MODELLING OF TRIP GENERATION IN FEDERAL CAPITAL TERRITORY, ABUJA (FCTA): INFLUENCE OF RESIDENTS SOCIOECONOMIC FEATURES ON TRIPS MAKING

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ABSTRACT

The goal of this study is to model the numbers of trip generated in FCT, Abuja using socioeconomic characteristics of inhabitants to determine trip making. The authors utilized a correlational research design to evaluate the association between the number of trips made per day and socioeconomic characteristics (such as age, gender, marital status, monthly income, education, occupation, and the number of cars owned). The authors purposefully administered1500 surveys to Abuja residents using simple random approaches. The collected data was analyzed with frequency and percentages. While the numbers of trips per day was modelled with multiple linear regression. The findings reveals that 33.9% of the residents of Abuja make 6-7 trips per day. In addition to the findings, the socioeconomic characteristics stated above were a good predictor of the number of trips made per day by Abuja residents. The study concluded that since there is higher proportion of private car on FCT, Abuja's Road compares to the public transport this may results to serious traffic challenge in the future. The study recommends that the Federal Government of Nigeria (FGN) through the ministry of transport should resurrect the abandoned light rail project in Abuja and ensure that the metro lines are effectively connected, which will minimize the number of private cars on Abuja's roads.

Keywords: Trip generation, socioeconomic features, FCTA, numbers of trips, & Trip prediction

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1. INTRODUCTION

Road transit, as the most frequent mode of transport, has resulted in numerous traffic concerns, including traffic congestion caused by increased trips to city centers. Naturally, different land use generates varied volumes of traffic, and this traffic is drawn to the CBD or land use that offers viable economic activity. According to Ojekunle and Owoeye (2018), activities like working, shopping, religious worship, relaxation, and others entail the mobility of people or households from one neighborhood to another. The elements impacting trip generation and attractiveness have been determined by researchers over time. This factor has been linked to individual characteristics, residential density or location, status, income, and

other factors that are known to draw people to a specific area (Hanson & Hanson, 1981; Kansky, 1967).

According to Ojekunle et al. (2021), the spatial distribution of land uses, the population, the socioeconomic characteristics of the inhabitants, the density of city centers, and the density of residential land use all influence the spatial differences in traffic volume and scale of urban trips. Fadare and Hay (1990), asserted that the density of residential areas has an impact on the generation of trips for urban residents, leading to a variety of trips based on socio-economic features. Age, mode of transportation, sex, employment, duration of stay, rent, number of workers, and wealth are important factors that affect the number of trips generated in a city (Solanke, 2014).

In order to forecast the number of trips attracted to a zone different model has been used by modelers and the most common are the multiple regression model and category analysis. Also, Logit model has also been used in the 19th century for predicting trips. However, research conducted by Justin et al. (2014) reveals that category analysis produces satisfactory result especially when considering home-base work trips. Almasri (2012) states that the trip generation model predicts the distribution of district trip terminals, or the attractions and productions for each zone, which helps the trip prediction model estimate the flow of trips from each origin to each destination.

The benefits of trip prediction are vast, particularly when it comes to creating new infrastructure or planning current infrastructure. A plethora of study on trip generation has been undertaken in the developed world, particularly Europe, Asia, and parts of the Middle East (Almasri& Al-Jazzar, 2013; Verma & Ukil, 2022; Horbachov & Svichynskyi, 2018; Small & Verhoef, 2007). Few studies have been undertaken by researchers in developing nations that disclose the elements impacting trip making, traffic flow patterns, and travel characteristics in some African countries (Diaz-Olvera et al., 2004; Roux & Bruwer, 2017; Ojekunle & Owoeye, 2018; Masharya & Paul, 2021). And Nigeria being a developing country still requires serious studies to be undertaken to understand the factors influencing trip making in order to carryout proper transportation planning. Its' on this basis that the study aimed at modelling the numbers of trip generated in Federal Capital Territory, Abuja using socioeconomic characteristics of the residents.

2 LITERATURE REVIEW

2.1 Theoretical framework

The foregoing study utilize multiple linear regression to model trip making behavior of the residents of FCT, Abuja. The multiple regression model is the most commonly employed for modelling trip generation rate apart from categorical analysis or cross classification. Karl Pearson coined the term "multiple regression" in 1908 as an expansion of "linear regression." The purpose of multiple linear regression is to model the linear connection between explanatory (i.e., socioeconomic features) and dependent (numbers of trips) variables. When utilizing multiple regression analysis for calculating amount of trips emphasis is paid to land use and socioeconomic characteristics of the residents.

2.2 Examining the factors affecting trip making

Researchers have identified a wide range of elements that affect trip making. The socioeconomic background of the trip maker is the most important element determining trip making. For example, there is a negative correlation between resident income and the number of bus travels, which influences the number of excursions (Dargay & Hanly, 2002; Bresson, et al., 2004). On the other hand, research has demonstrated a favorable correlation between car use and income. The price effect is another element that affects the decision to travel (Holmgren, 2007).

Service Trasport Similar to physical products, quantity demanded is inversely correlated with price. In the transport industry, fewer individuals choose to travel at higher fares and associated costs (such as gasoline). We may further understand the price effect by looking at the elasticity of demand with regard to fuel prices, which indicates that rising fuel prices lead to a decrease in car travel (Goodwin, 1992). Paulley et al. (2006) said that the fare elasticity of demand for transit is contingent upon the mode of transport and time frame, with buses having a fare elasticity of –0.4 in the short term and –1 in the long term.

Similar to this, spatial considerations influence trip making. In order to explain their modal choice, Kain and Fauth (1977) have taken into account urban development as assessed by the population density in each zone, the socioeconomic features of the households, and the locations of their occupations and houses. According to Small and Verhoef's (2007) theory, building density and activity type affect people's judgements on where to go. According to Button et al. (1993), there is a positive correlation between the degree of urbanization and car ownership rates. However, this association is only partially true. Past this point, the infrastructure becomes so saturated that the number of trips, energy consumption, automobile ownership rates, and car use all decrease with increasing urban density (Camagni et al., 2002).

2.3 Empirical review

Home-based work trips in the Seoul metropolitan region were used in a comparative examination of trip generation models by Justin et al. (2014) to ascertain the number of trips drawn to a zone. Comparing the effectiveness of multiple classification, ordered logit, regression, Tobit, Poisson, and category analyses with home-base work trips was the focus of this study. According to the results, the category-type approach performed better overall.

Verma and Ukil's (2022) study was to calculate the trip generation rates for various land uses in an Indian city. The goal of the study was to ascertain the trip rates for trips generated and attracted to various land use types during peak morning and evening hours. The findings show that when compared to non-SEZ areas, Special Economic Zones (SEZ) have a greater trip attraction rate. The survey also shows that on weekdays, the travel rate for retail is higher in the evening than it is in the morning.

In South Africa, trip generation rates for retirement communities and villages were investigated by Roux and Bruwer (2014). The aim of the research was to ascertain if retirement facilities require their own set of trip generation indicators, or if the trip generation rates that are now available for residential use can be employed. Retirement institutions must have their own set of trip generation indicators because the study's findings showed no association between the trip generation for these facilities and the overall residential trip generation used in South Africa.

Diaz-Olvera et al. (2004) investigated the travel habits of the impoverished in West and South African cities through a meta-analysis. The goal of the study was to compare and contrast the travel habits of low-income populations in francophone and anglophone African nations, and to talk about how these findings would affect the creation of strategies and policies aimed at enhancing the travel experiences of the underprivileged. According to the study's findings, the majority of African city dwellers walk a lot, and this has an impact on the social and economic growth of these cities. Also, because there are extremely few options for modes of transportation, low-income individuals are the most disadvantaged.

In another study, Almasri and Al-Jazzar (2013) conducted an additional study in which they applied GIS and TransCAD techniques to estimate traffic demand and its application in Gaza City. The study's findings indicate that the city's center, particularly the intersection of Aljala and Omer Almokhtar, is currently the most congested region. The report also forecasted increased traffic congestion on the road network in 2015. Tillema et al. (2021) compared neural networks with conventional techniques to investigate trip production and distribution. The authors came to the conclusion that trip creation in a neutral network does not outperform regression model, and that gravity model outperforms neutral technique when enough information is provided.

Using the case of Jordan, Al-Masaeid and Fayyad (2018) predict trip generation rates for residential areas. The study's goal was to create trip generation utilizing regression analysis and a cross-classification strategy for Irbid City's residential districts. The results of the survey indicated that approximately one-third of all home-based excursions are related to business. Additionally, it was discovered that the quantity of travels made on holidays accounts for almost one-third of the total number of journeys made during the workday. The study found that while both approaches performed well, the cross-classification approach produced numbers that were more accurate.

Principal component analysis was used by Pitombo et al. (2014) to study behavior connected to work travel in Brazil. The findings suggest a connection between socioeconomic class and vehicle ownership, urban environment characteristics, and travel preferences. In Minna Metropolis, Ojekunle and Owoeye (2018) investigated the geographical patterns of household travel. The information from 1303 respondents was gathered using an Open Data Kit (ODK), which the authors utilized to partition the city of Minna into four (4) clusters. According to their research, there are notable differences in trip generation and attraction between the city's various residential densities. The study also shows that there are notable differences in the journey distances travelled by various city residential areas.

Using a gravity model, Yousif et al. (2020) investigated trip distribution in the city of Al-Diwaniyah. According to the study, a home base work trip's trip length frequency distribution (TLFD) ranges between twenty and twenty-five and fifty minutes. Additionally, the study divides the estimated duration of home-based educational visits into two categories: 11–15 minutes for short journeys (to schools within the same zone) and 16–20 minutes for longer trips. In a separate study, Hakimelahi and Krishna Rao (2018) utilize fuel data to investigate transportation planning and trip distribution by trip duration frequency distribution. Their findings indicate that the old functional forms trends and patterns that were previously responsible for the travel-distance factor size from travel distance in current research or the time factor in significant studies are no longer followed by factors based on refuel data.

Li et al.'s (2018) paper uses Poisson distribution theory to estimate the intercity trip distribution in Shandong province, China, through a multisource data-driven modelling approach. The study's findings indicate that the gross domestic product is a key determinant of how trips are distributed throughout Shandong's cities. The investigation also demonstrated that the created model replicates the observed intercity origin-destination matrix with good accuracy. Theoretical validation of the trip length distribution for home-based work visits in Ukrainian urban transit systems was investigated by Horbachov and Svichynskyi (2018). According to their analysis, there is a clear relationship between the gamma distribution and the trip duration distribution in various cities when it comes to mass transit.

Another research project by Mounir Mahmoud MoghazyAbdel-Aal (2014) involved calibrating a doubly-constrained gravity model for the trip distribution of the city of Alexandria based on a household travel survey conducted in 2002. The model was stratified by the trip purposes. The outcome indicates that the various trip distribution patterns for each purpose are illustrated by the suggested model. Additionally, it demonstrates a notable movement in Alexandria towards non-obligatory travel objectives.

Public transport demand analysis was examined by McSharrya and Paul (2021) using the Lagos metropolitan region as a case study. Their study's objectives were to look at Lagos's urban transport demand and examine the dynamics of passengers over time and space. Demand patterns are analyzed by day, week, and bus station using individual commuter trip data from tickets purchased from the Lagos State Bus Rapid Transit (BRT). Station segmentation is used to group stations based on demand factors in order to customize individual bus itineraries. The intraday demand for public transit in Lagos BRT is examined, and predictions are made. According to their research, using fixed and dynamic bus scheduling can minimize average waiting time by up to 80%.
Basorun and Rotowa (2012) investigated regional assessment of public transport operations in Nigerian cities using the case of Lagos Island. The study employs simple descriptive data such as frequency counts and percentages, as well as a Pearson's Correlation test-based pair-wise correlation between the amount of service provided by the private sector in public transport systems and commuter patronage. The result suggests that the role of the private sector in public transport services is substantially associated with patronage (0.95).

The goal of the Usanga et al. (2020) study was to calculate the trip generation rates associated with Uyo's residential land use. The most important factors, household size, household income, and car ownership, were used in the study to create cross-classification trip rates. According to the survey, religious travel accounted for 24.7% of recorded trip rates, while work travel accounted for the highest 29.6%. Likewise, private automobile journeys accounted for 42.8% of all trips, making them the most popular means of transportation. The study found that the biggest socioeconomic factor influencing trip generation in Uyo residential land use is household size.

The study conducted by Dike et al. (2018) examined the estimation of inter-city travel demand for public road transport in Nigeria. From Owerri Urban, the authors create a 19-directional O-D city-pair urban transport demand model. They made use of disclosed preference data from sixteen transport providers in Owerri, Imo State, that operated between 2014 and 2016. According to the study's findings, there is generally little elasticity of fare,

meaning that raising prices will almost always result in higher profits. They also offer an empirical model that was developed to evaluate the feasibility of intercity passenger transit in Nigeria.

From the review literature, there is still a gap in studies in Nigeria particularly modelling the numbers of trips made per day using socioeconomic attributes of the trip makers. Therefore, this study is here to fill the gap by using multiple linear regression to model the numbers of trips made by the residents of Abuja.

3. RESEARCH METHODOLOGY

This study utilized correlational research design. According to Bhandari (2023), correlational research design examines correlations between variables without requiring the researcher to alter or modify any of them. This study utilized questionnaire survey to gathered households' perception on the socioeconomic factors influencing trip making in Abuja. The study divided Abuja into 6 zone based on Abuja area councils (i.e., Abaji, Abuja Municipal, Bwari, Gwagwalada, Kuje, & Kwali). While 1500 questionnaire were purposefully administered across the zones using simple random techniques. The house-hold data collected were analyzed using percentages, and frequencies while the numbers of trips made in a day was modelled using multiple linear regression. The multiple regression model in equation one estimates the numbers of trips generated in FCT, Abuja. It established the functional relationship between numbers of trip made per day by the residents of Abuja and their socioeconomic features of the trip makers.

Therefore, the multiple linear regression model equation is expressed as:

$$Y = \beta o + \sum_{i=1}^{n} \beta_i X_i + e \quad \text{..... EQN (1)}$$

The above equation can be further expressed as follows;

$$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + e \text{..... EQN (2)}$$

Where Y is the dependent variable (i.e., number of trips per day); βo is the constant term; β = slopes coefficients; x_1= age; x_2 = sex; x_3 = Marital status; x_4 = monthly income; x_5 = education level attained; x_6 =occupation; x_7 = numbers of cars owned and = the error term. The trip generation model can be further representing as follows;

$$Y = \beta o + \beta_1(Age) + \beta_2(Sex) + \beta_3(Marital\ status) + \beta_4(Monthly\ income + \beta_5(Education) + \beta_6(Occupation) + \beta_7(Numbers\ of\ cars\ owned) + e$$

However, a considerable change in the independent variable (i.e., socioeconomic factors) by 1% will result to a change in the dependent variable (i.e., numbers of trip made per day) by 1%. Meaning a unit change in the socioeconomic features will result to a unit change in the numbers of trip made by the residents of Abuja.

4. DATA ANALYSIS AND PRESENTATION

4.1 Analysis of socioeconomic features of the respondents

Table 1 shows the results of the investigation into the socioeconomic factors of Abuja people. According to the data, 55.86% of the respondents were male, while just 44.14% were female.

This result indicates that there are more male making trips in Abuja, which may be due to males having more access to vehicles and engaging in various activities that necessitate more trips. According to the marital status reported in Table 1, 53.42% of them were still single, 42.79% were married, and just 3.79% were divorced. This result reveals that more trips may be done by unmarried persons. This is because unmarried people have more freedoms and can participate in more social activities than married pe/ople, resulting in more trips.

Table 1 shows that the majority (56.94%) of respondents were between the ages of 29 and 39 years, 22.07% were between the ages of 18 and 28 years, 17.12% were between the ages of 40 and 49 years, and 3.87% were beyond 50 years. The study results allow the authors to conclude that the bulk of Abuja trip makers are between the ages of 29 and 39. The more youthful a person, the more they may likely want to travel anytime and everywhere with no set itinerary. this case is differ from the more older people who will require a reason to leave their homes. Similarly, Table 1 shows that 38.11% of the trip makers in Abuja had a degree, 28.38% had an Ordinary National Diploma or National Certificate in Education, and just 15.05% had a Senior School Certificate or West Africa Examination Council. In addition to the findings, 12.16% of the trip makers had a Primary School Certificate and 6.3% had a postgraduate school certificate.

In addition, Table 1 shows a study of the trip makers' occupations. According to the findings, 27.12% of those who took the trip were self-employed, 26.04% were students, and 21.17% were civil servants. Similarly, the results show that 23.06% of those who took the trip were company owners, whereas only 2.61% were farmers. Also, the analysis of the monthly income of the respondents are shown in Table 1. From the result, 19.19% earned around ₦ 101,000 and ₦ 150,000 per month, 34.05% earned between ₦ 151,000 and ₦ 200,000, and 26.94% of them earned over ₦ 200,000 in a month. Similarly, 11.08% of the earned between ₦ 51,000 and ₦ 100,000 and only 8.74% earned less than ₦50,000 per month.

Moreso, Table 1 shows an investigation of the number of cars owned by the residents of Abuja. According to the findings, 34.50% did not possess an automobile, 28.19% had one, and 24.50 owned two. In addition, 7.93% owned three cars, while only 4.88% claimed to possess more than three vehicles. When a person owns a car, he or she is more likely to travel than when they do not. Moreover, The analysis of the family size of the residents of Abuja reveals that 39.37% indicate that their family size is made of 6-10 peoples, 29.18% said their family size is made of 5 persons, 19.28% reveal that their family size is made of 11-15 persons and only 12.17% agreed that their family size is made of 16-20 persons. The smaller the family the less the numbers of trips made by the household and vis-versa.

Furthermore, the research in Table 1 revealed that 33.9% of respondents make 6 to 7 trips per day, 23.3% make 4-5 trips per day, and just 19.9% make 8-9 trips per day. Similarly, the data finds that 13.1% of respondents make more than 10 trips each day, while only 9.8% make 2-3 trips per day. Finally, an examination of the modes of transportation used by Abuja inhabitants for their trips reveals that a bigger proportion of people use private automobiles for their trips, while just 43.5% use public transportation.

Table 1: socioeconomic and demographic characteristics of the respondents

S/n	Socioeconomic features of the respondents	Criterion	Frequency	Percentages
1.	Sex of the respondents	Male	620	55.86

		Female	490	44.14
		Total	1110	100.0
2.	Marital status	Single	593	53.42
		Married	475	42.79
		Divorced	42	3.79
		Total	1110	100.0
3.	Monthly income	below ₦50,000	97	8.74
		₦ 51,000-100,000	123	11.08
		₦ 101,000-150,000	213	19.19
		₦ 151,000-200,000	378	34.05
		Above, ₦200,000	299	26.94
		Total	1110	100.0
4.	Age of the respondents	18-28 years	245	22.07
		29-39 years	632	56.94
		40-49 years	190	17.12
		50 and above	43	3.87
		Total	1110	100.0
5.	Educational level attained	Primary School Cert	135	12.16
		SSCE/WAEC	167	15.05
		OND/NCE	315	28.38
		Degree	423	38.11
		Postgraduate	70	6.3
		Total	1110	100.0
6.	Occupation of the respondents	Bussiness	256	23.06
		Farming	29	2.61
		School	289	26.04
		Self employed	301	27.12
		Civil servant	235	21.17
		Total	1110	100.0
7.	Family size	0-5 persons	324	29.18
		6-10 persons	437	39.37
		11-15 persons	214	19.28
		16-20 persons	135	12.17
		Total	1110	100.0

Source: Author's survey (2023)

Table 1: Continuation

S/n	Socioeconomic features of the respondents	Criterion	Frequency	Percentages
8.	Numbers of cars owned	None	383	34.50
		One	313	28.19

		Two	272	24.50
		Three	88	7.93
		More than three	21	4.88
		Total	1110	100.0
9.	Numbers of Trips per day	2 – 3 trips	109	9.8
		4 – 5 trips	259	23.3
		6 - 7 trips	377	33.9
		8 - 9 trips	221	19.9
		Above 10 trips	144	13.1
		Total	1110	100.0
10.	Travel mode	Public transport	483	43.5
		Private	621	56.5
		Total	1110	100.0

Sources: Authors' survey (2023)

4.2 Modelling of the numbers of trip generated in Abuja

The modelling of the personal trips generated in Abuja was done using the socioeconomic characteristics of the trip makers across different zones in Abuja targetting the major road intersections. The summary of the models is shown in Table 2. Table 2 reveals the R, R^2, Adjusted R^2 and Standard error of the estimates, which are used to predict how well the regression model fits the data. From the analysis, it was observed that R value (61.6%) indicate a good level of predictions. The coeficient of determination (i.e., R^2= 57.3%) describe the proportion of variability of the dependent variable which are explained by the independent variables. This outcome indicate that the socioeconomic characteristics of the people of Abuja is enough to predict their trips.

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.616[a]	.573	.568	.85303

a. Predictors: (Constant), Age, Sex, Marital status, Monthly income, Education, Occupation, and Numbers of cars owned

The analysis of the Anova table in Table 3 reveals that the F-value (32.940) is greater than the confident level of 0.05 which indicate that the independents variables are statistically significantly predict the dependent variables. That is there is a good model fit for the data.

Table 3: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	167.781	7	23.969	32.940	.000[b]
	Residual	801.877	1102	.728		
	Total	969.659	1109			

a. Dependent Variable: Numbers of Trips per day

b. Predictors: (Constant), Age, Sex, Marital status, Monthly income, Education, Occupation, and Numbers of cars owned

The model formulation for the numbers of trip per day for the study is stated as follows;

$$Y = 3.199 - 0.209(Age) + 0.314(Sex) + 0.041(Marital\ status) - 0.284(Monthly\ income - 0.121(Education) - 0.048(Occupation) - 0.020(Numbers\ of\ cars\ owned) + 0.176$$

From the Table 4 reveals that the unstandardized constant is βo is 3.199, the coefficient of age (i.e., β_1) is -0.208 indicating that 1% decrease in the age will results to 0.208 decrease in the number of trips made per day. In addition, the unstandardized coefficient of the monthly income ($\beta_4 = -0.284$), education (β_5 =-0.121), Occupation (β_6 =-0.048), and Numbers of cars owned (β_7 =-0.020) point that a 1% decrease will results to -0.284, -0.121, -0.048 and -0.020 decrease in the number of trips made by the residents of FCT, Abuja. Similarly, the unstandardized coefficient of the sex (i.e., β_2) and marital status (i.e., β_3) are 0.314 and 0.0241 respectively, meaning that a 1% increase in sex and marital status will result to 0.314 and 0.0241 increase in the number of trips per day. In conclusion, the study outcome enables the author to conclude that the socioeconomic features of the resident of FCT, Abuja influence the numbers of trip per day and is are statistically significant at 0.05. This study is inline with the work of Ojekunle et al. (2018) whom utilize multiple regression model to model the numbers of trips made per day among physically challenges people in Minna using their socioeconomic attributes.

Table 4: Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.199	.176		18.162	.000
Age	-.209	.027	-.235	-7.875	.000
Sex	.314	.061	-.150	-5.158	.000
Marital status	.041	.020	-.068	-2.022	.043
Monthly Income	-.284	.024	-.358	-12.029	.000
Education	-.121	.024	.152	5.019	.000
Occupation	-.048	.029	.048	1.671	.045
Numbers of cars owned	-.020	.023	.029	.864	.038

a. Dependent Variable: Numbers of trips per day.

5. CONCLUSION AND RECOMMENDATIONS

This study modelled trip generation in Federal Capital Territory, Abuja (FCTA). The findings enable the authors to concluded that 33.9% of the residents of Abuja make 6-7 trips per day. In addition to the findings, the socioeconomic characteristics stated were a good predictor of the number of trips made per day by Abuja residents. The study concluded that since there is higher proportion of private car on FCT, Abuja's Road compares to the public transport this may results to serious traffic challenge in the future. The study further concluded by recommending that;

1. The transport needs of diverse groups of people should be taken into condition when planning and designing the future transportation system in Abuja. This will reduce the mobility challenges in Abuja.
2. The Federal Government of Nigeria (FGN) through ministry of transport should revitalize the abandoned light rail project in Abuja and ensure that the metro lines are well connected this will reduce the number of private cars use on the road in Abuja.
3. The aim of trip generation is to identify the functional relationship between the socioeconomic factors and trip making. In future, if the socioeconomic status of the resident improved more trips will be made giving rise to traffic issues like more congestion therefore a sustainable transportation system should be incorporated in the planning of future transport.

REFERENCES

Al-Masaeid, H. R., & Fayyad S. (2018). Estimation of trip generation rates for residential areas in Jordan. *Jordan Journal of Civil Engineering*, 12(1),162-172.

Almasri, E. & Al-Jazzar, M. (2013). TransCAD and GIS Technique for estimating traffic demand and its application in Gaza city. *Open Journal of Civil Engineering*, 3(1), 242-250. Doi: http://dx.doi.org/10.4236/ojce.2013.34029

Basorun, J. O & Rotowa, O. O. (2012). Regional assessment of public transport operations in Nigerian cities: The Case of Lagos Island. *International Journal of Developing Societies*, 1(2), 82-87.

Bhandari, P. (2023). Correlational research: When & how to use. Retrieved from https://www.scribbr.com/methodology/correlational-research/.

Button, K., Ngoe, N., & Hine, J. (1993). Modelling vehicle ownership and use in low -income countries. *Journal of Transport Economics and Policy*, 27(1),51-67.

Bresson, G., Dargay, J., Madre, J.-L., Pirotte, A., 2004. Economic and structural determinants of the demand for public transport: an analysis on a panel of French urban areas using shrinkage estimators. *Transportation Research Part A*, 38(4), 269–285

Camagni R, Gibelli, M.C, & Rigamonti, P. (2002). Urban mobility and urban form: The social and environmental costs of different patterns of urban expansion. *Ecological Economics*, 40(2),199-216.

Chatterjee, A. & Venigalla, M.M. (2004). Travel demand forecasting for urban transportation planning. Handbook of Transportation Engineering. ISBN: 978-0071391221

Dargay, J.M., & Hanly, M. (2002). The demand for local bus services in England. *Journal of Transport Economics and Policy*, 36(1), 73-91

Diaz-Olvera, L., Behrens, R., Plat, D., & Pochet, P. (2004). Meta-analysis of travel of the poor in West and Southern African cities. 10th World Conference on Transport Research, Istanbul.

Dike, D. N., Ibe, C. C., Ejem, E. A., Erumaka, O., & Chukwu, O. E. (2018). Estimation of inter-city travel demand for public road transport in Nigeria. *Journal of Sustainable Development of Transport and Logistics*, 3(3), 88-98.

Fadare S.O. & Hay, A.M. (1990). Housing densities, Life style and travel behavior in Third World City: The example of Ibadan. *Nigerian Journal of Economic and Social Studies*, 32(2), 177-191.

Goodwin, P., 1992. A review of new demand elasticities with special reference to short and long run effects of price changes. *Journal of Transport Economics and Policy*, 26 (2), 155–169.

Hanson, S. & Hanson, P. (1981). The travel activity pattern of urban residents: Dimensions and relationships to socio-demographic characteristics. *Journal of Economic Geography*, 51(4), 332-347.

Hakimelahi, A., Krishna Rao, K.V., Dhingra, S.L., Peiravian, F., & Borzooei, S. (2018). Transportation Planning and Trip Distribution by Trip Length Frequency Distribution with Fuel Data. 17th International Conference on Traffic and Transportation Engineering At: Tehran, Iran

Holmgren, J. (2007). Meta-analysis of public transport demand. *Transportation Research Part A*, 41(10), 1021–1035.

Horbachov, P. & Svichynskyi, S. (2018). Theoretical substantiation of trip length distribution for homebased work trips in urban transit systems. *Journal of Transport and Land use*, 11(1), 593–632. http://doi.org/10.3886/E100393V1

Justin S. C., Dongjae J., Jaekyung K. & Taeseok K. (2014). Comparative analysis of trip generation models: Results using home-based work trips in the Seoul metropolitan area. *Journals of Transportation Letters*, 6(2), 78-88. DOI: 10.1179/1942787514Y.0000000011

Kain, J.F., & Fauth, G.R. (1977). The effects of urban structure on automobile ownership and journey to work mode choices. *Transportation Research Record*, 658(658), 9-17

Kansky, K. J. (1967). Travel patterns of urban residents. *Journal of Transport Science,* 1(4), 261-285.

Li, Y., Wang, H., Zhao, J., & Du, B. (2018). *Multisource Data-Driven Modeling Method for Estimation of Intercity Trip Distribution. Mathematical Problems in Engineering, 2018(1), 1–11*. doi:10.1155/2018/8948676

McSharry, P. E. & Paul, O. (2021). Public Transportation Demand Analysis: A Case Study of Metropolitan Lagos. Available at SSRN: https://ssrn.com/abstract=3852747 or http://dx.doi.org/10.2139/ssrn.3852747

Mounir Mahmoud MoghazyAbdel-Aal (2014). Calibrate a trip distribution gravity model stratified by the trip purposes for the city of Alexandria. *Alexandria Engineering Journal*, 53(3), 677-689

Ojekunle, J. A. & Owoeye A. S. (2018). Spatial pattern of household travel in minna metropolis, Nigeria. *International Journal of Research - Granthaalayah,* 6(5), 276-288. https://doi.org/10.5281/zenodo.1283377.

Ojekunle, J.A., Owoeye, A.S., & Oluwole, M.S. (2018). Modelling the effect of socio-economic characteristics on trip generation by the physically challenged people (PCP) in Minna, Nigeria. *International Research Publication,* 16(1), 1-16.

Ojekunle J. A., Owoeye E., & Owoeye, A. S. (2021). Modelling inter-urban trip flow pattern of selected cities in Niger State, Nigeria. *Journal of Geography and Regional Planning*,14(1), 1-9.

Pitombo, C.S. & Gomes, M.M. (2014) Study of Work-Travel Related Behavior Using Principal Component Analysis. *Open Journal of Statistics*, 4(11), 889-901.

Paulley, N., Balcombe, R., Mackett, R., Titheridge, H., Preston, J., Wardman, M., Shires, J., & White, P. (2006). The demand for public transport: The effects of fares, quality of service, income and car ownership. *Journal of Transport Policy*, 13(4), 295-306.

Yousif, R.A., Sady A. T., & Abbas F. J. (2020). Trip Distribution Gravity Model of Al-Diwaniyah City: A Case Study, Proceedings of AICCE'19, Lecture Notes in Civil Engineering 53, https://doi.org/10.1007/978-3-030-32816-0_7

Roux, J. & Bruwer, M. (2017). Trip generation rates for retirement homes and villages in South Africa. 36th Southern African Transport Conference, Pretoria, South Africa.

Small, K.A., Verhoef, E., 2007. In: The Economics of Urban Transportation. Routledge 276p

Solanke, M. O. (2014). Socio-economic determinants of intra-urban trips generation in Ogun State, Nigeria. *Current Research Journal of Social Sciences*, 6(1), 15-20.

Tillema, F., Van Zuilekom, M., Van Maarseveen, M.F.A.M, & Huisken, G. (2021). Trip generation and trip distribution: Comparison of neural networks and traditional methods, at: https://www.researchgate.net/publication/261913267

Usanga, I. N., Etim, R. K., & Umoren, V. (2020). Estimation of trip generation rates for residential land use in Uyo, Nigeria. *Nigerian Journal of Technology (NIJOTECH),* 39 (4), 972 – 980.

Verma, A., Ukil, S. (2022). Estimation of Trip Generation Rates for Different Landuses for an Indian City. In: Singh, D., Vanajakshi, L., Verma, A., Das, A. (eds) Proceedings of the fifth International Conference of Transportation Research Group of India. lecture notes in Civil Engineering, vol 218, 155-164. Springer, Singapore. https://doi.org/10.1007/978-981-16-9921-4_10