PUBLIC MODE ACCESS AND WAITING TIME VARIABILITY IN MAIDUGURI METROPOLIS.

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ABSTRACT

This work examines public mode access and waiting time variations in Maiduguri Metropolitan Area. Data for the study were sought through a comprehensive field survey using a travel diary questionnaire. A total of 623 households were surveyed in 342 dwelling units. The results indicate that variations in modal access and waiting time occur as a result of the unconventional operation pattern of the public transport systems. Another finding reveals that difference in land use activities in the city does not cause any significant variations in time. The implications of the work for policy considerations are outlined

KEYWORDS: Mode, Access, Variation, Time, Waiting, Split

INTRODUCTION

Travel demand is underlined by an array of decisions that are related to the characteristics of the competing modes, those of the traveler and the trip. It is therefore a function of human and perceived vehicular attributes. The modal split sub-component of the travel demand model is one area that has attracted the attention of many researchers due to the increasing demand for mobility in cities. For example, Koppleman and Lyon (1981) have shown how the peoples' perceptions and feelings are significant in determining their preference for specific modes. In a similar work, Ogunsanya (1987) noted that attitudinal variables explain more the choice of mode to work and therefore are more important than the conventionally used socio-economic factors.

Studies on modal split within the context of the developed countries have revealed high sensitivities to the factors of income (vehicle ownership) and travel time in mode selection (Pratt and Dean, 1977, Macintosh and Quarmby, 1970, Ben-Akiva and Richards, 1975). This could be attributed to the high levels of affluence that necessarily requires efficient transportation systems to cope with the increasing needs of mobility. Direct access to transport mode therefore does not appear to pose any serious problems, as it is more readily available to the trip maker.

This situation is unlike in the cities of the third world where pervasive poverty and the lack of adequate means of mobility has made the people very sensitive to cost of transport (fare charges) than to the traditional value of time considerations (Lioukas, 1982, David and Raimundo 1984). In his analysis of the costs of intra-urban work trips in Benin city, Efue (1987), revealed that there is a high monetary costs of transportation faced by the urban poor and these costs differ according to locations. A similar study in Maiduguri by Galtima (2000) reveals high sensitivities to costs than travel times.

However, the factor of mode access and waiting time has rarely received attention especially in a developing environment like Nigeria. This is in spite of the role it plays in mode and the trip making decisions. For example, Okpala (1981a) merely pointed out the frustrations of commuters in spending long waiting times at bus/taxi parks in metropolitan Lagos. According to him the people show preference to long in-mode travel times than long waiting periods. Adefolalu (1977), Oduola (1981) and Adeniji (1987) have attributed the high waiting times for public mode of transport in some Nigerian cities to the high demand for mobility, which is inadequately provided. However, these works have failed to identify any silient factors that are responsible for mode access and waiting times in the cities.

The objective in this study therefore is to examine the public mode access and waiting time variations in the urban trip making process. Specifically the following research questions of interest are addressed; Does the operational characteristic of the urban public mode of transport influence inter-modal access and waiting times? How does the variation in urban land use pattern affect public mode access and waiting time in the city? This work will attempt to provide answers to these and other questions through a focus on Maiduguri metropolitan area as a case study. It is believed to typify the situation in several other Nigerian towns and cities.

The study is in eight parts; the first being an introduction, the second part examines the theoretical framework; the third section is on the study area and the methodology of the work; the fourth part examines the operational characteristics of the public modes of travel in the city, the fifth part is on the pattern of modal split in Maiduguri; the sixth section discusses the results while the seventh is on the policy and planning implications of the findings, and the last section concludes the study.
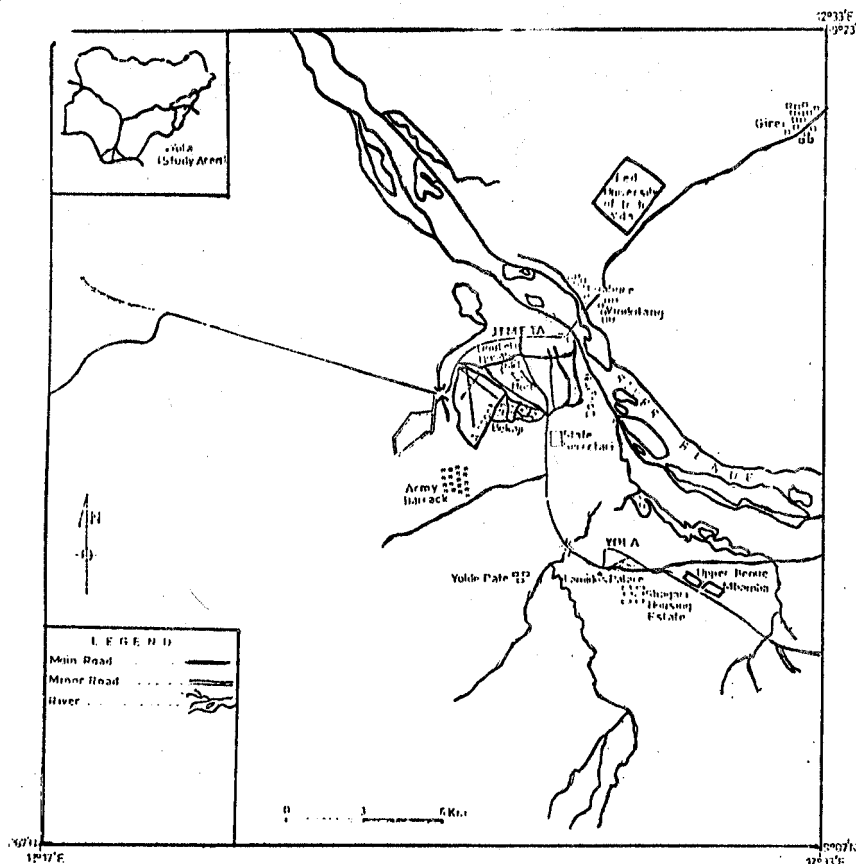
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Fig. 1 : YOLA METROPOLITAN AREA

Theoretical Framework

Urban transport demand analysis is essential for effective transportation planning. Transport demand is a derived demand; it is not required for its own sake but to achieve some specific objectives. The threshold of its analysis is centered on the development of relations between the outcomes of travel choices and a set of variables. Therefore, it employs the behavioral approach whose major theoretical underpinning is propounded in the 'choice theory' of economics and psychology. The view of the psychologist according to Wilson (1974), stated that individuals could make travel choices on the basis of the comparison of alternative levels of service provided by the transportation system, modified by the characteristic of the individual.

This approach is believed to largely enhance the understanding of the overall pattern of modal split component of the travel demand model. However, the 'time factor' in the modal split decision process has been a very important issue of this sub-model. This is because the desire to use a particular mode of transport is often influenced by the value of time considerations. It is implicit that the urban mode access and waiting time variations may be as a result of many factors. Conceptually therefore it can be explained whether the operational characteristics of the public modes of transport result in inter-modal time variations.

Study Area & the Methodology

(i) The Study Area

The study area Maiduguri is a creation of the European influence in 1902, as a seat of both the colonial administration and the Borno traditional political authority under the Shehu. Therefore, the city has expanded in size and population over the years as a dual administrative center. The population of the town has increased substantially. In 1931, there were about 24,000 people living in Maiduguri, and in 1952 and 1963 the figure rose to 56,740 and 88,186 people respectively (Ajaegbu, 1976). The high rate of urbanization in Nigeria, especially in the early 1970's put the population growth rate at 9.0% per annum during this period. By 1981, the estimated population stood at about 300,000 people (Borno tatistical year book, 1986). Today, according to the 1991, National Population Census, there are 629,386 people living in the city of Maiduguri, making the town one of the major urban centers in Nigeria, see figure, 1.

Correspondingly, the size of the city has also undergone a rapid expansion. With an area of 50.78sq/km in 1965, the town by 1985 had increased to 548sq/km, representing a more than 500% increase. The total area of the metropolis is now put at over 720sq\km. However, the town has been playing a very important role vis-a-vis her urban fields. It has been an administrative headquarters for a long time, a function that has

tremendously contributed to the growth of the city. Maiduguri was the divisional headquarters of Borno division between 1920 and 1926, and from 1926-1928, it served as the headquarters of the then Borno province. The internal political crisis in Nigeria, during the late 1960's that ensued in the creation of states, saw Maiduguri becoming the capital of the then northeastern State between 1968 and 1976. At present it serves as the capital of Borno State.

The coming of the railway in 1964 increased the commercial function of the city, a transshipment center for goods and persons, from rail to road transport. Maiduguri is also well connected by air transport to other parts of Nigeria and the world. These developments have enhanced the position of the town as the largest market focus for many towns and villages in the entire northeastern region of Nigeria and in many areas of neighboring Chad, Cameroon and Niger republics. The growing number of industrial establishments in recent times has made a very significant impact on the city's growth.

(ii) Methodology

The study requires a comprehensive data, especially from the primary source. Thus, the data sought are on the public modes of transport, the taxi, bus and the motorcycle. Other data include those on trips and travel behavior of the people. These data were obtained by direct field interviews and from secondary published sources. The data comprise the type and frequency of trips, public mode of transport and their operational characteristics, reasons for mode choice, and the fare charges. They also include mode access and waiting time in the various land use zones of the city.

These data were collected through a comprehensive household survey and personal interviews in areas of major land use activities. A travel diary questionnaire was administered to individuals, and heads of households or their representatives, who provided information on some members of the household who are of 15 years and above. In the selection of sample size for the home interviews, a sample size of 1 in 70 as suggested by Burton, (1984), was adopted. For Maiduguri, with a population of 629,846 people, a total of 623 households were surveyed in 342 dwelling units, using the systematic sampling method. The data were subjected to descriptive and explanatory statistics. The Analysis of Variance (ANOVA) technique is employed to determine the variation in mean access and waiting time of the three modes of public transport in the city.

The Operational Characteristics of Public Modes of Travel

Transport plays a service function in meeting the complex demand for travels created by the diverse urban land use structures. Thus, the major means of public passenger transportation in Maiduguri are the bus, taxi and the motorcycle. The bus can be classified in to two; the mini-bus and the big bus. The mini-bus system is mostly owned and operated privately, along some specific routes that are linked to major centers of land use

activities. Its services are unregulated along such routes, with no defined areas of stop and without fixed time schedules. With a designed capacity of 12 passengers they can be accessed at any point along its route,

provided there is space to take in more people to fill its actual capacity of 15 people. The fare charged is Ten Naira (N10.00), and sometimes less than that amount is collected, depending on the remaining distance to its' scheduled destination.

However, most of the mini-buses are old, their average age was found out to be 15 years and have dilapidated seats and windscreens, generally unsuitable for passenger transportation. The other bus (big) types that have carriage capacity of between 24-40 people are not indifferent from what obtains of the mini-buses. This is inclusive of the bus service provided by the Borno Express, a government owned Transport company to complement the private operators. At the moment there are very few of such buses in operation in the city. The characteristics of the public transport systems in the city are presented in table 1.1, below.

The taxi service, which has a very limited normal capacity of four passengers at a time per vehicle, shows similar operational characteristics with that of the bus system. However, the taxis are not restricted to any routes but mostly found along the main corridors of movement, where the passenger demand is usually high. In table 1.1, the minimum taxi fare charged per drop is N20.00. Sometimes higher fares are paid depending on the distance involved being negotiated at the discretion of the operator. The taxi service in Maiduguri is also operated on a 'hail and ride' basis along any of the routes. The ownership of this type of mode is absolutely in the private hands.

The motorcycle passenger service emerged in the last few years as a result of the increasing demand for urban passenger transportation in Nigeria. Although, it has come to stay but its operation as a mode of urban public transportation leaves much to be desired (Ogunsanya and Galtima, 1993). The motorcycle has a carrying capacity of only one person at a time and provides direct accessibility to individual dwelling units and other buildings. Thus the fare charged is between N20.00 and N25.00, or can be more than that depending on the journey length. The local chapter of the National Union of Road Transport Workers (NURTW) guides the operations of the public transport systems in the city. The Union membership comprises serving and retired drivers, and others who are less educated in the management of public transport system.

However, the general vehicle fleet, which accounted for most urban travels in Nigeria is found to be shrinking in size (Hathaway, 1993). In Maiduguri the commercial vehicle fleet (the bus and the taxi) have drastically reduced in size from 10,218 vehicles in 1986, to less than 4,000 vehicles in operation by 1995. This decline in vehicle fleet, the nationwide, could be attributed to the downward growth trend in the Nigerian economy since 1986. This has ensued in the high cost of vehicles and spare parts, which meant that fewer vehicles could be owned and maintained. The increasing demand for urban

Table, 1: Public Transport System Characteristics in Maiduguri.

Type of Vehicle	Designed Capacity	Actual Capacity	Average Age	Routes Plied	Fare Per Drop
Bus(Big)	30	35	10	1	N10.00
Mini-Bus	12	15	15	1	N10.00
Taxi	3	6	18	2	N20.00
M\Cycle	2	2	17	2	N20.00

*Routes Plied: 1 = Regulated routes, 2 = Un-regulated routes
Source: Field Data Analysis.

travels, which is faced by unorganized public transit modes coupled with the declining stock of vehicles have therefore resulted in a chaotic pattern of movements.

The bus is chosen more than any other mode, because of its fare charges that are considered to be affordable or cheap by the people. The fares may be required to be low, in order to survive the competition. However, none of the three modes in the city have been chosen on the basis of the 'reliability' reason.

(i) Mode Access Distance & Time

The dependents of urban public transit systems often trek some distances to access the mode of their choice. These vary according to trip maker's location in relation to the points of access of the desired modes. It is therefore implicit that inter-modal access distance and time variations exist and this helps in the explanation of the quality of transport service provided in an area. An examination of the public modes in Maiduguri revealed some differences in the accession of the taxi, bus and motorcycle forms of transport. The people are found to access the motorcycle through an average walking distance of 100.59 meters from the various trip locations in the city.

The patronizers of the bus system cover a longer distance of 122.89 meters within an average time of 4.15 minutes to access the bus services. The taxi, which is the most popular vehicle for transport in the city, is accessible through an average distance of 110.96 meters to its service route. Thus, the mean public mode access distance (walk) to the public transport parks/routes is 111.48 meters, which is covered within a mean trekking time of 3.73 minutes across the city.

Further examination of the public mode access time through the disaggregation of the city's land use structures has shown some variations. In table 2, the mode access time in the areas designated as educational land use is higher than in other parts of the city. This land use has a mean access time of 7.15 minutes and only two modes, the taxi and the 'bus, are the dominantly patronized vehicles in this zone. The residential areas of medium and high densities have lower access times 4.66 and 4.99 minutes respectively. The commercial land use type has the lowest mode access time of 3.35 minutes. This is not unexpected, as areas of commercial activities are well served by public transport.

The assessment by type of mode shows that the longest walk time (12.50 minutes) is experienced in accessing the taxi mode in areas of educational land use zone. The bus service is also accessible through a long walk time of 9.0 minutes within the land use. The motorcycle passenger service has generally lower access time in all the land use zones except in the recreational area (7.50 minutes), which is well served by the only competing mode, the taxi. However, the mean access time for each of the public modes in the city revealed that the taxi and the bus have 6.33 and 5.18 minutes respectively. The motorcycle has the lowest time of 2.92 minutes and hence the most easily accessible mode.

(ii) Mode Waiting Time

The factor of mode waiting time has been one of the most intractable problems in urban transportation especially in the cities of the developing countries. This has been attributed to the few number of vehicles serving the teeming urban population. According to Okpala (1981), most commuters in Lagos, Nigeria are found to show preference for long in-mode travel time than waiting

Table 2: Land Use Zone Public Mode Mean Access Time

Type of Land Use	Access Time by Type of Mode			Mean X
	Taxi	Bus	M/Cycle	
Commercial	5.06	5.00	-	3.35
Industrial	5.80	4.93	4.33	5.02
Resid. Low	4.60	4.80	5.00	5.13
Resid. Medium	5.50	5.00	3.50	4.66
Resid. High	5.28	6.71	3.00	4.99
Recreational	5.92	-	7.50	4.45
Educational	12.50	9.00	-	7.15
Institutional	6.00	6.00	-	4.00
Mean Total	6.33	5.18	2.92	-

Source: Field Data Analysis.

Table 3: Public Mode Mean Waiting Time by Land Use

Type of Mode	Mode Waiting Time By Land Use								Mean X
	Comm	Ind.	R.lo	R.me	R.hi	Rec.	Edu.	Inst	
Taxi	12.5	4.5	11.5	8.9	7.2	12.0	9.5	11.5	9.7
Bus	12.0	4.0	9.5	4.5	7.0	-	6.5	20.5	8.0
M/Cyc.	-	4.5	9.0	3.9	1.0	11.5	-	-	3.7
Mean Total	8.18	4.3	10.0	5.8	5.0	6.7	5.3	10.7	-

Source: Field Data Analysis.

time. However, the assessment of public mode waiting time in Maiduguri shows that the people spend an average of 7.72 minutes. This waiting time period can be judged as reasonable considering the limitation in the size of fleet and the variety that serve the city.

An assessment of the mean waiting time as in table 3, shows that the taxi mode has waiting time of 9.56 minutes while the bus has 8.00 minutes. The high demand for the taxi mode might be responsible for its longer waiting time. The motorcycle passenger service has the lowest waiting time of 3.73 minutes. A spatial perspective of the mode waiting time in the city showed some variability. The results indicate that areas of commercial, institutional and recreational activities have higher mode waiting times of 8.18, 10.67 and 6.67 minutes respectively.

The high mobility needs of the people in these areas and the lack of patronage of some modes could have been the cause for the longer times. For example, the motorcycle mode is not selected for any trip purpose in the institutional and the commercial land uses of the city. The split in these areas is therefore between the competing modes, the taxi and the bus that have high waiting time of 12.00 minutes each. On the other hand the residential zones of high and medium densities, and the industrial area have lower waiting time of less than 6.00 minutes. In the high-density residential neighborhoods the motorcycle is readily available to the trip maker within an average time of 1.0 minute. This is perhaps due to its pattern of operation that guarantees accessibility more than all the other modes in the city.

DISCUSSION OF RESULTS

The three modes of public transportation in Maiduguri can be generally described as para-transit modes. They have limited capacity for passenger movements and hence ineffective for any form of transit that could facilitate the efficient mobility demands of over 600,000 populations. The services provided are generally not regulated and un-coordinated, and often without any fixed place for loading and unloading of passengers. The operational pattern of the public transport system can be described as un-conventional. The people are forced to

Table 4: Analysis of Variance of Mode Access Time

SOURCE	DF	SS	MS	F	P
Factor	2	48.3	24.6	3.55	0.047
Error	21	476.3	6.81	-	-
Total	23	191.8	-	-	-

Source: Computer Output.

Table 5: Analysis of Variance of Public Mode Waiting Time

SOURCE	DF	SS	MS	F	P
Factor	7	17.5	16.8	0.56	0.774
Error	16	476.3	29.8	-	-
Total	23	593.8	-	-	-

Source: Computer Output.

rely on this haphazard arrangement that brings uncertainties in accessing the mode of their choice through the cumbersome 'hail and ride' method.

The total vehicle fleet, whose ownership is mostly in private hands (about 98%), is fast declining in size as a result of old age and the lack of money for their effective maintenance. This has affected the trip makers' travel demand. The passengers are found to patronize the public transport in the city mostly on the basis of the 'availability' reason rather than an expression of their genuine desires. The high preference shown for the taxi mode could be regarded as a selection of the best among the known 'devils'. Otherwise the people could not have refused the choice of all the three modes in Maiduguri on the basis of the 'reliability' reason.

The analysis of the pattern of mode access time in the city also revealed some variations. The data in table 2, were subjected to the analysis of variance (ANOVA) technique to determine whether the mean access time values of the three modes of travel in the city are the same statistically. The results in table 4, show that the values for the MS (factor) 24.6, is much larger than that of the MS (error) 6.81, and the F-ratio is 3.55. This

therefore means that the inter-modal access time variations are significant and are therefore not due to land use differentiation.

This result further indicates that the operational characteristics of the public modes greatly influenced the access distance and time. Mode selection, therefore, determines the length of walk time to be covered by the people in their daily movements. This could also be interpreted to mean that the attitudinal responses in mode choice also explain the differences in the time variations. A similar pattern of analysis was employed to examine the variations in the mean values of the mode waiting time in the city (as in table 3). The result indicated that the variations in the mean waiting time are not statistically significant. The mean waiting time at each of the land use zones is therefore the same.

In table 5, the MS factor is less than the MS error and the F-ratio statistics is as low as 0.56. This confirms that the variations in time are due to error. Therefore, the egress time variations are as a result of mode selection than to the factor of land use zonations in the city.

From the foregoing, certain facts have emerged; (i) The public transport system in Maiduguri is declining in size and quality of service, and hence unreliable in meeting the present and future travel demands of the people; (ii) There are variations in inter-modal access and waiting time and these occur as a result of the un-conventional operation pattern of the public modes; (iii) That the spatial variation in mode access and waiting time are not significant. The time values exhibited by the various land use structures in the city are the same.

The Pattern of Modal Split

Trips can be defined as any single movement between points of origin and destination for a specific purpose. They can be classified into types, but this according to Barber (1986) varies from city to city and on the basis of the objective of the study. The intra-urban trips in Maiduguri are categorized into the following, work, school, shopping, religious, market, and business, recreation, social, hospital and 'others'. This is informed by the need to have broad based trip types that are sufficient enough to understand the nature of travel demand in the city. These trips are distributed through the various modes of transport available. These include the private automobile (car), bus, taxi, motorcycle, bicycle and 'walk'. The modal split in Maiduguri is examined from the perspective of the public modes of travel.

The analysis reveals that the taxi is responsible for 23.84% of the total trips (5,763) in the city, while the bus service accounted for 13.28% of the trips. The share of the motorcycle passenger service is put at 16.79%. The high patronage of the taxi (23.84%) and the motorcycles might not be unconnected with their service flexibility of accessing the modes along most of the routes in the city. Further analysis by type of trip shows that the taxi mode carries the highest work trip volumes in the city. More than 29% or 373 of the total work trips share is taken by this mode and the motorcycle accounts for 18.76%. The combined work trip split of the commercially operated vehicles (taxi, bus and the motorcycle) stands at 40.46 percent of the total.

The higher number of shopping and school trip types are also accounted for by the taxi, representing 27.47% and 36.47% respectively. The taxi also accommodates one of the highest volumes of the journeys tagged as 'others'. The public bus service is found to be the highest carrier of passengers on market trips, representing 27.27% of the total. However, the bus accounts for a very little fraction of 4.10% and 6.45% of the business and recreational trips. This suggests that the bus is an inconvenient mode of travel for the purposes of these journeys. The motorcycle service is responsible for 15.38% and 21.21% of the trips tagged as shopping and market types. The motorcycle is the least patronized mode on school and hospital trips among the three public modes in the city.

However, a number of reasons were forwarded by the commuters in Maiduguri to explain their decisions in choosing a particular mode of travel for a given journey. It is found that the 'availability' reason is ranked as the most important factor in modal split decisions. This factor explained about 48.85% of all the reasons for public mode choice in the city. The taxi mode is highly rated under the time, safety and comfort considerations. It offers better service conditions than the other competing modes. The people select neither the bus nor the motorcycle, for a trip on the grounds of value of time or comfort. This is perhaps journey by the bus often entails long times and are least comfortable and covenient due to the dilapidated vehicle conditions.

Policy and Planning Implications

The study has revealed some results for consideration in urban transport policy and planning. There is the absence of any comprehensive policy guidelines on the operation of public transport system in the city. This has affected the demand for travel activities. Similarly the transport system is no longer reliable as a result of the increasing dilapidation of the vehicle conditions caused by the current economic hardships. Thus, to own a new vehicle or maintain one has become a serious cause of concern. It is therefore suggested that::

1.   The government should make definite policy guidelines on the operations of the public mode of transport in the city. This should comprise of a regulatory agency whose membership must include educated professionals in the field of transport and the like.

2.   A deliberate effort should also be made by the government and the city authorities at increasing the vehicle stock to boost the modal split demand of the city. This in addition to meeting the growing needs of the people, it is seen to remove the un-conventional pattern of public mode operation through increased participation and the anticipated regulation.

3.   There is the need for government assistance, to the private sector, in terms of loan facilities and subsidies for the procurement of new vehicles and

spare parts. These categories of operators who constitute the majority in the public transport sector are already incapacitated by the prevailing hard economic conditions in the country. Therefore depending on them without further government assistance would mean the total collapse of the urban transportation system.

CONCLUSION

The objective in this study was to examine public mode access and waiting time variability in Maiduguri metropolis. The observed differences in waiting time among the competing modes were influenced by the un-conventional method of operation of the public modes of travel. In view of the growing urban population, which means an increase in the mobility needs of the people, the government should take some active measures in the management of the transit systems. This will eliminate or reduce the present operational problems, if left un-checked will likely aggravate the situation in the future. The measures may also lead to the achievement of desirable levels of efficiency in the operation of public transport in the city. A number of other suggestions and policy implications of the study were outlined.

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