

DETERMINANTS OF PUBLIC TRANSPORT ACCESSIBILITY IN THE FEDERAL CAPITAL TERRITORY (FCT), ABUJA, NIGERIA

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Abstract

The study aimed at examining the determinants of public transport accessibility in the Federal Capital Territory (FCT) in view of the prevalence of private cars used for commuting at a point in its physical development stage. Ten access levels indicators: safety level of the vehicle, fare charged by the operators, real time availability of the vehicle, vehicle comfort level, public transport speed on transit, delays at parks, bus stops and on transit highway, adherence to estimated arrival time, adherence to estimated departure time, reliability of bus schedules on routes and level of overloading practices. Data on these factors were collected from administration of questionnaires to 859 public transport commuters in 17 major public transport terminals across the FCT. Using the Factor Analysis, the result shows that three factors namely, adherence to estimated departure time, fare charged by the operators and reliability of bus schedules on routes together explained about 54% of the cumulative total variance, leaving the remaining 46% to seven other factors namely; safety, bus availability, comfort, speed, delays in parks and bus stops, adherence to estimated arrival time and level of overloading practices by operators and residuals. The Spearman's' rank correlation matrix for all the variables shows that they were all positively correlated at varying degrees. The standardized co-efficient of the regression model revealed that, bus service reliability is the major determinant of public transport access level. In order to raise the current access level of commuters' access to public transport in FCT, operators must improve on the level of service in line with the three critical factors which the study has identified.

Keyword

Introduction

Public transport accessibility is a cornerstone of sustainable urban development, facilitating mobility, reducing traffic congestion, and promoting equitable access to opportunities such as employment, education, and healthcare. In the Federal Capital Territory (FCT) of Abuja, Nigeria, the role of public transportation is particularly crucial as the city experiences rapid urbanization and population growth. As the administrative and political hub of Nigeria, Abuja's development trajectory underscores the importance of efficient and accessible transport systems to enhance the quality of life for residents and support economic productivity (Pillah, 2022).

However, the accessibility of public transportation in Abuja faces several challenges, including inadequate infrastructure, limited coverage of transit networks, and operational inefficiencies. These challenges are compounded by socio-economic disparities, urban sprawl, and inconsistent urban planning policies. Understanding the determinants of public transport accessibility in this

unique urban context is essential for addressing these issues and fostering an inclusive and functional transport system (Pillah, 2022).

This study explores the factors influencing public transport accessibility in Abuja, focusing on physical, economic, social, and institutional dimensions. It examines key determinants such as the availability of transport facilities, affordability, spatial distribution, frequency, and reliability of services. By analyzing these factors, the research aims to provide insights into the barriers to accessibility and propose recommendations for enhancing public transport systems in the FCT.

Public transport service access level is defined as the overall measured or perceived performance of the public transport system from the commuters' point of view (Hay, 1977). It is used to denote the ease of getting to and quality of service derived from the operational characteristics of transportation facilities (Mfinanga and Ocheng, 2006 as cited in Papacostas and Prevedouros 2008). Public transport service accessibility indicators reflect two important aspects of transport service: the degree to which transit service is available to a given location and the comfort and convenience of the service provided to commuters (Qualtro, 2004 as cited in Papacostas and Prevedouros 2008). For any public transport service to be accessible within the framework of a viable public transport planning system, the indices such as: safety, reliability, comfort, availability, public transport fare, distance to access points and convenience must be relatively addressed. These indices differ from the traditional highway service quality measures which are more vehicle-oriented than person-oriented and these were used in this study.

Empirical Studies on Commuters Access to Public Transport Service in Nigeria

Cities across the world are in a state of rapid transition, the inability and sustainability of these cities are intrinsically interwoven with not only the degree of efficiency and effectiveness with which existing transport capacity is managed but also how well intermediate and future transportation plans and programmes are articulated, laid out and implemented in order to meet the needs of the people (Adesanya 2011). The spatial structure of cities especially in developing countries is highly varied and complex, some areas are adequately provided with services and facilities while in other area is grossly inadequate. The variation in the spatial structure results in different socio-economic characteristics of urban dwellers with strong challenges of getting equal and efficient urban service for the disadvantaged. The quality of life in most cities is poor and closely related to accessibility to alternative employment, education and medical facilities, essential public services and nature of recreational open spaces (Vasconcellos, 2011). Generally, car ownership in Nigeria is low in the cities; there is an average of 4 cars per 100 populations which translates to about 0.04 car owned per person (Adesanya 2011). With such relatively low level of car ownership the cities experience so much congestion with public transport. However the solution is different in some countries. The levels of car ownership are 0.831 in Brazil, 0.8 in Argentina, 0.825 in South Africa and 0.683 in India. If vehicle growth will be twice the growth of income, there will be a greater necessity for protective measures for traffic management in Nigerian cities (Ogwude, 2011)

A comparison of government and private operation of public transport operations in Nigeria shows that the state and local government public transport are more organized while private sector operators are largely unorganized. Private sector operators rely mainly on revenue and financial support from informal sector such as friends, relative. Government – owned public transport have better trained staff and maintenance facilities than most of the private sector operators; their service are often provided on fixed routes and are relatively cheaper than those

provided by private sector operators. Government owned public transport operator also have service schedules, but in practice are rarely followed because of the inadequacies of vehicle, declining fleet utilization rates, growing competition with private and para-transit operators, poor traffic management, congestion especially during peak travel periods and other problems associated with the operating environment (Umar 2003). Estimate of transport demands in metropolitan Lagos in the 1990 range from 7 to 10 million passenger trips daily out of which over 95% are undertaken by road, primarily by car bus and taxi (Mabogunje, 2008).

In a study of public transport in Nigeria, the World Bank (1990) and Adetunji (2000) reported that taxis and private vehicles carrying fare paying passengers represent 53% of the public transport trips, while 30% made use of motorcycles. In many cities in developing countries, motorcycles account for about 90% of feeders' trips to taxis and mini bus terminals. Similarly, in a study of the supply of transport infrastructures in Lagos metropolis, Ogunsanya et al (2004) found that most urban road networks are not only poorly developed with feeder streets, they are grossly inadequate and their inadequacies more often than not forced vehicles to concentrate on the primary roads with serious implications on commuters modal choice and mobility pattern especially along the same urban transport corridors. The World Bank (1997) and Adesanya et al (2002) affirmed that urban poor in Nigeria pay very high proportion of their income for transport services and spend long period of trekking time, travelling time and waiting for infrequent and unreliable bus service.

Commuters and the public transport operators in Nigeria face a wide range of problems. Ndikom (2008), identifies poor state of the road and poor road design as one of such problems, he pointed out that both the rural and regional roads in Nigeria today are in high degree of deterioration and disrepair the result of which is high maintenance cost to vehicle operating on the roads, this coupled with poor maintenance culture, have led to a regular break down of most public transport. Oyesiku (2002), believed that road traffic accidents which are in most cases caused by human error arising from recklessness, excessive speeding, lack of experience and education of motorists on the workings of the transport system constitute a major problem to commuters and public transport operators in Nigeria. He further argued that 95% of public transport vehicles in Nigeria are second hand vehicles, some of which are rickety with smoking engines emitting poisonous gases like carbon-monoxide, nitrogen oxide, volatile compounds, lead etc. into the environment and which pose health risks to motorists and commuters and even the ecosystem.

Methodology

The data collected for the study were: Factors influencing commuters access level to public transport, Frequency of commuter's trip using public transport, Level of public transport usage by commuters who own car, Distance from commuters residences/offices/activities centers (Point of Interest (Pol's) to public transport bus stops, terminals, and average walking time to bus stops/terminals (Service Access Points (SAP's) from commuters' trip origin and destination. Others are duration of time commuters wait at the bus stop, transit highway and terminals before catching the public transport and variation in the duration, of the commuters waiting time at the different traffic conditions, monetary costs of transport along a route under different traffic condition (peak and off-peak), commuters' responses to different public transport fare regime among others. These data were sourced from commuters in the FCT.

Five out of the six FCT Area Councils accounting for about 96% of the territory's population were selected (Figure 1). The Area Councils were: Abuja Municipal Area Council (AMAC), Bwari,

Gwagwalada, Kwali and Kuje. In addition to their population strength, these Area Councils were also the closest to the City Centre as well as where majority of the intra and intercity commuters within the FCT reside. In each of the five area councils all the major settlements and terminals that serve as commuters' traffic concentration points for smaller settlements around them were considered for questionnaire administration. Considering, the target population which are commuters, it is believed that the best form of contact with them will be at their respective public transport terminals and bus stops. To achieve this, the study encompassed fourteen public terminals managed by private entities, along with three operated by public organizations. Derived from the pilot survey a total of 16,563 commuters were estimated under the privately owned public transport while 740 commuters were estimated under the government-owned public transport. Therefore, a total of 872 commuters representing 5% and 315 operators representing 30% of both the private and government operators were adopted for survey as the sample size. By selecting 5% of commuters (872 individuals) and 30% of operators (315 individuals), the sample aimed to achieve a balance between practicality and statistical accuracy. A larger sample percentage for operators (30%) may be chosen because they are fewer in number compared to commuters, and their responses are likely to have significant variability that needs better representation. The chosen sample sizes (5% for commuters and 30% for operators) aligned with the objectives of the survey, where understanding the perspectives of operators might require a more intensive study than that of commuters.

The adoption of 5% sample size for the commuters is justified on two grounds. Firstly, Borg and Gall (1971), suggested a minimum of 5% sample size as being adequate for population of 10,000 above and minimum of 10% for population of 5000 and below, especially where the population of studies is homogenous as it is the case with the FCT commuters. Secondly, the need to reduce the likelihood of double sampling of the commuters, bearing in mind that they can make multiple trips between and along a route within and between days of the months which the survey lasted. The survey was conducted over different time scales, morning, afternoon and evening period of the weekdays (Monday-Sunday) and over different traffic and weather conditions so as to capture the various dimensions that the different conditions may introduce into the public transport fare, time, and the general access level in the FCT.

Different sampling technique was used, the purposive sampling method was adopted to choose five (AMAC, Gwagwalada, Bwari, Kuje and Kwali) out of the existing six, while stratified sampling methods was used in the selection of the public transport vehicles, based on two classes of private and government operators. This is equally sequel to the preliminary understanding that there are different public transport operators and vehicle types (small, medium and large), which the commuters used and where they must all be captured in the survey. Systematic random technique was then used in the identification of the specific vehicle types and commuters to be surveyed. This is because there is no comprehensive sampling frame from which random numbers can be generated for the adoption of simple random scheme. Since vehicles and commuters are always mobile the point of interaction with them is the motor parks or bus stops. This is because the waiting time during the period of boarding and disembarking by commuters provide the allowance for the elicitation of the information required with the aid of field assistants that were well trained.



The access level determinants were based on ten widely reported public transport access level measurement items (Ali 2011; Basorun and Rotowa 2012) as contained in Table 1 below.

S/N	Variables	Label
1	Safety level of the vehicle	X ₁
2	Fare charged by the operators	X ₂
3	Real time availability of the vehicle	X ₃
4	Vehicle comfort level	X ₄
5	Public Transport Speed on transit	X ₅
6	Delays at parks, bus stops and on transit highway	X ₆
7	Adherence to estimated arrival time	X ₇
8	Adherence to estimated departure time	X ₈
9	Reliability of bus schedules on routes	X ₉
10	Level of overloading practices	X ₁₀

In order to evaluate the reliability of the instrument internal checks were conducted using the KMO and Bartlett's test of measure of sampling adequacy. KMO and Bestlett's test, according to Malhotra et' al (1996) (as cited in Landau and Everitt (2004) is the average of all possible split – half coefficient resulting from different ways of splitting the scale items. A value of 0.7 or below indicates unsatisfactory consistency and reliability, any value above 0.7 indicates satisfactory reliability and it is significant enough for the variables to be correlated. The result shows that the internal consistency of each measure is 0.889 which implies a good level of reliability (Table: 2).

Table 2: Reliability (KMO and Bartlett's) Test Statistics

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.889
Bartlett's Test of Sphericity	Approx. Chi-Square
	3366.277
	Df
	45
	Sig.
	.000

Source: Authors Computation 2022

The factor analysis was used to derive the set of variables in terms of smaller (critical) number of dimensions out of the total number of variables in the analysis. Essentially, it assesses whether the co variances between the set of variables can be explained in terms of smaller (critical) number of common factors sometimes called latent variable. The factor analysis model expresses each variable as a linear combination of underlying common factors $f_1, f_2, \dots, f_m$, with an accompanying error term to account for that part of the variable that is unique (not in common with the other variables).

$$\begin{array}{llllll}
 \text{For } y_1, y_2, \dots, y_p \text{ in any observation vector } \mathbf{y}, \text{ the model is as follows:} & & & & & \\
 y_1 = \lambda_{11} f_1 + \lambda_{12} f_2 + \dots + \lambda_{1m} f_m + \mu_1 + \epsilon_1 & .. & .. & .. & \dots & \mathbf{1} \\
 y_2 = \lambda_{21} f_1 + \lambda_{22} f_2 + \dots + \lambda_{2m} f_m + \mu_2 + \epsilon_2 & .. & .. & .. & .. & \mathbf{2} \\
 \dots y_p = \lambda_{p1} f_1 + \lambda_{p2} f_2 + \dots + \lambda_{pm} f_m + \mu_p + \epsilon_p & .. & .. & .. & .. & \mathbf{3}
 \end{array}$$

Ideally, m should be substantially smaller than p ; otherwise we have not achieved a Parsimonious description of the variables as a functions of a few underlying factors. The f 's is the random variables that engender the y 's. The coefficients λ_{ij} are called *loadings* and serve as weights, showing how each individually depends on the f 's. With appropriate assumptions, λ_{ij} indicates the importance of the j th factor f_j to the i th variable y_i and can be used in interpretation of f_j .

The variables $y_1, y_2, \dots, y_p$ is represented as linear combinations of a few random variables $f_1, f_2, \dots, f_m$ ($m < p$) called *factors*, with mean vector μ_i . The factors are underlying *constructs* or *latent* variables that "generate" the y 's. The $F_1, F_2, \dots, F_k$ are the common factor in each variable Y . while λ_1, λ_2 signify *loading* and serve as weights, which shows how y_i depends on the common factors F_i . it is therefore open to question. If the original variables $y_1, y_2, \dots, y_p$ are at least moderately correlated, the basic dimensionality of the system is less than p . The goal of factor analysis is to reduce the redundancy among the variables by using a smaller number of factors. Suppose the pattern of the high and low correlations in the correlation matrix is such that the variables in a particular subset have high correlations among themselves but low correlations with all the other variables. Then there may be a single underlying factor that gave rise to the variables in the subset. If the other variables can be similarly grouped into subsets with a like pattern of correlations, then a few factors can represent these groups of variables. In this case the pattern in the correlation matrix corresponds directly to the factors.

The Spearman's Correlation matrix was used to investigate the types and strength of association between the pairs of variables in table 4.3 and 4.4 that influence commuters' access to public transport services in FCT. The regression analysis was used to build a model that will explain the contribution of each of the accessibility factors to commuters' level of access to public transport service.

It was conceptualized that, there is as set of variables $X_1, X_2, X_3, \dots, X_n$, which can be used to explain public transport access level in the FCT. This may be mathematically stated as:

$$y = f(X_1, X_2, X_3, \dots, X_n) \quad - \quad - \quad - \quad - \quad - \quad 4$$

And can be operationalized using the multiple regression equation thus:

$$y = a + b_1X_1 + b_2X_2 + b_3X_3 + \dots + b_nX_n + e \quad - \quad - \quad - \quad - \quad 5$$

Where

y= the dependent variable i.e. access to public transport;

a= Constant;

$b_1, b_2, b_3, \dots, b_n$ = the coefficient of independent variables

$X_1, X_2, X_3, \dots, X_n$ are the independent variables, i.e. distance from bus stops/terminals to commuters' trip origin and destination, public transport fare, bus service comfort, safety, speed in transit, adherence to estimated arrival time etc.)

e = random error term (measuring the unexplained variable)

Findings and Discussions

The result of the analysis in table 3 indicates that the estimates of the communality before and after extraction of the variable when factorized reveals that not much of the variance of the variable items safety (40%), delays in terminals/bus stops and in-transit (47.2%) and overloading of buses (36%) can be attributed to the three common factors in the communalities table. However, variables like *adherence to estimated departure time*, *fare charged by the operators* and *reliability of bus schedules on routes*, showed a variance of 69%, 61.6% and 60.4% respectively. This high percentage variance suggests that the variable can be attributed to the three common factors.

Table 3: Communalities of the Factors influencing the use of Public Transport

S/N	Factors	Initial	Extraction
1	Safety level of the bus	•246	•403
2	Fare charged by the operators	•453	•616
3	Real time availability of the bus	•440	•563
4	Bus comfort level	•471	•558
5	Speed	•447	•524
6	Delays at parks, bus stops and on transit	•404	•472
7	Adherence to estimate arrival time	•515	•574
8	Adherence to estimate departure time	•669	•690
9	Reliability of bus schedules on routes	•484	•604
10	Level of overloading practices	•319	•360

Extracted Method Principal Axis Factoring

Source: Authors Computation (2022)

Furthermore, the variances of the extracted factors (Table 4) indicate that the percentage of the total variance accounted for by the factor analysis shows two factors with Eigen values greater than 1. The total variance explained indicates that factor one show an Eigen value of 4.410 accounting for 44.10% of the total variance explained by the analysis. Similarly factor two reveal an Eigen value of 1.676 thereby accounting for 16.76%. The factor loadings provide a clear indication of the underlining level of the quality of the services of public transport that influence its accessibility. The importance of the loadings is that it has reduced the most influencing factors to two major factors with Eigen value greater than 1:00. These are the dominant loadings for each

factor. These Eigen values are the proportion of the total variation in the data set that is explained or at best by a factor.

Table 4: Total Variance of the Factors Influencing Public Transport Access Level

Factors	Total	Initial Eigen values		Extracted sums of square loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4•410	44•101	44•101	3•967	39•669	39•669
2	1•676	16•755	60•856	1•208	12•078	51•746
3	•714	7•136	67•994	•188	1•881	53•628
4	•604	6•046	74•034			
5	•545	5•454	79•487			
6	•469	4•687	84•174			
7	•443	4•429	88•603			
8	•412	4•116	92•719			
9	•407	40•69	96•788			
10	•321	3•212	100•00			

Extracted method: Principal Axis Factoring

Source: Authors' computation (2022)

The cumulative percentage of the variance reveals that the two factors alone account for about 52% of the explanations i.e. commuters access to public transport service in the FCT. In other words, this is the proportion of the total variation that is explained by these two factors alone. Interestingly, the third factor accounts for very small proportion of the total variation of the explained variables (about 1.9%). In order to identify the manner in which this unexplained variation is distributed among the variables, a scree plot is employed to depict the loadings as shown in fig 1. This plot demonstrates the distribution of the variance among the factors graphically. The 'elbow' shape of the curve indicates that higher order factors contribute a decreasing amount of additional variance with a marked decrease in the second (fare charged by public transport operators) and third factor (real time availability of the bus). This implies that the choice factors under consideration can be summarized by the first two or three factors.

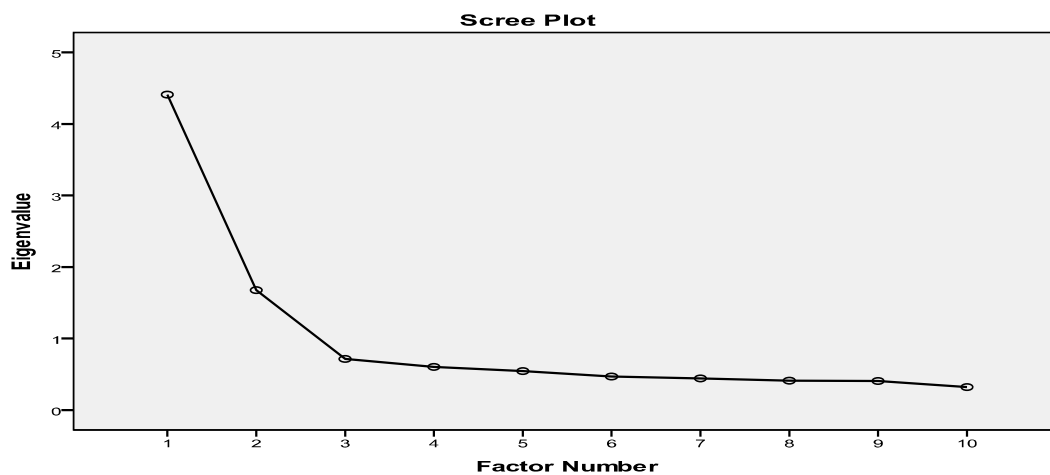


Fig 2: Distribution of the Factor Loading

Landau and Everih (2004), posit that attempt must be made to identify the variable that can be used to explain the underlining dimensions of the issues under consideration. However, the communality table alone cannot be relied upon to identify the factors that explained commuters' access to public transport service. Therefore, the factor rotation (varimax) is employed. The purpose is to maximize the variance of the square loadings to produce orthogonal factor with a view to interpreting the factor analysis. In practice, an arbitrary threshold value of 0.4 is equated as high loadings so that the factor loadings are recorded according to size. Furthermore, variables that load on factors 1 and 2 are considered important explanatory variables. Shows the rotated factor matrix, a careful examination of the table shows that all the variable load on atleast one factor. Variable 4 (comfort of the bus) load on factor 1, 2 and 3, while variable 5 (the bus speed) load on factor 1 and 3. However, Bus departure (number 8 in table 5) time appears to be the most important factors which influence commuters' access to public transport as it loads the highest value (•812) on factor 1. This is followed by the Ninth variable (Bus Service Reliability) which load •769 on factor 1 also, followed closely again by the seventh factor arrival time which load *700 on factor 1. Notwithstanding, factor 4 (Comfort) and 5 (Speed) are also very important in public transport (bus) access level determination as they load on more than 2 factors.

Table 5: Rotated Factor Matrix of the Public Transport Access Level Variables

S/N	Bus Service Level Element	Factor		
		1	2	3
1	Bus safety level		•631	
2	Fare charged		•710	
3	Availability of Bus		•688	
4	Bus comfort level	•429	•446	•418
5	Bus speed	•520		•409
6	Minimum delays	•509		
7	Adherence to estimated arrival time	•700		
8	Adherence to estimated departure time	•812		
9	Reliability of Bus	•769		
10	Bus overloading practice	•589		

Extracted Method: Principal Axis Factoring; Rotation Method: Varimax with Kaiser Normalization

Source: Authors Computation (2022)

All these important factors in Table 5 can be summed – up in one phrase: fast access and short transit time. This implies that commuters will be attracted and patronize public transport service if the time spent at bus stop, terminals or transit highway before getting bus to commence the trip as well as the time spent before reaching the destination is short. The implication of these can be explained against the background of the fact that, the FCT is predominantly an administrative territory with high concentration of economic and administrative activities at the city centre, while majority of the workers (commuters) reside at the periphery, having to commute daily over a working hours that is less flexible (as all work places, schools etc) open between 7am – 9am and close between 2pm – 5pm. It is expected that there will be serious rush to catch – up any available public transport vehicle at that hour where most often, the supply capacity of the public transport service is very limited. During this time, commuters will be less mindful of the fare charged and safety level of the bus, all in a bid to just reach their activity places.

It is therefore not surprising that strict adherence to departure time of bus (•812), reliability of bus service (•769), and the adherence to estimated arrival time at the point of destination (•700) stand out as the most important factors that FCT bus commuters consider to determine their patronage of public transport in FCT. This finding is similar to the outcome of the UK Department of Transport (2003) study as cited in Ali (2010), which highlights the importance of providing reliable and frequent services to meet the needs of UK public transport users. Moreso, Mistral and Nandagopal, (1993) identify in India that public transport system have been criticized for their low quality of service reflected in the growing number of standing passengers, lack of punctuality, irregularity and substandard amenities. Table 6 shows the correlation matrix between the ten factors. The factors are denoted as:

- X₁ – Bus safety level
- X₂ – Fare charged
- X₃ – Availability of Bus
- X₄ – Bus comfort level
- X₅ – Bus speed
- X₆ – Minimum delays
- X₇ – Adherence to estimated arrival time
- X₈ – Adherence to estimated departure
- X₉ – Reliability of Bus
- X₁₀ – Bus overloading practices

The results as presented (Table 6) show that the associations of the variables are all positively correlated.

Table 6: Correlation Matrix of the Public Transport Access Level Factors

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀
X ₁										
X ₂	•436									
X ₃	•420	•573								
X ₄	•251	•496	•492							
X ₅	•147	•395	•412	•534						
X ₆	•132	•371	•344	•488	•478					
X ₇	•065	•257	•291	•451	•509	•510				
X ₈	•061	•232	•301	•446	•498	•479	•650			
X ₉	•056	•179	•239	•407	•457	•423	•555	•635		
X ₁₀	•021	•115	•130	•319	•367	•377	•404	•484	•486	

Source: Authors' Computation (2022)

It is instructive to note that the strongest positive correlation between the pairs of variable under investigation is between availability of bus and public transport fare along the route, $r = 0.573$, $P < 0.001$. The implication of this result is that the more available the public transport bus in real time and commuters are seeing it to be meeting their daily commuting needs, the more they feel less bothered with the fare charged by the operator. Since the commuters are getting value for their money, they tend to be less sensitive to how high or low the fare charged for the use of such public transport.

Similarly, the correlation between bus speed and comfort level shows strong correlation ($r = 0.534$, $P < 0.001$). Indeed, this association is instructive, the greater the commuter using public transport consider speed in transit, the more likely, they will consider the trip comfortable and will be disposed to the use of public transport as against the use of private car. This again is expected; a rationale commuter will want to maximize him /her time while making his /her trip. Furthermore, the association between adherence to estimated arrival time and minimum delays ($r = 0.510$, $P < 0.001$), is also strong. With regard to the study area, this suggests that the trip transit time will be short and the estimated arrival time to the destination by the bus will be achieved, even if there are minimum delays due to incessant stops to pick and drop passengers at both official and unofficial bus stops or those due to security checks, road construction works, bad roads, traffic congestion vehicle breakdowns among others. It is fundamental to understand that this correlation provides essential integrity checks on the commuters' responses on the variables under investigation.

The results as presented, in this section indicate that the ten variables under investigation are important in explaining the access level of commuters to public transport service in FCT. This is because the ability of the public transport system to attract commuters depends to a large extent on the values which prospective commuters' attach to the public transport services. This is coupled with the perception of the public transport user with regards to certain information at his disposal that could translate to actual choice behaviour.

Result of Regression Analysis

The overall access level to public transport service in the FCT (dependent variable) was determined using a regression model which incorporate: bus safety level, fare charged, availability, adherence to departure time, bus service reliability, estimated arrival time, bus comfort, delays in transit and bus overloading to come out with a model which explains access level to public transport services in the FCT (Table 7).

Table 7: The Regression Model

Independent variables	Unstandardized Coefficients		Standardized Coefficients	T	Sig. (p)
	B	Std. Error	Beta		
(Constant)	1.407	.411		3.424	.001
Safety	-.003	.071	-.003	-.041	.968
Fare Charged	-.084	.073	-.088	-1.156	.249
Availability	.093	.076	.094	1.219	.224
Comfort	.031	.059	.038	.522	.602
Speed	.093	.065	.100	1.427	.155
Delays	.001	.085	.001	.007	.994
Arrival Time	-.071	.076	-.074	-.926	.355
Departure Time	-.049	.086	-.050	-.574	.567
Reliability	.461	.070	.470	6.557	.000
Overloading	.182	.072	.182	2.523	.012

$R^2 = .375$, Adjusted $R^2 = .345$ $P < .001$

*Dependent variable: Commuters' level of access to public transport service

Source: Author's Computation (2022)

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Departure Time	-.049	.086	-.050	-.574	.567
Reliability	.461	.070	.470	6.557	.000
Overloading	.182	.072	.182	2.523	.012

The overall commuters' level of access to public transport service is described thus:

Commuters' level of access to PT= 1.41 (constant)+-.003 (safety)+-.088 (Fare charged) +.094 (Availability)+.038 (Comfort) +.100(Speed) in transit)+.001(Delays) +-.074(adherence to estimated arrival time)+-.050(Adherence to estimated departure time) +.470 (bus service reliability)+.182 (bus overloading)

The R^2 which is the percentage of the variance in y (dependent variable) that can be predictable from x (independent variables) is .375 or 38%. Keren (2013), observed that there are two reasons why it might just be fine to have low R^2 value. Firstly, investigation which attempt to predict human behavior regarding certain issue- such as this study has done, typically has R^2 lower than 50%, This is because humans are just harder to predict than any physical process. Secondly, if R^2 is low but predictors are statistically significant, important conclusion about how changes in the predictor values are associated with changes in the response values can still be drawn. This is because regardless of the R^2 , the significant co-efficient still represent the mean change in the response for one unit of change in the predictor, while holding other predictors in the model constant Furthermore, noting the closeness between the R^2 value (.375) and the Adjusted R^2 value of .346 in table 7 it can be concluded that the data is fit for the model.

These four factors (bus service reliability, absence of overloading in bus, speed of bus in transit and real time availability of bus) therefore, can be said to be very important and critical in explaining the level of commuter access to public transport service in FCT. The reliability of bus service along the routes, devoid of breakdowns and delays on the road, combine with the real-time availability in the bus stop and terminals when the commuters intends to make their trip will determined the continuous patronage of the public transport by the car-owned and non-car groups of commuters. The result therefore indicates that if public transport service can be made more reliable, available and speed in transit enhanced, therefore, commuters' access level to public transport service in FCT can be boosted.

The principle of real-time availability of public transport vehicles when needed is very important, because commuters trip are mostly work, school, office or business appointment related, whose

time are fixed. The demand for public transport at this time is usually high. This time also coincides with the popular *peak or rush hours* in the FCT and it occur in the early morning between 7:00am-9:00am and early evening hours between 3:00pm- 5:00pm during the working days (Monday-Friday).

The service comfort of FCT public transport at the time of field investigation was relatively poor; this has been a disincentive for commuters who have private car. For example, the basic requirements like comfortable seats, open window for air flow, bus floor height among others do not measure up to standard. Majority of the vehicles are minibuses which do not provide for adequate leg room or adequate ceiling height for standing. The situations can be critical during rush hours when commuters' will have to stand for a long time, in a crowded bus and on a congested road. Though the issue of comfort at the time of this survey does not influence access level as it might be expected, it is important that consideration should be given to it in the public transport improvement effort. This is because most commuters on provide cars which this study could not elicit data from are likely to be attracted to public transport patronage if the current level of comfort is improved upon.

Summary

From the findings above the following key findings can be made: The estimates of the communality before and after extraction of the variable in factor analysis shows that not much of the variance in safety, minimum delays and overloading can be attributed to the three common factors that can be used to explain access to public transport service. Factors like adherence to departure time, fare charged by public transport operators and reliability of bus schedules, show high variance suggesting that the access level to public transport can be greatly influenced by this factors. The percentage of the total variance accounted for by the factor analysis shows two factors (safety level of public transport and fare charged by operators) have Eigen values greater than 1, which by implications are the two important factors explaining access to public transport in the study area;

The Scree plot demonstrates the distribution of the variance in such a way that the 'elbow' shape of the curve indicates that higher order factors contribute a decreasing amount of additional variance with a marked decrease in the second and third factor. Bus departure time appears to be the most important factor which influence commuters choice of public transport as it loads the highest value on factor 1, followed by bus service reliability and arrival time and the correlation matrix of the ten (10) factors considered in the study shows that the strongest positive correlation is between the pair of availability of bus and public transport fare along the route. This is followed by public transport speed in transit and comfort level. The standardized regression coefficient beta (β) values indicate that bus service reliability has the greatest impact on commuters' overall access level, this is followed by absence of overloading of bus, public transport speed in transit and real-time bus availability. The R^2 which is the percentage of the variance in y (dependent variable) that can be predicted from x (independent variables) is approximately 38%.

Recommendations

In view of the forgoing major findings and discussions, the following recommendations are offered towards enhancing better commuters' access to public transport service in FCT in particular and elsewhere in Nigeria with similar public transport challenges in general, both the FCT administration, Area Councils and private sector organizations should collaborate to provide a sound, neat and safe public transport buses for commuters, with a view to increasing service

frequency, reduce waiting time and public transport fare, thereby making it more accessible to the commuters with or without private car. Adequate, clean and affordable public transport should be provided at major activity centers (public institutions, markets, schools etc) that meet the criteria set by the FCT master plan and land transport policy. This will eliminate frequent need for intermediate transport and the associated costs or walking distance to the existing public transport bus terminals/stops in the FCT. There should be periodic public transport drivers and operators' training/ sensitization to be jointly carried out by FCTA, DRTS, FRSC and transport operators unions, in order to initiate and sustain good attitudinal modifications amongst public transport operators. Such training/sensitization should include but not limited to defensive driving, road traffic rules and regulation, accident causes and prevention methods, the right of other road users, quality service management among others. There should be a dedicated public transport lane in all the routes which will separate public transport vehicles from other vehicular traffic, this will not only increase bus frequency, it will reduce transport fare and transit time and also, in a way, discourage private car usage for commuting within the FCT. Policy makers in FCT like the FCT Transport Secretariat, Ministry of Federal Capital Territory, Federal Ministries of Works and Transport should conscientiously strive to make public transport attractive. This is because commuters' make their decision based on some attributes which this study has shown. The accessibility and patronage of public transport will therefore depend on commuters' perception of their service quality, closeness of terminals to their trip origin/destination, cheap fare, and comfortable interior and safe operation as all things being equal; they are likely to attract commuters than other means of transport in the FCT. Therefore, policy goal, objectives and strategies should be formulated and implemented on each of the factors.

Conclusion

This study has established with respect to FCT, the four major factors influencing commuter's usage of public transport and by implication commuters' adoption of it. Therefore, basic standards should be set with regard to these parameters and compliance should be strictly monitored by the law enforcement agents i.e. DRTS, FRSC and FCT Transport Secretariat.

Finally, the study has identified some key factors such as walking distance to bus stops/terminals, public transport fare, reliability, comfort, adherence to estimated departure and arrival time as very crucial in raising commuters' access to public transport in the FCT. Therefore, constant improvement of the service level of these factors should constitute part of the public transportation planning and administration agenda of the Federal Capital Territory hence forth. The implementation of these recommendations is important because Transport as a derived demand can affects the quality of life and the rate of general productivity and development of the Territory.

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