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Inter-Urban Trip Generation Models for the Urban Centers in Akwa Ibom State, Nigeria

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Abstract
The study was conducted in Akwa Ibom State, a fast emerging State in the Niger Delta Region of Nigeria. The aim of the study was to model future patterns of trips in the study region. To achieve this, types and volumes of trips generated weekly on the inter-city roads of the region were determined; the influence of the socio-economic development factors on the various trips generated was analyzed. Data on trip were obtained from travel survey while data on the socio-economic development factors were derived from existing records. Multiple regression analysis was used. Eleven types of trips were identified namely; work, school, recreation, religious, medical, wedding, burial, market, personal business, visit to friends/relations and other trips. Models for future estimate of the trips were generated. Establishment of Surveillance Transportation Programme to constantly generate and maintain trip data for update was recommended.
Keywords: Inter-urban, Trip generation, Models, Akwa Ibom State, Nigeria.

1. Introduction

A city without transportation cannot exist. The major things a city needs are contacts, communication and connection with the "outside world". Since the past one and half decades there have been phenomenal increase in the demand for inter-city passenger travels, and public and private transport services in the emerging countries of the world. This has been due to increasing personal income, improved transport infrastructure and availability of vehicles for long distance travels in the market (Oyesiku, 1995). In Nigeria for instance, the demand for inter-city and regional trips in public transport rose from 41.5% in 1986 to about 65% in 1990 (Bolade, 1992).

The inter-urban trips do not occur by chance but occur because of need for them. There are varied socio-economic development activities and uses in the respective urban centers such as schools, markets, recreational centers, churches, hospitals, industries, private and public offices. It is because of these activities, people have to move. The materials for inter-urban transportation planning therefore include not only the physical ways and vehicles within which people and goods move about but also the trips themselves and the activities which generate them. The effective transport planning in any region both for the present and the future requires understanding of the existing transport situation.

Part of the difficulties faced by the operators of the inter-city road passenger transport services in Nigeria is the lack of understanding of inter-city travel behavior and analysis of trip production and socio-economic development factors in the region. Public and private agencies operating inter-urban passenger transport services have been

confronted with the increasing demand and forecasting procedures, which pose a great problem in making inter-city and regional transport service decisions (Oyesiku, 1995).

The goal of trip generation process is to forecast the number of various purpose trips that will begin from and end at each travel analysis zone contained in the area of study. This process usually considers some socio-economic data as input producing trip production/ attraction values as the output (Oyedepo & Makinde, 2009).

The present inter-urban traffic situation in the study region presents the same challenges experienced in many regions without inter-city transportation plan. Long–range plan for coordinated transportation systems to serve the expanding urban system cannot be developed based on intuition and judgment, but on rigorous processes, including computer tests, which demonstrate that the recommended plan maximizes performance in relation to an accepted goal. The current trend has brought to the fore the need for a better understanding of the demand for inter-city trip generation. Solution to the chaotic traffic problem on the inter-city roads requires not haphazard actions, but a new urban development policy based on sound knowledge of the inter-city movement patterns.

It is therefore proposed that if the volume of the various trips among the urban centers are determined and analyzed with the present number of socio-economic development variables in the urban centers, it will be possible to develop models that can aid in forecasting future trip volumes. This is very essential for planning transportation improvements. With ignorance about the present and future travel patterns in the region, the planners and decision makers would either have to guess or simply build facilities to ease existing areas of congestion and the scenario may eventually become more complex. On the other hand, with foreknowledge based on models demonstrably able to simulating travel patterns, plans could be prepared on a rational basis.

2. Aim and Objectives of the Study

The aim of the study was to generate models for the future trip patterns among the urban centers in Akwa Ibom State, Nigeria. In order to achieve this aim, the following objectives were set out:-

1. To determine the types and volumes of trips generated among the urban centers in the State.
2. To analyze the influence of the socio-economic development variables on the various types of trips generated in the region.
3. To model future patterns of trip in the region based on the existing situation.

3. The Study Location

The study was conducted in Akwa Ibom State, Nigeria (see Fig.1). It is one of the thirty-six States in the Federal Republic of Nigeria with the Population of over 3.5million people. There are 31 Local Government Areas including Uyo the State Capital. The State is located at the Southeastern corner of Nigeria between latitudes $4^{o}30^{1}$ and $5^{o}\ 33^{1}$ North and longitudes $7^{o}\ 30^{1}$ and $8^{o}\ 25^{1}$East (Mbat, Ibok & Daniel, 2013).

4. Models for Trip Generation Study

Models usually used to estimate future travel patterns include Growth factor model, cross-classification or category analysis and multiple linear regression. Growth factor model attempts to estimate future number of trips by households for specific purpose by any of specified categories of household attributes based on current trip rates. cross-classification or category analysis model is similar to the growth factor in that it also attempt to estimate the number of trip productions on household basis for a given trip purpose as a function of household attribute (Daniel,2005).

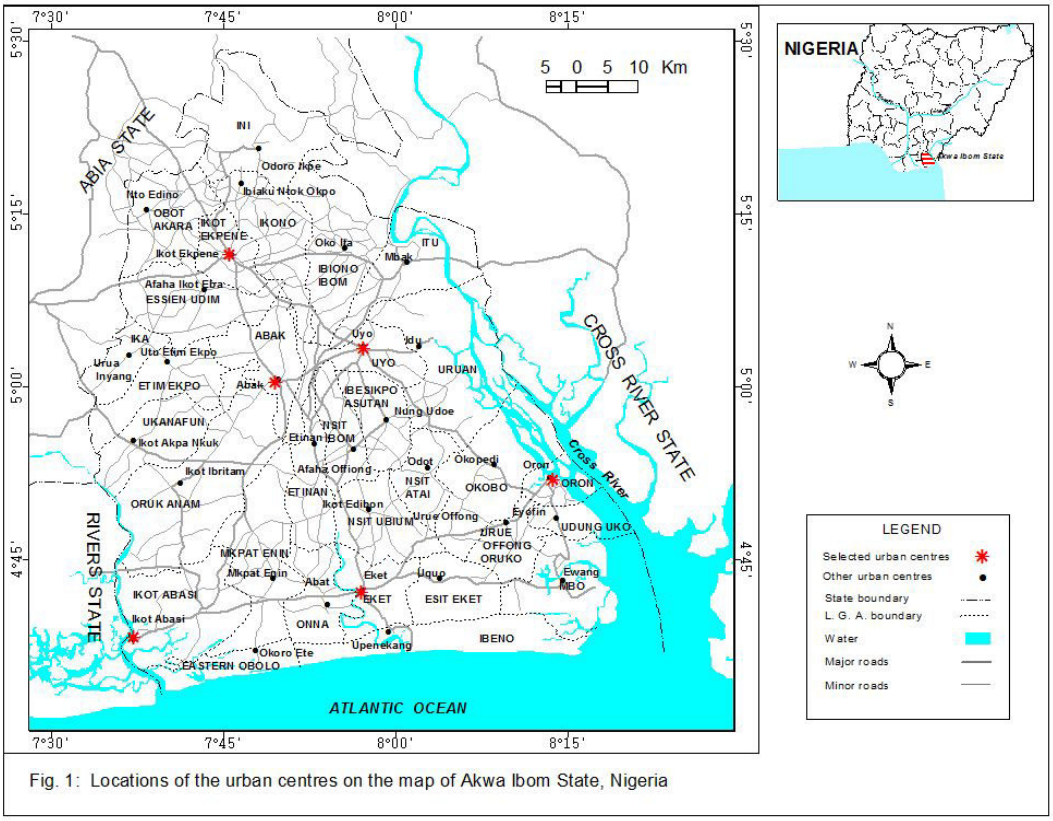

Fig. 1: Locations of the urban centres on the map of Akwa Ibom State, Nigeria

The multiple linear regression model in trip generation measures the separate and combined influence of the socio-economic factors (household or location socio-economic
variables) on trip production. The model attempts to expose the relative and combined importance of determining factors of trip production on the volume of trips generated.
Oyedepo and Makinde (2009), for example based their study of Household Trip Generation of Ado-Ekiti Township, Nigeria on regression model. They identified three trip production purposes; (i) Home Based work purpose (ii) Home Based other purpose and (iii) Non- Home Based purpose. These were considered as the dependent variables against socio-economic variables of the trip makers such as age, family size, income and car ownership etc as independent variables. The analysis showed that people with higher income and more automobile availability made more trip than people with low income and less automobile availability.

Also, to determine the strength of influence of residential land use on trip generation rate in Akure, Nigeria, Okoko and Fasakin (2007) used stepwise regression technique. They noted that the residential land use did not make any significant contribution to the trip generation rates in Akure.

In this study, the multiple linear regression model was used because of its explanatory function in identifying the separate influence of the socio-economic variables of the urban region in order to establish the importance of the relationship between each of these variables and volume of trips generated in the region. Mathematical it is as follows:

$$Y_o = a + b_1x_1 + b_2x_2 + b_3x_3 \ldots . f\, b_nx_n + e$$

where Y_o = estimated value of the dependent variable,
a = Y intercept,
$b_1, b_2, b_3, \ldots . b_n$ = the regression plane of independent variables,
$x_1, x_2, x_3 \ldots x_n$ = the independent variables, and
e = error term or residual.
Source: Daniel (2012).

5. The Study Materials

Trip data used in this study were obtained from travel survey conducted in six randomly selected urban centers in the study region. (see Table 1). Thirty (30) field assistants were trained and used for the survey exercise. The survey was conducted simultaneously in the six urban centers for a period of one week (Mondays to Saturdays), during the hours of 7am – 9am; 12-2pm and 4-6pm each day. The survey was conducted precisely during the week beginning on Monday 11th May, 2009 to Saturday 16rd May, 2009. This period was considered most suitable because it falls within the transition period between the hot dry season and the wet rainy season. Temperature and other related climatic factors were quite conducive for trip makers. It was ensured that the period of the survey was devoid of any local or national festivals and holidays. A total of 1856 copies of pre-coded questionnaire that were properly completed were used in the analysis. The questionnaire was designed such that the needed pieces of information were quickly obtained from all willing trip makers as they individually boarded buses and taxis at the motor parks. At each park, there were five field assistants, each targeting buses and taxis loading to the targeted urban center. Data on socio-economic development factors in the six selected urban centers were obtained from government annual reports, year books, journals, diaries, manuals and maps (see Table1). They included: (i) number of industries; (ii) number of tertiary educational institutions; (iii) number of major markets; (iv) number of tourism sites; (v) number of hospitals; (vi) population size; and (vii) distance. These functions were chosen and information obtained on them because they were easily measurable, relatively available, and relevance as potentials of inter-urban passenger trips production and attraction factors. They were also considered as variables that measure urban socio-economic growth and political functions (Oyesiku, 1995).

6. Methods

Step-wise multiple regression model was used in the study. The model measured the separate influence of each socio–economic factor acting in conjunction with other factors and thereby determined their separate influence on the volume of interaction (Akpoghomeh, 2003). The observed relationship between the socio-economic development factors and the volume of trips was then translated into regression models for future estimate of interaction among the urban centers. In analysis, the dependent variables (y) were the volumes of the different categories of trips generated/attracted to and from the six selected urban centers. The independent variables (x) were the number of socio-economic development indicators in the selected urban centers. Statistical Package for Social Sciences (SPSS) was used to carry out these analyses and the following indices were obtained: (i) correlation coefficients, (ii) linear regression constants, (iii) partial and standardized regression coefficients, and (iv) the residuals.

7. Results and Discussion

7.1. Types and volumes of trips generated

The study identified the eleven types of trips generated among the urban centers in the region. They are: (i.) work trips (y_1); (ii) school trips (y_2); (iii) recreation trips (y_3); (iv) religious trips (y_4); (v) medical trips (y_5); (vi) wedding trips (y_6); (vii) burial trips (y_7); (viii) market trips (y_8); (ix) personal business trips (y_9); (x) trips to visit friends/relations (y_{10}); and (xi) other trips (y_{11}). The average weekly total of each and all the trips are shown in Table 1. Details on each of the trips can be found in the trip models section.

8. Influence of the socio-economic development factors on the trips

In Table 2 the significance of the respective socio-economic development factors on each of the trips generated in the region are shown.

9. The Trips Models

9.1 School trip: An average weekly total of 373 school trips were recorded and they accounts for 20.0% of all trips generated. A strong positive relationship (r = .880) was observed between school trip and the number of institutions (see Table 2). This means that the higher the number of institutions in the region the higher the school trip made.

It therefore confirms that many people make trip daily from one urban centre to other centers where there are higher institutions of learning. Also, a substantial negative relationship of r = - .600 was observed between school and the number of tourism sites. This means that the higher the number of tourism sites the less the school trip. There is no doubt about this because; tourism is in itself a very lucrative business. It therefore seems that where there is greater potential for tourism development investors would like to invest in tourism business rather than in education business. This is probably why there are less educational institutions where there are more tourism sites. Using step wise multiple regression analysis the following model has been derived for estimating future school trip:-

School trip = 11.073 + 14.77 (Nos. of Institution)- 6.56 (Tourism sites). As seen in the above equation, two of the seven independent variables were selected because of their significance in explaining changes in the school trip, 88% and 60% respectively.

Table 1: Average weekly **data obtained for dependent and independent variables**

		Trip Types (Dependable Variables)													**Socio-economic Development Factors (Independent Variables.)**						
S/N	Origin / Destination of Inter – urban trips	Work	School	Recreation	Medical	Market	Personal business	Visit to friends	Religious	Wedding	Burial	Others	Total	%	Distance	Population	No. of school	No. of market	No. of hospital	No. of industries	Tourism sites
1	Uyo – Abak	45	61	24	27	17	32	40	20	17	22	0	305	16.4	17.5	139	5	5	4	1	4
2	Uyo – Ikot Ekpene	44	94	17	25	20	18	30	10	9	10	2	279	15.0	30.0	176	7	5	6	1	5
3	Uyo – Oron	22	31	16	17	14	19	27	22	13	16	6	203	11.0	45	173	6	6	4	1	8
4	Uyo – Ikot Abasi	8	31	8	4	4	7	14	3	8	4	0	91	5.0	100	137	5	5	4	2	6
5	Uyo – Eket	33	37	45	18	23	27	42	30	24	22	4	325	17.5	57.5	160	6	6	6	3	5
6	Abak – Ikot Ekpene	6	26	5	9	2	9	15	4	1	5	0	82	4.42	27.5	70	2	2	4	0	1
7	Abak – Oron	0	3	0	1	0	3	1	0	0	0	0	8	0.43	46.3	76	1	3	2	0	4
8	Abak – Ikot Abasi	11	0	4	3	1	5	8	2	0	0	0	34	1.80	82.5	40	0	2	2	1	2
9	Abak – Eket	15	12	18	11	5	18	18	10	5	12	1	125	6.7	40	63	1	3	4	2	1
10	Ikot Ekpene – Oron	8	16	3	6	2	18	10	3	2	1	0	69	3.7	75	113	3	3	4	0	5
11	Ikot Ekpene – Ikot Abasi	8	2	3	1	2	6	3	2	0	1	0	28	1.5	110	77	2	2	4	1	3
12	Ikot Ekpene – Eket	15	23	12	10	1	12	21	4	6	9	1	114	6.2	67.5	100	3	3	6	2	2
13	Oron – Eket	21	17	10	9	4	38	8	3	2	1	1	114	6.2	42.5	97	2	4	4	2	5
14	Oron – Ikot Abasi	6	0	3	2	1	5	1	2	2	1	0	23	1.2	85	74	1	3	2	1	6
15	Ikot Abasi – Eket	12	0	11	3	1	17	10	2	0	0	0	56	3.0	42.5	61	1	3	4	3	3
Total		254	373	179	146	97	234	248	117	89	104	15	1856								
%		13.7	20.0	9.6	8.0	5.2	12.6	13.4	6.3	4.8	5.6			100							

Source: Author's Field Work (2009)

Table 2: Coefficient matrix of trips and socio-economic development factors of urban centers

Trips	Distance	Population	No. of institutions	No. of market	No. of hospital	No. of industries	No. of tourism sites
School trip	-.518	-.179	*.880	.174	-.245	-.178	* -.600
Work trip	*-.556	-.324	*.726	.081	.161	.347	-.205
Visit to friends	-.112	-.013	*.781	*.775	-.260	-.213	*-.720
Personal bus. trip	-.497	-.148	-.181	*.556	.264	.244	-.316
Recreation trip	.224	-.176	-.167	*.714	.153	.383	*-.753
Medical trip	*-.508	-.356	*.767	-.125	.151	.078	-.390
Religious trip	-.268	-.026	.066	*.785	.209	.059	-.515
Burial trip	-.053	.209	.164	*.723	-.066	-.377	*-.708
Market trip	-.463	-.081	*.848	.358	.014	.245	-.210
Wedding trip	.339	.143	.166	*.857	.024	-.123	*-.454
Other trip	-.039	.090	.013	*.721	.152	-.006	.016
Total trip							

* Significant at 0.05 level of Significance
Source: Computed from Table 1

9.2 Work trip: Work trip accounts for 13.7% of average weekly generated trips with average total of 254. A substantial negative relationship (r = -.556) exist between work trip and distance, indicating a decrease in work trip in the region with increased distance. This shows that workers prefer to reside in the town of employment, even if it is not their home town rather than make daily trip to and from work. On the other hand, the coefficient of r = .726 shows a significant relationship between work trip and number of institutions. The following regression model explains that there will be increase in work trip with increase in number of institutions. The reason is that many people wish to take up employment where there are institutions of higher learning. This affords them opportunity to take supplementary education. The following regression model is therefore derived for work trip:- ***Work trip = 32.92 + 7.87 (Nos. of institution) – 0.28 (Distance)***

9.3 Trip to visit friend and relations: A total of 248 trips were recorded for this type of trip. This accounts for 13.4% of all trips. There is a strong positive relationship (r = .781) between visit to friends/relations and number of institution. The impression here is that higher institutions attract significant number of visitors. There is also a strong positive (r = .775) relationship between visit to friends and number of market. The findings showed that there is a strong affinity among friends and relations in study region, but the motivation to visit friends residing in towns where there are major markets is stronger. Markets in the region offer a wide variety of goods and services. To the contrary, there is a strong but negative relationship between visit to friends and relations and number of tourism sites (r = -.720). The more the number of tourism sites, the less trips to friends/relations. People who visit town with resort centres do so for recreational purposes not because they have friends or relations residing there. The following model has been formulated for this type of trip: ***Trips to friends/Relations: = -6.61+4.6(No. of institutions) -5.98(no. of tourism)+10.12(No. of markets);***

9.4 Personal business trip: Personal business trips account for 12.6% of the average weekly total with 234 number. However, only *number of market* was selected as significantly contributing to variation in personal business trip with r = .556 regression coefficient, explaining about 55% of variation in personal business trip. This is because many trips in the region are indirectly associated with market activities. Consequently, the following simple regression model is derived for personal business trip:- ***Personal business trip = -29.19 +12.27 (nos. of market).***

9.5 Recreation trip: Recreation trip recorded 179 average weekly total, representing 9.6% of total trips generated in the region. It is interesting as one would expect that number of tourism sites along with market were selected as

significant variables explaining changes in recreation trip. It is not surprising that "number of tourism sites" shows a negative but strong relationship (r = -.753) with recreation trip. This shows that as the number of tourism sites increases, volume of recreation trip will rather decrease and not increase as would normally be expected. However, such situation is not all together out of place, because in a broader understanding, recreation is quite a different thing from tourism. Tourism sites are therefore expected to attract tourists and this involves external travel flow which is outside the scope of this study. The following model is still relevant in understanding future recreation trips in the region:- ***Recreation trip = -12.71 + 11.82 (market) – 8.607 (nos. of tourism site).***

9.6 Medical trip: Average weekly total of 146 medical trips were recorded and they account for 8.00% of all trips generated. A substantial negative relationship (r = -.508) exists between medical trip and distance. That means the greater the distance, the less the trips taken for medical purposes. The regression coefficient of 0.767 indicates a strong positive relationship between "number of institutions" and medical trip. Using step wise multiple regression SPSS analysis, the following model has been derived for medical trip. ***Medical trip = 14.22 + 2.91 (Nos. of tertiary institution) – 0.192 (distance).***

9.7 Religious trip: Religious trip accounts for 6.3% of trips generated weekly with an average total of 117. A strong positive relationship is indicated by the coefficient of r = .785 between "number of market" and trips for religious purposes. This is the only variable selected as significant in explaining changes in religious trip. Consequently, the following simple model has been developed for religious trip: ***Religious trip = -21.69 + 10.17 (nos. of markets***).

9.8 Burial trip: Trips for burial purposes recorded 104 average weekly total, representing 5.6% of sample trip observed. The "number of markets" scored r = .723, giving a strong positive relationship between burial trip and the "number of markets". This is true because many people who undertake this type of trip do not necessarily do so to attend burial occasions on the trip day, but take the trip earlier in the week to prepare for the actual burial occasion that usually takes place during the week ends. The strong positive relationship between market and burial trip occurs, because the existence of markets attracts early burial trip makers so as to make purchases in those markets in preparation for the actual burial occasion. Also, a strong but negative relationship (r = -.708) was observed between the "tourism sites" and burial trip. This is so because tourism sites attract vacation makers who, even at incidence of death are not buried there. This study is probably the first to report this type of trip. The following model has therefore been derived for burial trip: ***Burial trip = -10.45 + 8.08 (markets) – 3.58 (tourism attraction).***

9.9 Market trip: Market trip accounts for 5.2% of total trips generated weekly with average total of 97. A strong positive relationship indicated by r = – .848 was observed between the "number of higher school and market trip", while the regression coefficient of r = .358 indicates a small but moderate relationship between market trip and the "number of markets". This shows that, apart from the usual business transactions that take place in the various markets in the region that attract moderate number of trip makers to them; institutions of higher learning appear to be significant centers of marketing transactions in the region. Step wise multiple regression SPSS analysis has thus been used to derive the following simple prediction model for market trip: - ***Market trip = - 8.23 + 5.94 (institutions of Higher learning).***

9.10 Wedding trip: Wedding trip accounts for 4.8% with 89 average weekly trips. Markets and Tourism sites are selected as, significant variables with regression coefficient of r = .857 and r = -.450 respectively, explaining about 85% and 45% respective variation in wedding trip. There is a strong relationship existing between markets and wedding trip. This is due to the fact that many people who undertake this trip do not necessarily do so for the purposes of attending wedding ceremony on the trip day but decided to move early in order to make purchases in the available markets in preparation for the wedding proper which usually takes place during the week ends just as in the case of burial. The moderate negative relationship (r = -.454) between tourism sites and the wedding trip shows that the more the tourist sites the less the volume of wedding. This is not surprising because tourist sites attract holiday makers who visit for sight seeing and not primarily for the purposes of attending marriage ceremonies. Model derived for wedding trip is as follows:- ***Wedding Trips:- -12.21 + 6.87 (markets) -2.24 (Tourism sites).***

9.11 Other trips: Other trips are those trips undertaken for purposes not classified in this study. They include trips to collect forgotten items, trip to recover vehicle impounded by the law enforcement agencies, trips to drop others, etc. This constituted an insignificant proportion (0.8%) of the average weekly total trips. Market is selected as the only significant variable with regression coefficient of r = .721 showing a strong position relationship between number of market and other forms of trip in the region. It means then that significant number of other trips is attracted by markets or market related activities. The following model has therefore been derived for other trips: ***Other trips = -4.707 + 1.83 (markets).***

10. Conclusion

The study has revealed eleven types of trips involved in the movement among the urban centers in the study region. They are; work trip, school trip, recreation trip, religious trip, medical trip, wedding trip, burial trip, market trip, personal business trip, trips to visit friends/relations and other trips. The volumes of these trips generated each week have also been determined. According to the analysis, school trip ranked the highest trip type the people undertake in the region, while wedding trip is the least generated type of trip.

A number of socio-economic development factors have been identified as contributing to variations in the interaction patterns. These factors are the number of tertiary educational institutions, the number of markets, the number of industries, the number of tourist sites and the number of hospitals. The levels of their influence have also been unraveled. Using step-wise multiple regression analysis, models were formulated to aid estimate future patterns and changes in volumes of the various types of trips undertaken given any change in the number of the socio-economic factors in the region.

The continuing transportation planning process requires adequate monitoring and updating the interaction patterns and trips generation relations when sufficient change warrants. Since the interaction patterns provide the linkage between socio-economic development factors and trip, it is important that the relationships established be evaluated periodically for stability and applicability. Likewise, changes in the socio-economic characteristics in the various urban centers must be monitored on a continuing basis to evaluate changes in trip generation for the most current forecast. To accomplish this "Surveillance Transportation Programme" is recommended. The 'programme' will constantly generate and maintain data on trip, land-use and socio-economic data. It will constantly evaluate, update previous forecasts through a routine review process. The "programme" will thus become the regional transportation decision support base.

References

Akpoghomeh, Osi S. (2003). *Transport Development Analysis and Planning* (2nd Ed.). Nigeria: Man Printers, pp. 101-117.

Bolade, T. (1992). Long-Range Plans for the Development of Urban Mass Transit in Nigeria. In: Ikya, S. G. (Ed.) *Urban Passenger Transportation in Nigeria*. Nigeria: Heinemann, pp.51-78.

Daniel, E. (2012). *Inter-Urban Transportation Patterns in a Sub-Region of Nigeria: Analysis.* Lap Lambert Academic Publishing GmbH & Co. KG, Saarbrucken, Germany.

Daniel, E. (2005). Trip Generation Models in a Developing City of Nigeria. *International Journal of Social Sciences,* 5 (1): 1-18.

Mbat, D., Ibok, E and Daniel, E. (2013). Exxon-Mobil and Corporate Social Responsibility in Akwa Ibom State, Nigeria: Past and Present. *Public Policy and Admnistration Research,* 3 (3): 21-28.

Okoko, E. and Fasakin J. (2007). Trip Generation Modelling in Varying Residential Density Zones an Empirical Analysis for Akure, Nigeria. *The Social Sciences*, 2 (1) : 13 – 19.

Oyedepo, O. J. and Makinde, O. O. (2009). Regression Model of Household Trip Generation of Ado-Ekiti Township in Nigeria. *European Journal of Scientific Research,* 28 (1): 132 – 140.

Oyesiku, K. (1995). An Analysis of the Demand for Inter-city Trip Generation Attributes of a Developing State in Nigeria. *Journal of Transport,* 1(1): 17-27.