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Telecommunication (GSM) and Urban Spatial Structure in Ibadan North Local Governmnet Area, Nigeria

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Abstract: The role and impact of novel telephone technology in shaping urban structure has produced two schools of thought. The first is evolutionary, which believe in the continuing primary of physical movements and the second, is revolutionary which elevates the importance of non-physical information flows. The revolutionaries believes that new telecommunication innovations will create a flexible electronic environment that will enable people to inhabit attractive amenity environments, remote from declining urban centers thereby influencing people's choice as regards location in urban setting. In this study an analysis of the effect of mobile communication through the use of GSM phone on intra-urban movements and location decision was considered. Study revealed that mobile communication does not have much effect on important trips such as trips to work, to market place, shopping centers and recreational locations. It is concluded that most of the trips eliminated through the use of mobile phone are discretionary trips. The study also discovered that income rather than communication largely determines the location of households in Ibadan North. It is therefore concluded that communication has not inverted the existing spatial pattern since it has not withdrawn trip away from important centers or changed the location pattern of activities in the study area.

Keywords: Environment, intra-urban, spatial interaction, telecommunication, transportation

INTRODUCTION

Urban areas all over world are noted for complexities and concentration; these complexities arise from various activities that go on in urban space. Such activities include those arising from manufacturing trading and finance, transportation and tertiary activities. All these activities are distinctively urban in nature and combined to create the spatial configuration of the urban centers. The spatial configuration of urban centers is however made up of several land use types that create spatial imbalances and necessitate spatial interaction in order to allow functional inter-relationships.

Spatial interaction as explained by Ullman (cited in Boyce and Ullman, 1980) is a system explaining materials interaction based on three factors namely; complementary a function of area differentiation promoting spatial interaction. Secondly, intervening complementarily complimentary ("or opportunities") between two regions or places which set up a constraint as to the possibility of interaction taking place and thirdly, distance or transferability, which is measured in real terms including cost and time of transport and effect of improvement in facilities.

The system thus applies primarily to interaction based on physical movement principally of goods, but also to a large extent of people. Spatial interaction is therefore a means for proving satisfaction of certain needs arising from the locational separation of producers and consumers. It depends on reciprocal relations between different places on the earth surface.

In an urban setting spatial interaction could be classified into two types the first are those that involve physical contact like day-to-day movement of people and the second are those that do not require such contacts like telephoning and or letter writing (Ayeni, 1979, 2000).

In urban analysis physical contacts especially day-to-day movement are important in studying the structure of a city, based to this are the day-to-day movements which has to do with activities such as trip making to and from places of work, markets and shopping centers and recreational and educational facilities. As Ayeni (1974) noted, "basic to the use of trips to characterize urban forms are two notions; first, that trips measure interdependence in an urban systems and second that each trips type is role of communication media in reshaping the urban future (Clark, 1973). The impact that telecommunication will have no urban morphology and human movements has attracted the interest of scholars such as Nilles (1975), Goddard (1968) and Goddard and Pye (1977); among many others. While some of these scholars recognizes geographical important of communication flow, yet they were unclear about the role of communication as

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agencies of change in the spatial system. Telecommunications have been used as indices of spatial structures (Nysten and Dyer, 1997) rather than as measures of dynamic process (Clark, 1973). Most scholars also stress on substitution hypothesis i.e., communication substituting transportation rather than focusing on effect of communication media on urban structure.

The advent of new, more advanced communication technologies particularly Gbobal System for Mobile Communications poses a fresh dimension to the scenario. The Growing use of Mobile phone (GSM) may be doing far more than influencing people movement in urban space. It has been reported that over 14 million people are telephone subscriber in Nigeria, with about 12.8 million digital mobile lines (The Guardian, Wednesday June 1st, 2005). Also call centers are on the increase on daily basis (The Punch, Tuesday May 4th, 2004). This perhaps may have begun to change the character of activities that occur in spatial system in this part of the world. The questions that now readily come to mind are; has new telecommunications technologies close geographical variation? Has it alter our concepts of time and space/and has it remove the disadvantages of remoteness? All these worth investigation.

This study therefore attempt to investigate the influence Global system for mobile communication on human movement within the city and locational decision, in order to place in proper perspective the relationship that exist between communication and spatial structure.

STUDY AREA AND METHODOLOGY

Study area: The choice of the study area for this research is faced with three major criteria; first, an area that has economic base that could generate sufficient spatial interaction is needed if appropriate data and analysis shall be obtained. Secondly, there is time constraint on the part of the researcher which necessitate that an area that satisfy the first condition and at the same time could be easily covered is necessary.

Thirdly, an area with population of diverse socio-economic characteristics is needed, this is necessary to support viable interactions data, for viable interaction could only exist among diverse socio-economic characteristics.

Based on the above criterion, Ibadan North Local Government was chosen as a study area because it satisfies all the conditions above.

Ibadan North was part of former Ibadan Municipal Government; it has her headquarter temporarily at Quarter 87, GRA Agodi. The Area extent of the local government is about 163 km^2 with a population of 302,271 people (1991 population census). Ibadan North Local Government Area has 12 wards, its host major institutions in Ibadan and contains several other land use zone viable for interaction studies such as zoo, trans-amusement park etc., for recreational purposes. Large part of its area could be classified as middle outer suburb.

Majority of the population of Ibadan North are in private sector. Tfeey are mainly traders and artisans. A good number of its workers are civil Servants who live predominantly around Bodija estate, Agbowo, Sango, Mokola, the University of Ibadan Quarters and Polytechnic Ibadan Area (Abumere, 1994).

Methodology: Here the research hypotheses for this research and technique used in testing them were discussed, the data base for the study, the research design and sampling size were also discussed.

Research methodology: The following research hypotheses are formulated:

- Ownership of GSM phone is significantly related to the socio-economic characteristics of respondents.
- There is a significant relationship between the volumes (number) of telephone calls and location (distance) separating the residence of the user of GSM phone from their workplace.
- The volume (number) of telephone calls made by the user correlates significantly with the number of work trips made from home. Operational variables and Method of Analysis.

For hypotheses 1, the dependent variable is ownership of GSM phone, while the independent variables used in testing the hypotheses are, income, job type, level of formal education, size of family, marital status, sex and age. Regression analysis was used in testing this hypothesis.

However, in hypotheses 2 and 3 correlation analysis was used. The volume (number) of telephone call made by the user in a week was correlated with distance separating him/her from her workplace. Also the volume of telephone call made in a week is also correlated with the number of work trips made from home in a week.

The data base for the research: For this present research, a very detailed data base that includes both primary and secondary data was employed. One reason for this is to allow accuracy and cross-checking, four major types of data are required for this research; they include those on urban interactions, socio-economic characteristics, residential location and record of telephone call.

As a source of primary data, a structured questionnaire was used to collect information on telephone call among respondents. The questionnaire contains telephone diary to be kept by respondents for a

week for a record of telephone calls made and received. It also contains the socio-economic characteristics information, it further investigates information on location decisions both telephone owners and non-telephone owners.

Secondary data used in this research include data on population, land use and other institutional data obtained majority from the Local Government Ministry and Parastatals and Corporations.

Research design and sampling size: The determination of sampling size for this research was on the basis of the field report and rate valuation data obtained from Oyo State valuation office. The 2006 census survey data was first determined to be used but unavailability of data as regard number of households in each wards of the local government serve as constraint.

The rate valuation data divided Ibadan North local government into 26 rate districts and communities and provide number of properties and class of properties including number of the rate payers in the area. The number of properties identified in their latest report is 27,881 properties which include residential properties; this was used to sample population for this study. For this research a 10% sample survey would mean interviewing 2,788 heads of households which is indeed enormous.

However, because of time constraints involved in research of this nature, it was felt that the proportion might be reduced. Therefore, about 1% sample survey was consequently decided to be interviewed. A total of 222 head of households were interviewed. The next stage was the distribution of the questionnaire to the 222 heads among the rate district and communities in Ibadan North. This is done in percentages according to the numbers of properties identified in each rate district. Having found the percentage questionnaire to be distributed in each area based on the data for each district, (Hen Street layouts were used in distributing the questionnaire.

The research involve a random sample of respondents, therefore random sampling technique was employed. A location was chosen as a centroid in each rate district and using the street layout the questionnaire was distributed among households in each rate district and communities that made up Ibadan North local government area.

THEORETICAL AND CONCEPTUAL UNDERPINNING

Concept of urban spatial interaction: Ullman (1954) in an attempt at explaining the bases for interaction in space bequeathed three concepts of spatial interaction to the field of human geography. The three concepts are complementarities, intervening opportunities and Distance/Transferability. Complementarily is a function both of natural and cultural areal differentiation based on existence of demand in one area and a supply in the other. The areal differentiation is simply based on the operation of economics of scale.

However, complementarily generates interchange between two areas only if no intervening, complementarily source of supply exist. Intervening opportunities therefore set up constraints as to the possibility of interaction taking place (Ayeni, 1979).

The third concept in an interaction system is Distance/Transferability measured in terms of time and cost. If distance between areas of supply and demand were too great and too costly to overcome, interaction would not take place in spite of perfect complementarily and lack of intervening opportunity. Thus while complementarily may generate interaction, the factors of interviewing opportunities results in a substitution of areas and factors of transferability results in a substitution of products (Ullman, 1954 cited in Boyce and Ullman, 1980). These concepts of spatial interaction were applicable to this study because human movement in urban space is based on me urge or desire to satisfy felt needs arising from the separation of activities in space. Because activities are not located in one place, that is. A place of demand is different from a place of supply and also because distance varies over space, human being needs to move. These movements therefore create interactions in space which could involve physical contacts like the day-to-day movement of people and those that do not require such contacts like telephoning (Ayeni, 1974, 1979).

Significantly day-to-day movement have become a crucial variables in studying the structure of a city, particularly those that involve trip making to and from places of work, market and shopping centers and recreational and educational facilities, (Ayeni, 1974, 1979).

Trip generation model (multiple linear regression models: Trip Generation model strives to forecast the number of person trips that will begin from or end in each traffic zone within the town for a slated period of time. The sum total of person-trips generated constitutes the dependent or criterion variables of the model. The predictor or independent variable include land use and socio-economic factors that are known to influence trip making e.g., income, size of me household, distance, age, sex, level of education of the household head etc., (Okoko, 1999).

Multiple regression analysis as a model is frequently used in trip generation analysis for example as in Ayeni (1974), Wilson (1972), Abumere (1986) and Okoko (1999), etc. The use of the model is founded on its ability to provide information on the current volume of trips associated with a zone and which could also be projected to determine future trip generation for the zone in concern.

Table 1: Model summary

Model	PR	R^2	Adjusted R^2	S.E.E.
1	0.540	0.291	0.268	0.404

Table 2: ANOVA

Model	S.S.	Df	M.S.	F	Sig.
Regression	14.325	7	2.046	12.567	0.000
Residential	34.846	214	0.163		
Total	49.171	221			

The model can also incorporate dummy variables and thereby give room for variables or determinants which could not be measured or calibrated at intervals, ratio or continuous scales but in binary or dichotomous forms. The model equation is defined by the form:

$$Y = a + \sum bi\ xi + e \quad (1)$$

The equation above Eq. (1) can be expanded to accommodate 'n' numbers of predictor variables as follows:

$$Y = a + bixi + b2x2 + b3x3 + ... bnxn + e \quad (2)$$

where,

Y = The criterion dependent variables
a = The intercept of the regression plane or hyper plane
Xi-xn = The predictor or explanatory or independent variable
bi-bn = The partial regression coefficients
e = The error terms of prediction

However, for the mode! to be effective its basic assumptions must be satisfy, which include; normality, linearity, measurement error free, no auto correlation and ko the sample must be randomly selected from the sample assume (Ayeni, 1974, 1979). Violation of these assumption produce wrong analysis and interpretation. The model as a result becomes more suitable to this study.

RESULTS AND DISCUSSION

GSM ownership and socio-economic characteristics of respondents: To examine the relationship between the above, hypotheses 1 was tested.

Hypothesis 1 states that, "Ownership of GSM phone is significantly related to the socio-economic characteristics of respondents".

The null hypothesis (Ho) states that "Ownership of GSM phone is not significantly related to the socio-economic characteristics of respondents".

Having explored the socio-economic characteristics of the respondents, this hypothesis was tested (Table 1, 2 and 3).

From the result presented above, the multiple correlation coefficient (R) which expresses the relationship between the dependent variable (y) (ownership of GSM phone) and the predictors variables (income, marital status, age, level of formal education, job type, gender and size of family) is 0.540 which implies that ownership of GSM is significantly related to the socio-economic characteristics or respondents However, the coefficient of multiple determinations (R^2) is found to be 0.291. The R^2 gave the contribution of explanatory variables to GSM phone ownership, therefore when multiplied by 100; it indicates that the variables used in this analysis could explain only 29% of the total variation in phone ownership.

The above suggests that other relevant variables such as car ownership, type of accommodation, length of residence, number of workers per households among many others should be included. The analysis of variance value of F = 12.567, which is significant at 0.000 confirms the significance of the regression equation, so hypothesis is accepted and the null hypothesis is rejected.

One can now turn to look at the contributions of each explanatory ^variable. Here, the beta coefficients become useful because they have the advantage that they represent the weights of the contribution of each variable (Ayeni, 1979). The beta coefficients show us that the size of the family is the highest contributor to the regression model contributing about 0.214, followed by age which contributes 0.16 and job type which contributes about 0.415, this is quite true, because the size of the family being catered for will determine monthly expenses and the left over from which purchase of GSM could possible. Young head of households half the possibilities of owning GSM phone

Table 3: Coefficients

	Unstandardized coefficients		Standardized coefficients		
Model	B	S.E	6	t	Sig.
Constant	1.65	0.234		7.036	0.000
Age	5.300E-E	0.020	0.016	0.276	0.786
Gender	-3.74-02	0.640	-0.037	-0.580	0.563
Marital status	-111	0.116	-0.060	-0.953	0.341
Size of family	5.522E-02	0.017	0.214	3.307	0.001
Level of educ.	-1.97E-02	0.033	-0.035	-0.595	0.553
Job type	1.334E-02	0.006	0.145	2.287	-23
Income	-3. 9 IE-02	0.005	-0.480	-8.204	0.000

Author's field survey (2012)

Table 4: Correlations

	Average calls made in week	Dist. traveled to place of work
Average calls	1	0.091
Sig. (2-tailed)		0.179
N	222	222
Dist. traveled	0.091	1
Pearson corrl. sig. (2-tailed)	0.179	
N	222	222

Author's field survey (2009)

because they have few family members to catered for likewise those who job requires them to be on the move or in regular contacts are likely to own GSM.

Significantly we can see from the beta coefficient that income does not contribute significantly to the model. The reason is because GSM phone ownership is not dependent largely on income. The low and high income earners could own GSM phone since the price has been on decrease. Moreover it could be bought for others as gift based on goodwill.

Relationship between volumes of telephone calls, distance and number of work trips: Hypothesis two and three are tested to examine the above. Hypothesis two states that:

"There is a significant relationship between the volume of telephone calls and distance separating the residence of the user of GSM phone from then-work place" The null hypothesis states that:

"There is not significant relationship between the volume of telephone calls and distance separating the residence of the user of GSM phone from their work place"

Correlation analysis was used to test the above stated hypothesis. Using Pearson correlation, r is found to be 0.091 and significant at 0.179% as shown in the Table 4.

The correlation result presented in Table 4 shows that there is positive relationship between the volume of telephone calls and distance separating the residence of the user of GSM phone from their workplace. In other words, the result implies that distance between workplace and residence is a factor determining the volume of telephone calls made by users of GSM phone. So hypothesis 2 is accepted and the null hypothesis is rejected. However, the strength of the correlation shows that there is little correlation between distance separating the residences of users of GSM phone and their workplaces, which implies that distance has little impact on volume of telephone calls made by respondents.

To determine the contribution of distance separating residence and workplace to volume of telephone calls made by respondents, the correlation coefficient of determination was calculated and found to be 0.0083. The percentage contribution is therefore 0.0083100 which gives 0.83%. The implications of this are mat other factors account for about 99% of variations in volume of telephone calls made by respondents. Such factors will largely include economic factors accessibility to mobile communication system, human perception, among others.

Table 5: Correlations

	Average calls made in week	No of work trips before GSM
Average calls	1	0.151
Sig. (2-tailed)		0.025
N	222	222
No of trips to work before GSM Pearson cord	0.151	1
Sig. (2-tailed)	0.025	
N	222	222
	Average calls made in week	No of times now in a week
Average calls in a week	1	154
Sig. (2-tailed)		022
N	212	222
No of times now in a week	0.091	1
Pearson corrl. sig. (2-tailed)	179	
N	222	222

To rest for hypothesis three Pearson correlations was also used and the results are presented in Table 5. Hypothesis three states that:

"The volume of telephone calls made by the user correlates significantly with the number of work trips made from home" The null hypothesis states that:

"The volume of telephone calls made by the user does not correlate significantly with the number of work trips made from home"

Hypothesis three was tested twice, the volume of average calls made hi a week was tested against number of trips made to work place before the advent of GSM, was found to be 0.151, significant at 0.025%. For number of trips made now, r was found to be 0.514, also significant at 0.022% as seen in Table 5.

The correlations results show that there is relationship between volume of telephone call made by the user and the number of work trips made from home. However, the level of the correlation was low. If coefficient of determination which is r^1 is calculated then r^1 will be 0.023 and 0.024 which imply that about 2.3% variations in the volume of telephone calls among respondents can be explain by the work trips made from home.

The above shows that work trip influences some of the telephone calls made by the respondents. This therefore suggests that some work trips are scheduled or rescheduled by telephone calls while in some other instances work trips are generated by telephone calls. However, field survey data indicates that about 14% of the total call made by respondents within this period, of research lead to trip making.

Factors that inform respondent's residential location: Field survey data in Table 6 indicated that about 70% of respondents' decision on residential

Table 6: Correlations

	Frequency	(%)
Income	155	69.8
Proximity to work place	45	20.3
Personal satisfaction	22	9.9
Total	222	100.0

Author's field survey (2012)

location was determined by their income. This no doubt gives credence to Alonso model. However attempt was made to see whether availability of mobile communication system could influence the respondents' decision on residential location in the nearest future. About 3% of the respondents indicated that mobile communication system could influence their future residential location decision; so far it is affordable, accessible and makes contact easier than before.

Over 45% of respondents based their future decision on residential location on income, 29% based their decision on proximity and personal satisfaction while the rest do not contemplate relocation at all.

The foregoing imply that communication via mobile phone has not had any significant influence on residential location decision in Ibadan North, however there is a possibility of such occurrence taking place in the nearest future.

CONCLUSION

The discussion on the role and impact of telecommunication technology has raised two schools of thought; the first is evolutionary which believe in the continuing primacy of physical movements and the second, the revolutionary which elevate the importance of non-physical, information flows. The revolutionary believe that new telecommunication innovations will create a flexible environment that will enable people to inhabit attractive amenity environments, remote from declining urban centers, thereby influencing people's choice as regards locations in urban setting.

The present study has attempted contribution to the overall discussion by using primary data to examine the effects of new telecommunication technology on spatial structure. The study found that rather than altering the exiting spatial telecommunication shows the evidence of strengthening the existing structure because the use of this new innovation has not significantly withdrawn trips from the nuclei of growth in the study area, neither has it changed location in the urban setting as postulated by classical urban location theories.

However, future researches could examine trends of growth in spatial structure and the contribution of telecommunication to the spatial growth trends of the urban area particularly in developing countries.

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