Lagos metropolis, specifically, the BRT buses. (Jha et al., 2004) sees the environmental factor as an important factor of epidemiology study of road traffic accident in south India. Environmental factor is directly related to attention disturbances, caused by variableness in climatic and weather conditions, obscuring visibility, and issues of traffic density and congestion with its attendant elements such as collisions and crashes, are major environmental issues causing accident.

According to the (World Health Organisation, 2004), the scientific system approach to road safety is essential to tackling the challenges of safety as regards motorized mobility. This approach according to WHO, addresses the traffic system as a whole and looks at the interactions between vehicles, road users and the road infrastructure to identify solutions. The implications of this, for safety of BRT operation in Lagos metropolis, is to ensure a safe interaction between BRT vehicles, the passengers and other road users, and the exclusive infrastructure such as segregated lane on which the BRT operates, and the occasional interfaces with adjacent road infrastructure for other users.

(Evans 2004) sees the concept of traffic safety as the absence of unintended harm to living creatures or inanimate objects. It viewed quantitative safety measures as nearly always focusing on the magnitude of departures from a total absence of some type of harm, rather than directly on safety as such. The impacts of careful adoption of the concept of traffic safety to operations of BRT operation in Lagos metropolis would go along way ensure the safety of the BRT operation by the stakeholders in Lagos metropolis.

## **METHODOLOGY**

### **THE STUDY AREA**

The Lagos metropolitan area is located in the south western part of Nigeria. It is the largest metropolitan in Nigeria (Ayeni,1979; Ogunkoya,2008), Lagos metropolis lies generally on lowlands, with the density of 24,182/km and urban population of 7,937,932(Federal Government of Nigeria,2006). The Lagos metropolitan area consisted of up to 16 Local Government Areas. It is noteworthy to say that the study only covers sample of the municipalities who share in the first phase of Bus Rapid Transit implementation in Lagos metropolis.

The questionnaires were divided into two sections. The first section of the questionnaires elicits data on the socio-economic characteristics of Lagos metropolis using BRT and the second of the questionnaire elicits information on the Bus Rapid Transit passengers' perceptions on driver rating, bus rapid transit risks, emissions, traffic flow which is the focus of this paper. The questionnaires were distributed to the passenger at the bus stop as they were about access the bus. The data were analysed using one sample t test, correlation and regression analysis. Self completion method and cross-sectional survey were used for this study. The questionnaire was employed to elicit information on the safety operation of BRT in Lagos metropolis.

This includes the various groups of Lagos metropolis trips makers which make use of BRT buses for daily commute, which cut across different occupational strata. The sampling units include the urban workers, which include both public and private institutions workers,

artisans, university students and the commercial worker such as business women and men. A simple random sampling method technique was adopted for this study and a total of 100 questionnaires were administered to the residents of Lagos metropolis which represent 1% of the total sample frame. This is agreement with (Bruton 1975: 53) who recommended a sample size of 10% for population of area under 50,000 and 1% for areas having 1,000,000 people and above. Similarly, (Richardson et al,1995) asserts that it is the number of observations in the sample, rather than the sample size as a percentage of the population, which determines the precision of the parameter estimates. A total no of 96 questionnaires returned were eventually used for the analysis though the cost of procuring survey material and skilled staff for the survey was also responsible for this choice and number. However this will not in the least way affect the result of the research. In the analysis which was discussed afterwards, the one sample t test, correlation and regression analysis were tested on the variable of dependent and the independent variable in the analysis of the BRT operations and safety in passenger's movement in Lagos metropolis.

## FINDINGS AND DISCUSSIONS

Table 1 reveals the strength of relationships between two variables correlated together. The variable BRT operations and safety of passengers' relationships in Lagos metropolis were significant at both the 0.01 level (2-tailed) and 0.05 levels (2-tailed). The correlation coefficient of BRT operation and safety being the highest at 0.457 between BRT speed rating and BRT drivers rating. This study revealed that safety of BRT operation in passenger's movement in Lagos metropolis is significant. In fact, the efficiency of transfer of passenger as regards safety of operation requirement agreed with a general minimum standard for BRT safe operation in cities. This among other things include, sufficient system capacity to handle expected passenger demand; service speed that minimize travel times; and frequency of service to minimize waiting times. However, policy makers, the operators and stakeholders should not rest on their oars to come up with other policy options to further improve the safety of BRT buses

Similarly, other variables such as BRT SAFETY and BRT DRIVERRATING were significant at 0.01 levels (2 tailed), BRT SAFETY and BRTRISK, significant at 0.01 level (2 tailed), BRT SAFETY and BRTPEDROADUSER, significant at 0.05 level (2 tailed), BRTEMISSION and BRTDRIVERRATING, significant at 0.05 level (2 tailed). The table 1 showed all other variables whose correlation were significant at either 0.01 or 0.05 levels. The interpretation of these results is that, variables whose correlations were significant, shows that the covariance was positive in magnitude and dispersion. In other words, the variables whose correlations on safety of operations of BRT buses in Lagos metropolis were significant validate safety operations of BRT buses in Lagos metropolis.

Table2- 3 showing the one sample statistics and the one sample test of the variable BRTSAFETY with a 'T' value of -1970.507, a mean of 1.0625 and standard deviation of .24333 and a standard error mean of .02483. The 'T' value is significant at .000 at 0.05 (2 tailed). The impulse of this is that there is a significant difference in BRT operations and safety in the movement of passengers in Lagos metropolis. Hence, we reject the null hypothesis and accept the alternative hypothesis indicating significance in BRT operation and safety in Lagos metropolis.

Table 4-6 showing the model summary of the regression analysis, analysis of variance of the regression analysis and coefficient of the regression analysis, the dependent variable is BRTSAFETY, which is the variable on BRTSAFETY in passenger movement in Lagos

metropolis and the independent variable are BRTDRIVERRATING, BRTTRAFFIC, BRTROADUSER, BRTEMISSION, BRTRISK. The F ratio of the regression model is 4.354. As shown in table 5, the overall model is significant at 0.001 i.e., the variance for the predictors in the model is significant. The implication is that BRT safety operation in public transport operations in Lagos metropolis is significant. Moreover, other safety intervention towards sustainability of BRT operation in Lagos metropolis should be ensured.

In the table 4 showing the model summary, the R square is .210 and the adjusted R square which shows the amount of variance accounted for by the actual predictors use in the overall model is .162 which is still well off very positive indication of the significance of the predictors use in the model. This is indicative of the safety effect of BRT operations in the passenger movement in Lagos metropolis. In addition, the coefficients of the dependent and independent variable in the regression analysis as shown in Table 6, revealed that the dependent variable BRTDRIVERRATING and the model constant, which revealed the overall effects of the independent variable on the dependent variable - BRTSAFETY when zero is very significant.

**Table 1: The correlation coefficient between the dependent and independent variable**

Correlations	BRSAFETY	BRTEMISSIO N	BRTRDRIVER RATING	BRTRTRAFFIC C	BRTRNIOSEP OLL	BRTRTISPEED SAF	BRTRRISK	BRTRPEDROA DUSER
Pearson Correlation	1.000	.020	.363**	.010	-.148	.303**	-.300**	-.244*
Sig. (2-tailed)		.847	.000	.920	.153	.003	.003	.016
N	96.000	91	95	.96	.95	.96	.94	.96
Pearson Correlation	.020	1.000	.229*	.218*	.377**	.127	.060	.211*
Sig. (2-tailed)	.847		.030	.038	.000	.232	.579	.044
N	91	91.000	90	.91	.90	.91	.89	.91
Pearson Correlation	.363**	.229*	1.000	.254*	.029	.457**	-.225*	-.161
Sig. (2-tailed)	.000	.030		.013	.780	.000	.030	.120
N	95	90	95.000	.95	.94	.95	.93	.95
Pearson Correlation	.010	.218*	.254*	1.000	.110	.288**	-.145	.066
Sig. (2-tailed)	.920	.038	.013		.287	.005	.164	.526
N	96	91	95	96.000	.95	.96	.94	.96
Pearson Correlation	-.148	.377**	.029	.110	1.000	.097	.136	.280**
Sig. (2-tailed)	.153	.000	.780	.287		.348	.192	.006
N	95	90	94	.95	95.000	.95	.94	.95
Pearson Correlation	.303**	.127	.457**	.288**	.097	1.000	-.231*	-.221*
Sig. (2-tailed)	.003	.232	.000	.005	.348		.025	.031
N	96	91	95	.96	.95	96.000	.94	.96
Pearson Correlation	-.300**	.060	-.225*	-.145	.136	-.231*	1.000	.341**
Sig. (2-tailed)	.003	.579	.030	.164	.192	.025		.001
N	94	89	93	.94	.94	.94	94.000	.94
Pearson Correlation	-.244*	.211*	-.161	.066	.280**	-.221*	.341**	1.000
Sig. (2-tailed)	.016	.044	.120	.526	.006	.031	.001	
N	96	91	95	.96	.95	.96	.94	96.000

- \*\* . Correlation is significant at the 0.01 level (2-tailed)
- \* . Correlation is significant at the 0.05 level (2-tailed)

4.1 VARIABLE DENOTATIONS AND MEANINGS.

- BRT SAFETY – BRT Safety ratings.
- BRT MISSION – BRT Emission and global warming ratings.
- BRT DRIVERRATING – BRT Drivers rating.
- BRTTRAFFIC - BRT traffic congestion rating.
- BRTNOISEPOLL - BRT and noise pollution impact.
- BRTTISPEEDSAF - BRT speed safety.
- BRTRISK - BRT risk rating.
- BRTPENROADUSER - BRT impact on pedestrians and other road users

Table 2 Showing one sample Statistics

**One-Sample Statistics**

	N	Mean	Std. Deviation	Std. Error Mean
BRTSAFETY	96	1.0625	.24333	.02483

Table 3 Showing the One sample test

**One-Sample Test**

	Test Value = 50					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
BRTSAFETY	-1970.507	95	.000	-48.93750	-48.9868	-48.8882

Table 4 Showing the Model Summary of the Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.458 <sup>a</sup>	.210	.162	.23212

a. Predictors: (Constant), BRTDRIVERRATING, BRTPEDROADUSER, BRTRAFFICC, BRTEMISSION, BRTRISK

Table 5 Showing the analysis of Variance of the Regression analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.173	5	.235	4.354	.001 <sup>a</sup>
	Residual	4.418	82	.054		
	Total	5.591	87			

a. Predictors: (Constant), BRTDRIVERRATING, BRTPEDROADUSER, BRTRAFFICC, BRTEMISSION, BRTRISK

b. Dependent Variable: BRTSAFETY

Table 6 Showing the coefficient of the Regression analysis

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.209	.187		6.454	.000
	BRTEMISSION	-8.298E-5	.053	.000	-.002	.999
	BRTRAFFICC	-.040	.050	-.082	-.788	.433
	BRTPEDROADUSER	-.108	.078	-.152	-1.384	.170
	BRTRISK	-.053	.034	-.171	-1.555	.124
	BRTDRIVERRATING	.117	.039	.324	3.043	.003

a. Dependent Variable: BRTSAFETY

## **TOWARDS ENHANCED SAFETY OF BRT OPERATION IN LAGOS METROPOLIS**

According to Evans (1991) traffic safety is a desideratum to social and economic development as long as departures of modal transport operations are devoid of harm. The impulse is that of continuous pace in the development of paraphernalia associated with public transport operations in Lagos metropolis such as issues relating animate aspects of operations such as drivers, passengers or riders as well as other stakeholder in BRT operations and inanimate such as transport infrastructure such as segregated right of way and other associated facilities and amenities to enhanced BRT operation in Lagos metropolis. Similarly, WHO sees interaction between vehicles, road users and the road infrastructure in a well integrated and coordinated manner as necessary impacting safety and devoid of harms to the users and the structure itself.

Whilst the field survey last, the following issues are limpid to attract the attention of BRT infrastructure provider cum the policy maker in Lagos metropolis to enhance safety of bus operations. There is need to provide railings or guide rail on the shoulder dividing the BRT segregated lane traffic lane so as to discourage riders and passenger crossing these lanes.

- The segment of intersection of BRT segregated lanes with other traffic lane should be properly delineated to avoid traffic collision.
- There is need for installation of GPS device on all the fleet of BRT buses to monitor the speed and efficacy of the BRT buses towards safety of lives and property.
- Accessibility to BRT vehicles should be devoid of potential harm or dangers as riders and passengers often nearly collide whilst queuing up on an unguarded narrow shoulder of service lane adjacent the delineated BRT segregated lane.
- The other traffic should as much as possible be kept away from encroachment into the BRT segregated lane for enhanced safety operation.
- Accessibility to handicapped and the elderly urban metropolitan commuters should be enhanced and improved.

## **CONCLUSIONS**

In fact, this study of the impact of BRT buses operation on safety of passengers' movement in Lagos metropolis has been enormous and a significant contribution to literature, especially in a developing part of Africa with the highest road traffic casualty. It has helped create an evaluation regime of the safety of operation of the novel public transportation mode-BRT, as well as help the stakeholders and policy makers on the necessary intervention that would impact on enhanced safety of operation of the BRT buses and passengers as well as other road users. In addition, this study corroborated the safety traits of the concept of BRT as having an effective safety attributes as revealed in studies that have been carried out in developed and emerging industrial cities. From the analysis in this study, it can be seen that BRT operations in Lagos metropolis has a significant impact on passenger safety and as a result support earlier study in an emerging industrialised city. A major contribution to knowledge of this study is that it revealed that the concept of BRT as a form of public transportation mode has a high intrinsic safety capabilities compared to quondam informal or intermediate public transport mode already in operation before the introduction of the novel BRT buses as a form of public transportation in Lagos metropolis.

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