Arterial Road Network and Commercial Property Values: Case Study of Ikeja, Nigeria

By

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Abstract

A number of factors determine commercial property values in Ikeja, Nigeria, road network has been identified as one of them. This study was carried out to determine the contribution of arterial road network to variability in commercial property values in the study area in the presence or absence of other factors. In doing so, road network was decomposed into its explanatory variables and regression models used to analyze the relationship with commercial property values. It was found that accessibility, demand, and supply of commercial properties have significant relationships with commercial property values. Models to assist property developers predict commercial property values along the arterial roads in the study area were derived, while it recommended that road network be improved to enhance values of commercial properties to benefit Government, owners and occupiers of commercial properties in the study area.

Key words: *arterial roads, commercial property, property value, road network, valuation, variability*

Introduction

Roads may be classified as international, inter-city or intra-city. International and inter-city roads are usually major or arterial roads, while intra-city roads are routes within a city and may be minor or major (arterial). The pattern of road network somewhat influences ease of movements and provides accessibility to various land uses which compete for available spaces along the arterial roads. Commercial properties tend to cluster along such roads to take relative advantages of agglomeration. Also, competition makes locations along the road to be at their highest and best use translating in high rental values compared to other locations lacking such competition.

As result of the advantages, developers, financiers and investors in commercial properties are faced with dearth of data on what level of rental income a development project could reasonably be expected to realize in a transaction involving willing and able parties to such project. The overall impact of risks and uncertainty in the property market calls for tool to predict with some measure of accuracy the future trend in commercial property market. This is to ensure that income that a given commercial property generates in the nearest future will continue to recoup the capital outlay and be sustained subsequently.

A number of factors affect commercial property values in Nigeria. These include institutional and economic factors, location, complementary uses, competition amongst and between uses, design, degree of obsolescence, accessibility, road network, relationship between landlord and tenant, and negative externalities (McCluskey et al, 2000; Oyebanji, 2003; Kuye, 2003; Kauko, 2003; and Omoogun, 2006). These studies have focused on the factors in relation to commercial property values with less emphasis on road network that drives many of them.

The aim of this study was therefore to determine the relationship between commercial property values and arterial road network, in the presence or absence of the other factors. In doing so, one hypothesis was set and stated in the null form: "that there is no statistically significant relationship between arterial road network and commercial property values in the presence or absence of other property value determinants". The hypothesis was tested at alpha level set at 0.05 confidence level.

Related Studies

In explaining pattern of property values in relation to transportation, Lean and Goodall (1977) opined that the centre of an urban area is the position of greatest accessibility where transport routes and systems converge. Competition between firms whose revenue is high when in such a position will force up rents and land values above those in the remainder of the urban area.

Firms will compete to locate in the centre to take advantage of complementarity, which to a large extent, is a function of accessibility. The larger the urban areas the more distinct will the clusters of complementary uses become. For instance, office centre will separate from the shopping centre. Similarly, the higher the degree of accessibility and complementarity the higher the land values in the centre are likely to be. As accessibility decreases from the centre it is expected that the value of commercial property will decrease, that is, where main and secondary roads are placed will be major determinant in the location of the commercial uses.

According to Aderamo (2003), road network constitutes important element in urban development as roads provide accessibility required by different land uses in the urban areas; and proper functioning of such urban areas depends on efficient transport network, which is backbone to their very existence. The analysis of the road network involves recognition of the patterns and qualities of the roads, which can be emphasized through process of abstraction and symbolization (Xie and Levinson, 2006; Zang and Lund University, 2004; Mackaness and Edwards, 2002; Moilanen and Nieminen, 2002; Doak et al, 1992; Taylor et al, 1993; Lindenmayer and Possingham, 1996; Schumaker, 1996; With et al., 1997; and Tischendorf and Fahrig, 2000).

A number of techniques have been used in road network analysis, which include urban morphology (Conzen, 1969; Whitehand, 1981; Moudon, 1997), fractal analysis (Batty and Longley, 1994), cellular automata (Batty, 1997), traffic pattern analyses (Vaughan, 1987; Taylor, 2000), and graph theoretic approach (Muraco, 1972). Other techniques are connectivity, shortest path spanning tree, and minimum cost spanning tree to facilitate structural analysis and road selection in road networks have equally been used by Mackaness and Edwards (2002), Jiang and Claramunt (2004), and, Jiang and Harrie (2004). Thomson and Richardson (1999) used perceptual grouping of roads into segments according to continuation principle by ordering and selecting strokes into which the roads are segmented,

while agent-simulation approach consisting of algorithm base for road generalization was adopted to create version of network of roads that exhibits certain properties which includes connectivity, length of roads, degree of continuation, and degree and frequency of usage (Morisset and Ruas, 1997). Other method is graph theoretic analysis, which are conventional transport network analysis and a method of analyzing urban spatial structure (Thompson, 1948; Berge, 1958; Hagget and Chorley, 1969; March and Steadman, 1971; Kruger, 1979; Hillier and Hanson, 1984; and Broadbent, 1988).

Various studies have adopted the theory amongst which are Garrison and Marble (1960) and Nystuen and Dacey (1961). The former applied graph theory in measuring regional highways in the United States of America, while the latter analyzed functional connection between central places in Washington using communication flows in a network. In addition, Muraco (1972) used the concept in studying intra-urban accessibility in Columbus and Indianapolis, USA, and in estimating traffic flow in Barnsley, U.K. (Ogunsanya, 1986). In Nigeria, Aderamo (2003) used graph theoretic analysis in studying the growth of intra-urban network in Ilorin, Nigeria; while the technique was used to determine degree of accessibility and connectivity of nodal points within a road network using a university community in Nigeria as case study (Oni, 2008) and in analyzing accessibility and connectivity in the road network of a metropolitan area also in Nigeria (Oni, 2007; 2009). The works succeeded in establishing different levels of accessibility of the arterial roads in the study areas but did not relate the degree and levels of such accessibility and connectivity to commercial property values.

The Study Area

Ikeja city is a large component of the Lagos metropolis. Lagos itself is the largest city in Nigeria, located at 6°34′60″N, 3°19′59″E along the West African coast. There are ninety roads in Ikeja metropolis out which thirty-seven are arterial. From the thirty-seven arterial

roads twenty traverse the commercial axes while others serve institutional, industrial, and residential neighbourhoods. This study covered all major roads serving the commercial axis and inner areas of Ikeja metropolis to the exclusion of inter-city roads such as Lagos/Abeokuta Expressway, Oworonsoki/Apapa Expressway, Ikorodu Road, and Lagos/Ibadan Expressway that form rings around the study area. The study area is divided into seven sectors.

As shown in Fig. 1, Sector One consists mainly of residential neighbourhoods with occasional commercial users of banks and service offices; Sector Two is of predominantly industrial concerns and Sector Three which is almost centrally located is comprises residential users interspersed by few industrial concerns and commercial outfits. Sector Four lies at the eastern part, while Sector 5 is characterized by high concentration of commercial properties and represents the main commercial axis of the study area. Sector Six occupies the southern part of the study area consisting mainly of Government Residential Area (G. R. A), and institutional properties (Army Barracks, Police Barracks, High and Magistrate Courts, Lagos State Administrative Centre, Passport Office and Nigeria Telecommunication Limited) with properties along major roads in the Sector having undergone changes from residential to commercial user.

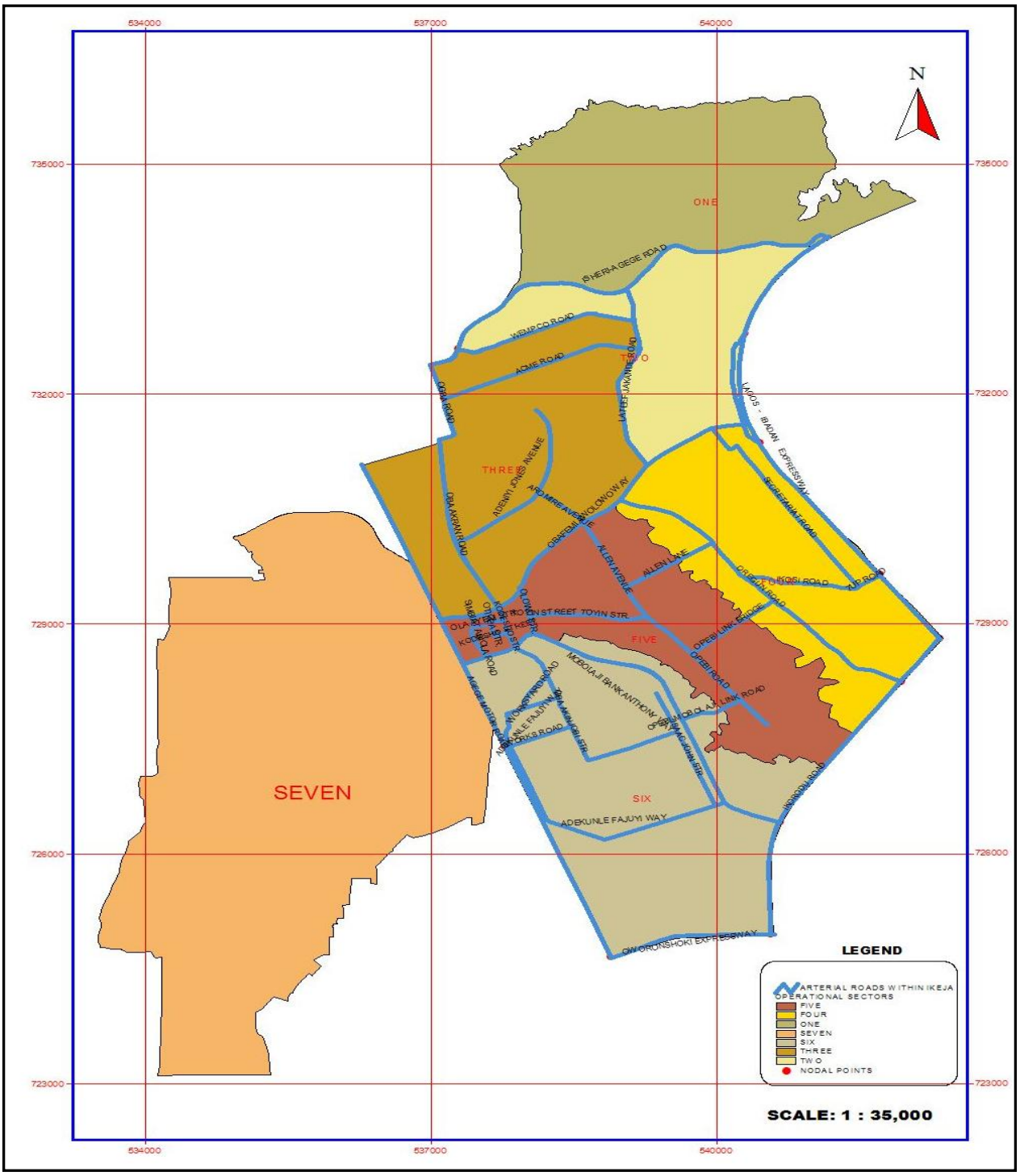

Fig. 1: Satellite Image of Operational Sectors in Ikeja Metropolis
Source: Lagos State Planning Information Centre, Ikeja

Materials and Methods

Data were collected from primary and secondary sources. The primary data were obtained from estate surveyors and occupiers of commercial properties, while secondary sources

included Survey Directorate in the Lagos Ministry of Land and Physical Planning; Ministry of Transportation; Directorate of Land Information Systems in the Land Bureau; Governor's Office, Ikeja; and West African Book Publishers Limited, Lagos. Details of road network were derived through the analysis of the satellites road maps while volumes of traffic were obtained from Lagos State Traffic Management Authority.

The entire Lagos metropolis has 9,197 roads consisting of carriageways, cul-de-sac, lanes, streets, avenue, ways, and crescents. Out of 9,197 roads in Lagos metropolis, only 350 are arterial. When the three hundred and fifty (350) arterial routes were divided according to zones in Lagos metropolis, Lagos Island has 102 arterial routes (representing 29%); Mainland, 119 (34%); Apapa, 39 (11%) and Ikeja, 90 (26%). From the ninety roads that traverse the study area only twenty (20) are commercial axes while the remainders serve institutional, industrial, and residential neighbourhoods. This study covered major roads serving the commercial axes in Ikeja to the exclusion of inter-city roads that form outlying ring around the study area. Sampling of the arterial roads was not necessary as hundred percent of roads is considered to make complete network.

There are three hundred and twenty-five registered firms of Estate Surveyors and Valuers practicing in Lagos metropolis out of which one hundred and ten (about 34%) operate in Ikeja. In respect of population of commercial properties in the study area, there are two thousand and eight commercial properties located along the twenty arterial roads giving an estimated five thousand occupiers. The number of commercial properties along arterial roads in the study area was obtained using application of geographical information system while population of occupiers was obtained by direct survey. The population of Estate Surveying firms in the study area was obtained from the register of firms at the Lagos State Branch of the Nigerian Institution of Estate Surveyors and Valuers.

In determining the appropriate sample size for each of the study populations, the

Bartlett et al (2001) model was used with alpha level set at 0.05. The model specified minimum sample size for continuous and categorical data based on specific population size and different alpha levels. The sample size of Estate Surveyors was obtained from population of one hundred and ten firms, this translated to ninety-nine firms six hundred occupiers out of total estimated population of five thousand were considered adequate based on the model. Average rental values of commercial properties were determined over a five-year study period.

Analysis and Discussion

In testing the hypothesis that there is no statistically significant relationship between arterial road network and commercial property values in the study area, the relationship between commercial property value and road network which were respectively the dependent and independent variables were tested at 95% confidence level. The road network was decomposed into its explanatory variables of traffic density (traden), road density (rlgt), length density (lden), accessibility (acc), connectivity (conn), and road quality (rqlt). This was in addition to other factors like demand (dmd), supply (spl), and location indices (lct) of each road in the network.

Average rental values of commercial properties were obtained by summing up the open market rents obtained from the respondents over a five-year study period and along each arterial road. Average rental value per annum expressed in Naira per square metre per annum was consequently determined as shown in Table 1.

Table 1: Mean Rental Values of Commercial Properties along Arterial Roads in Ikeja

S/N	Road	2003	2004	2005	2006	2007	Average Rent/m^2 p.a.
1	Allen Avenue	4,500	5,000	6,400	8,000	10,500	6,880
2	Adeniyi Jones Avenue	4,500	5,500	6,500	8,500	9,000	6,800
3	Opebi Road	4,500	4,500	6,000	8,000	10,000	6,600
4	Bank-Anthony Way	3,500	5,000	6,000	7,800	9,500	6,360
5	Oba Akran Avenue	3,600	5,000	6,000	8,000	9,100	6,340
6	Bank-Anthony/Opebi Way	3,500	5,000	6,000	7,500	9,000	6,200
7	Toyin Street	3,600	4,500	5,800	8,000	8,700	6,120
8	Aromire Avenue	4,000	4,500	5,600	7,800	8,500	6,080
9	Kodesho Street	3,000	4,200	5,000	6,500	8,000	5,340
10	Ogba Road	3,600	4,500	5,000	6,000	7,000	5,220
11	Awolowo Way	3,500	3,500	5,000	6,000	8,000	5,200
12	Simbiat Abiola Road	3,000	3,500	4,800	6,000	8,000	5,060
13	ACME Road	3,500	4,000	5,000	6,000	6,500	5,000
14	Lateef Jakande Road	3,000	4,000	4,500	6,500	7,000	5,000
15	Olowu Street	3,500	3,500	5,000	6,000	6,500	4,900
16	Opebi Link-Road	3,500	3,600	4,500	5,000	7,000	4,720
17	Oregun Road	3,000	3,500	4,500	6,000	6,500	4,700
18	WEMPCO Road	3,000	3,500	4,000	5,000	6,000	4,300
19	Ikosi Road	3,000	3,000	4,000	4,500	5,700	4,040
20	Isheri/Agege Road	3,000	3,200	3,500	4,000	5,500	3,840

Furthermore, the independent variables were consequently measured. The accessibility and connectivity indexes were derived using graph theoretic analysis of the arterial roads. Process of determining the accessibility index involved tracing out the arterial routes (in Fig. 1) using transparent paper to derive graph of the roads shown in Fig. 2 below.

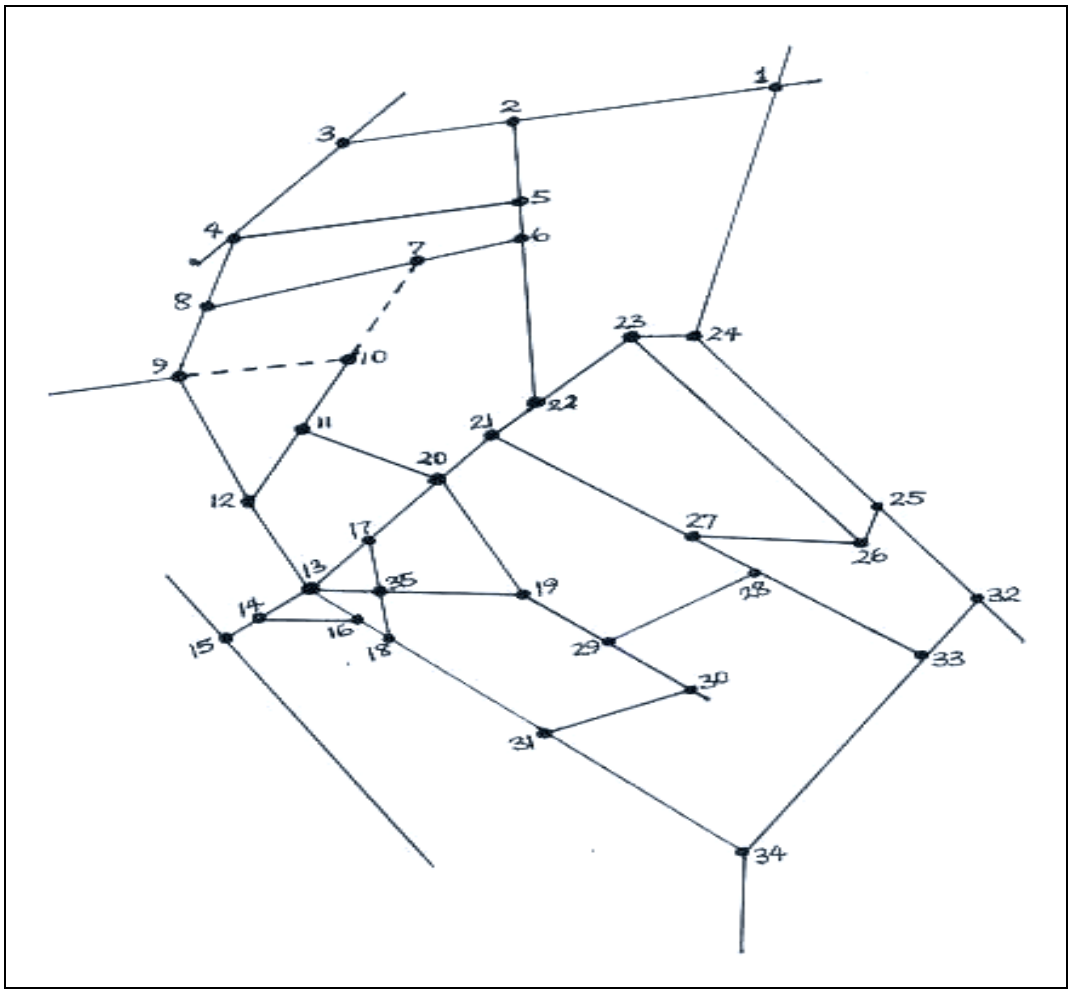

Fig. 2: Graph of Arterial Roads in Ikeja Nigeria

The resulting graph in Fig. 2 above though qualitative in nature was transformed into quantitative data by converting the road network into linear graph, each route represented by single line regardless of width, quality and standard analyzed to obtain required quantitative data. The connectivity and accessibility matrixes were derived from Fig. 2. This involved numbering of nodal points in the graph serially. Indexes for accessibility and connectivity were thereafter determined and indicated in the Shimbel matrixes (Appendices I and II).

The matrixes summarize the number of edges required to connect each node or vertex with every other nodes in the network through the shortest path, while the connectivity matrix indicates nodes with the highest total number of connections or linkages to other nodes. In the connectivity matrix, a score of 0 or 1 was given to each node, that is, where two nodes are directly linked; a value of 1 point was given. Where two nodes have no direct link, a score of

0 point is assigned. The connectivity matrix therefore shows the number of other nodes that a particular node is directly linked with and the node with the highest total number of points is considered as most connected. Similarly, the node with the least Shimbel index is regarded as the most accessible.

As shown in Fig. 2, twenty arterial roads in the network encompassed thirty-five nodal points. In measuring the accessibility and connectivity indices for thirty-five nodal points in the road network, each point was weighted in relation to the arterial roads to obtain accessibility and connectivity indices in the network using Eqn. 1 formulated by Oni (2009).

$$\beta\, a,(c)_i = \frac{\delta p_{1i} + \delta p_{2i}}{\sum (r\delta_1 + r\delta_2)} \times \frac{r\delta_1}{r\delta_2} \qquad \textbf{…Eqn. 1}$$

where, $\beta\ a(c)_d$ = weighted accessibility or connectivity index; δp_{1i} = accessibility or connectivity index of lower nodal point; δp_{2i} = accessibility or connectivity index of higher nodal point; $r\delta_1$= rank for lower nodal point; and $r\delta_2$= rank for higher nodal point.

The application of Eqn. 1 resulted in weighted accessibility and connectivity indices shown in Table 2.

Table 2: Weighted Accessibility and Connectivity Indices

S/N	Arterial Road	Weighted Connectivity Index	Weighted Accessibility Index
1	Opebi Link-road	0.02	0.10
2	Kodesho Street	0.08	0.55
3	Simbiat Abiola Way	0.10	0.57
4	Oregun Road	0.14	0.58
5	Toyin Street	0.15	0.64
6	Oba Akran Avenue	0.18	0.64
7	Bank Anthony Way	0.18	0.65
8	Awolowo Way	0.23	0.69
9	Aromire Avenue	0.23	0.72
10	Allen Avenue	0.23	0.73
11	Opebi Road	0.24	0.73
12	Lateef Jakande Road	0.25	0.73
13	Opebi/Bank-Anthony Way	0.26	0.73
14	Adeniyi Jones Avenue	0.27	0.74
15	WEMPCO Road	0.27	0.74
16	Ikosi Road	0.29	0.74
17	ACME Road	0.33	0.74
18	Isheri-Agege Road	0.33	0.74
19	Olowu Street	0.34	0.74
20	Ogba Road	0.35	0.75

Density of each road was measured by calculating the unit length of road in the network over total land area in the study area, and expressed as length per square metre. Eqn. 2 as formulated by Oni (2009) represents measure of density for each road in the network.

$$r_d = \frac{\sum_{i=1}^{n} lr_i}{A} \quad \textbf{…Eqn. 2}$$

where,

r_d = road density; $lr_{i\ldots n}$ = length of individual road; A = entire land area covered by the study area.

Traffic density was measured in terms of volume of vehicles over the entire land area. This determines the number of vehicles per square metre of land area and it is an indication of level of congestion in the study area. Data on traffic volume obtained from the Lagos State Traffic Management Authority (LASTMA) was determined by direct traffic counts along each of the arterial roads at specific hours over a six-month study period. The number of vehicles was subsequently related to the entire size of the study area. Length density expresses the relationship between individual length of arterial roads and total length of all arterial roads in the study area. The length of each road was determined and expressed in relation to total of lengths of all roads in the study area.

Quality of road was measured by direct observation of each arterial road in terms of width (whether dual carriage), lack of potholes, and motor-ability. A figure ranging between 1 and 5 was assigned to each arterial road depending on category of its quality, 5 represented the best quality and 1 the least. Arterial road that was tarred, motorable, with dual carriage and without potholes that could hinder vehicular movements was assigned 5; 4 for those that are tarred, motorable, having dual carriage but with potholes; 3 to road that was tarred, single carriage, with potholes but motorable. The road was tarred, with single carriage way, motorable and having potholes was assigned 2; while the road that was tarred, single carriage,

having potholes and are un-motor able is assigned 1. The width of road was measured by direct observation and physical measurement. Points were allocated based on whether the road is single- or dual- carriageway, dual carriage is assigned 2 while single carriage way is assigned 1 in the analysis.

In measuring location indices, the most accessible nodal point in the network of arterial roads was used as the reference point to which other locations were related. In doing so, the number of links from the farthest point on each road in the network was counted to the most accessible location in the network, taking the shortest routes possible. This resulted in location indices for the roads as shown in Table 3.

Table 3: Location indices of Arterial Roads in Ikeja

S/N	Road	Location index
1	Oba Akran Avenue	4
2	Kodesho Street	6
3	Obafemi Awolowo Way	5
4	Adeniyi Jones Avenue	3
5	Aromire Avenue	2
6	Allen Avenue	2
7	Opebi Road	4
8	Opebi Rd/Bank-Anthony Way	5
9	Bank-Anthony Way	6
10	Lateef Jakande Road	4
11	ACME Road	4
12	WEMPCO Road	4
13	Ogba Road	6
14	Isheri-Agege Road	5
15	Oregun Road	3
16	Ikosi Road	3
17	Olowu Street	3
18	Simbiat Abiola Way	4
19	Toyin Street	3
20	Opebi Link Road	2

Determination of demand for commercial properties was entirely based on transaction-based data obtained from the Estate Surveyors and Valuers. This involved analysis of the aggregate demand for income properties of various types and it is the sum of

all the quantities requested for by willing and able prospective tenants as available in the records of each firm of Estate Surveyors and Valuers in the study area. Aggregate demand was obtained by combining all demand schedules by individual firms in the study area. The aggregate transaction-based requests for commercial properties on yearly basis was obtained from the Estate Surveyors and Valuers over a five-year period for each arterial road.

Table 4: Demand for Commercial Properties along Arterial Roads in Ikeja

S/N	Road	Years/Average Number of Requests					Total	Percentage
		2003	2004	2005	2006	2007		
1	Obafemi Awolowo Way	18	23	31	54	49	175	13.57
2	Bank-Anthony Way	10	12	15	20	28	85	6.59
3	Oba Akran Avenue	11	14	20	22	21	88	6.80
4	Toyin Street	9	29	20	34	41	133	10.30
5	Oregun Road	6	9	11	12	13	51	3.95
6	Allen Avenue	23	21	29	33	38	144	11.00
7	Opebi Road	12	16	18	25	33	104	8.06
8	Adeniyi Jones Avenue	16	19	20	22	25	103	7.98
9	Lateef Jakande Road	6	11	11	12	12	53	4.10
10	WEMPCO Road	3	4	5	6	9	27	2.09
11	Isheri Road	5	4	5	5	8	27	2.09
12	Kodesho Street	5	7	8	11	14	46	3.57
13	Simbiat Abiola Way	6	8	8	9	11	42	3.26
14	Aromire Avenue	7	7	7	11	10	43	3.30
15	Olowu Street	6	7	9	9	14	46	3.57
16	Opebi Link-Road	3	3	4	6	6	23	1.78
17	Ikosi Road	2	3	2	3	4	14	1.09
18	Ogba Road	3	4	6	5	7	25	1.90
19	Bank-Anthony/Opebi Road	6	5	7	7	9	34	2.60
20	ACME	6	6	6	7	7	31	2.40
Total		**163**	**212**	**243**	**315**	**357**	**1290**	**100.00**

Similar approached was adopted to assess the supply of commercial properties. This was derived from sum of all the number of commercial properties effectively let in transactions involving willing and able tenants and owners acting through the firms of Estate Surveyors and Valuers within a five-year study period to arrive at average number of the transactions. Details of the number of letting transactions effectively completed in the study area during the study period are shown in Table 5.

Table 5: Supply of Commercial Properties along Arterial Roads in Ikeja

S/N	Road	Year/Average Number of Letting Transactions					Total	Percentage
		2003	2004	2005	2006	2007		
1	Obafemi Awolowo Way	16	18	14	11	16	75	7.9
2	Bank-Anthony Way	9	7	8	20	19	63	6.7
3	Oba Akran Avenue	7	8	12	22	19	68	7.2
4	Toyin Street	8	21	19	34	33	115	12.16
5	Oregun Road	6	7	10	12	9	44	4.65
6	Allen Avenue	14	11	18	33	34	110	11.63
7	Opebi Road	6	13	11	25	23	78	8.25
8	Adeniyi Jones Avenue	7	14	10	22	22	75	7.93
9	Lateef Jakande Road	5	8	6	12	7	38	4.02
10	WEMPCO Road	3	3	4	6	8	24	2.54
11	Isheri Road	5	4	3	5	7	25	2.64
12	Kodesho Street	3	3	4	11	8	29	3.1
13	Simbiat Abiola Way	4	4	6	9	7	30	3.2
14	Aromire Avenue	5	4	6	11	8	34	3.6
15	Olowu Street	5	6	5	9	8	33	3.5
16	Opebi Link-Road	3	2	2	6	5	18	2
17	Ikosi Road	2	2	1	3	3	11	1.2
18	Ogba Road	3	4	4	5	6	22	2.33
19	Bank-Anthony/Opebi Road	5	4	3	7	6	25	2.6
20	ACME	6	5	4	7	5	27	2.85
Total		**122**	**148**	**150**	**272**	**253**	**946**	**100.00**

Table 5 shows that 115 (12.16%) commercial properties were let along Toyin Street, followed by Allen Avenue (11.63%), and Obafemi Awolowo Way (7.90%) and Opebi Road (8.25%). This implies that many of the letting transactions occurred within the central part of the study area. This probably reinforced the attempt of Estate Surveyors and Valuers to meet high demand for commercial properties in the area. The least in terms of letting transactions of commercial properties are found along Ikosi Road confirming that, all things being equal, attempts would be made by Estate Surveyors and Valuers to meet high demand for commercial properties through increased number of letting transactions. The supply of commercial properties follows the direction of demand and spatial pattern of commercial property values. High supply of commercial properties is associated with central locations within the study area to benefit from high demand and property values.

At this juncture, a summary of the analysis of the various explanatory variables discussed is given in Table 6

Table 6: Summary of Explanatory Variables

S/N	Road	Traffic volume	Road Length (in metres)	Traffic Density	Road Density	Connectivity	Road Quality	Accessibility	Supply (average number of lettings)	Demand (average number of requests)	Location (number of links to the most accessible locations from farthest point along each road)
1	Oba Akran Avenue	16,651	2,307.18	7.22	0.06	0.18	4	0.74	14	18	4
2	Kodesho Street	16,240	559.465	29.03	0.01	0.08	4	0.74	6	9	6
3	Obafemi Awolowo Way	19,042	4,292.12	4.44	0.11	0.23	5	0.10	15	35	5
4	Adeniyi Jones Avenue	12,211	2,233.46	5.47	0.06	0.27	4	0.74	15	21	3
5	Aromire Avenue	17,414	616.81	28.23	0.02	0.23	4	0.73	7	9	2
6	Allen Avenue	18,038	1,411.30	12.78	0.04	0.23	5	0.74	22	29	2
7	Opebi Road	16,510	1,886.00	8.75	0.05	0.24	4	0.74	16	21	4
8	Opebi Rd/Bank-Anthony Way	18,392	674.13	27.28	0.02	0.26	5	0.74	4	7	5
9	Bank-Anthony Way	17,186	4,718.66	3.64	0.12	0.18	5	0.57	13	17	6
10	Lateef Jakande Road	17,173	2,443.60	7.03	0.06	0.25	4	0.58	8	11	4
11	ACME Road	18,433	2,200.49	8.38	0.06	0.33	4	0.75	6	6	4
12	WEMPCO Road	14,898	1,963.85	7.59	0.05	0.27	4	0.73	5	5	4
13	Ogba Road	15,539	1,121.50	13.86	0.03	0.35	4	0.64	4	5	6
14	Isheri-Agege Road	12,816	5,080.41	2.52	0.13	0.33	5	0.64	5	5	5
15	Oregun Road	18,276	3,888.18	4.70	0.10	0.14	5	0.65	9	10	3
16	Ikosi Road	14,900	1,207.08	12.34	0.03	0.27	3	0.73	2	3	3
17	Olowu Street	14,626	623.96	23.44	0.02	0.34	3	0.73	7	9	3
18	Simbiat Abiola Way	17,517	571.44	30.65	0.02	0.10	4	0.72	6	8	4
19	Toyin Street	13,608	875.48	15.54	0.02	0.15	5	0.55	23	27	3
20	Opebi Link Road	18,796	1,106.57	16.99	0.02	0.02	5	0.69	4	5	2
	Total	**328,266**	**39,781.68**								

In determine the relationship between the variables as summarized in Table 6, multiple linear regression models were used. This regression involved dependent and independent variables, which respectively are commercial property values and the explanatory variables. The application of Statgraphic® software package for the regression analysis resulted in the statistics shown in Table 7

Table 7: Summary Statistic of the Explanatory Variables

Parameter	Estimate	Standard Error	T-Statistic	P-Value
CONSTANT	-2044.95	2487.33	-0.822148	0.4285
Accessibility	7702.66	2167.5	3.55371	0.0045
Connectivity	633.735	2072.23	0.305823	0.7654
Demand	300.486	75.6406	3.97255	0.0022
Location	217.517	139.035	1.56448	0.1460
Road density	7305.53	9049.88	0.807251	0.4366
Road quality	1.53242	337.26	0.00454373	0.9965
Supply	-315.814	104.256	-3.02921	0.0115
Traffic density	8.48526	32.6862	0.259598	0.8000

Table 7 shows the result of fitting a multiple linear regression model to describe the relationship between commercial property values and the independent variables. P-value for each of accessibility, demand, and supply is less than 0.05, indicating that there is a statistically significant relationship between commercial property values at 95% or higher confidence level. Furthermore, except for accessibility every other explanatory variable of arterial roads (connectivity, road density, road quality, and traffic density) returned a "no statistically significant relationship" with commercial property values.

The output in Table 7 shows the results of fitting a multiple linear regression model to describe the relationship between commercial property values and the independent variables. The model to express the result of the fitting is shown in Eqn. 1

y = -2044.95 + 7702.66acces + 633.74connt + 300.49demnd + 217.52loctn + 7305.53rodens + 1.53qulrd - 315.81suply + 8.49traden **… Eqn. 1**

However, when road network is considered in the presence of other land value

determinants there is statistically significant relationship with commercial property value. This was determined with the Analysis of Variance showing F-ratio = 3.11 and P-value of 0.0423 as shown in Table 8.

Table 8: ANOVA of the Relationship between Commercial Property Values and Independent Variables

Source	Sum of Squares	Degree of freedom	Mean Square	F-Ratio	P-Value
Model	1.12374E7	8	1.40467E6	3.11	**0.0423**
Residual	4.96171E6	11	451064.		
Total (Corr.)	1.61991E7	19			

R-squared = **69.3705** percent; R-squared (adjusted for d. f.) = **47.0945** percent; Standard Error of Est. = **671.613** Mean absolute error = **354.052;** Durbin-Watson statistic = 1.59854 (P = **0.0705**); Lag 1 residual autocorrelation = 0.127051

The P-value of 0.0423 is less than 0.05, confirming that there is statistically significant relationship between the variables at 95.0% or higher confidence level. Therefore, the null hypothesis is rejected. In addition, R^2 of 69.37 in the output indicates that the model as fitted explains approximately 69% variability in commercial property values in the study area.

The analysis shows that the explanatory variables of road network, in the presence of location, supply, and demand jointly have statistically significant relationship with commercial property values in the study area. By implication, other determinants of commercial property values not considered probably account for the remaining 30.63%. The other factors probably include serenity of neighbourhoods within which it is located, effect of adjoining properties, facilities available in the property, security of life and property in the neighbourhood, national and global economy, political situation, facilities available in a particular commercial property and others.

What model can therefore be derived to predict trend in commercial property values along each of the arterial roads in the study area? In deriving predictive models for the trends of values of commercial properties along the arterial roads in the study area, rental values along each road was regressed against explanatory variables of each arterial road to obtain the predictive models shown in Table 9.

Table 9: Predictive Models of Commercial Property Values along Arterial Roads in Ikeja, Nigeria

S/N	Road	Predictive Model	R^2 value
1	Allen Avenue	y = 1500x + 2380	0.945
2	Adeniyi Jones Avenue	y = 1200x + 3200	0.973
3	Opebi Road	y = 1450x + 2250	0.926
4	Bank-Anthony Way	y = 1480x + 1920	0.991
5	Oba Akran Avenue	y = 1400x + 2140	0.990
6	Bank-Anthony/Opebi Way	y = 1350x + 2150	0.995
7	Toyin Street	y = 1370x + 2010	0.974
8	Aromire Avenue	y = 1230x + 2390	0.953
9	Kodesho Street	y = 1230x + 1650	0.988
10	Ogba Road	y = 830x + 2730	0.988
11	Obafemi Awolowo Way	y = 1150x + 1750	0.924
12	Simbiat Abiola Road	y = 1250x + 1310	0.960
13	ACME Road	y = 800x + 2600	0.984
14	Lateef Jakande Road	y = 1050x + 1850	0.958
15	Olowu Street	y = 850x + 2350	0.938
16	Opebi Link-road	y = 840x + 2200	0.874
17	Oregun Road	y = 950x + 1850	0.970
18	WEMPCO Road	y = 750x + 2050	0.969
19	Ikosi Road	y = 690x + 1970	0.927
20	Isheri/Agege Road	y = 580x + 2100	0.838

Furthermore, in describing the pattern of commercial property values in the study area, attempt was made to classify the values as minimum, mean, and maximum rents for each year of the study period, and details shown in Table 10 were obtained.

Table 10: Categories of Rental Values in the Study Area

S/N	Year	**Rent** (in Naira/m^2)		
		Minimum (Set A)	**Maximum** (Set B)	**Mean**
1	2003	3,000	4,500	3,750
2	2004	3,000	5,500	4,250
3	2005	3,500	6,500	5,000
4	2006	4,000	8,500	6,250
5	2007	5,500	10,500	8,000

To determine the trend of minimum, mean, and maximum rental values in the study area, analysis of the categories of rental values in the study area using the Microsoft Excel resulted in trend lines as shown in Fig. 3

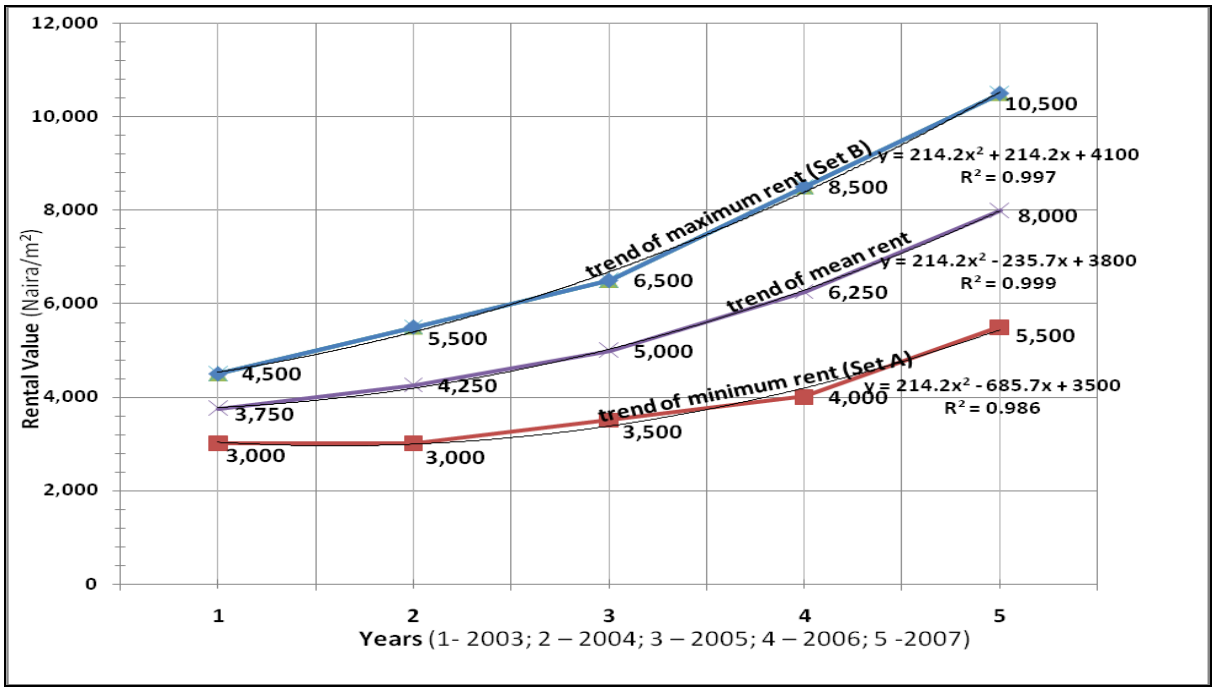

Fig. 3 : Graphical Illustration of the Trends in Commercial Property Values in Ikeja

As shown in Fig. 3, individual models were derived from the regression of the minimum, maximum and mean rental values in the study area individually against number of years. The analysis resulted in Eqns. 2, 3, and 4 for minimum, maximum, and mean rental values respectively.

$$\beta_{mini} = (214.2)\,\mu_{mini}^{2} - (685.7)\,\mu_{mini} + 3500 \qquad \textbf{…Eqn. 2}$$

Eqn. 2 is the model for predicting the minimum rental value of commercial property values along the arterial roads in the study area. In the model, β_{mini} is the minimum rental value expressed in Naira per square metre (N/m^2), while μ_{mini} represents number of years.

The model in Eqn 2 is fitted for predicting future minimum commercial property values with coefficient of determination equals 0.986, implying that *ceteris paribus* there is very high probability that the forecast will be realized.

The model for predicting maximum rental value of commercial property values along the arterial roads is shown in Eqn. 3

$$\beta_{maxi} = (214.2)\,\mu_{maxi}^{2} + (214.2)\,\mu_{maxi} + 4100 \qquad \textbf{…Eqn. 3}$$

β_{maxi} = the maximum rental value expressed in Naira per square metre (N/m^2);

μ_{maxi} = number of years considered in determining the trend in maximum rent

The model in Eqn. 3 is fitted for predicting future maximum commercial property values with coefficient of determination being 0.997, implying that *ceteris paribus* there is very high probability that the such prediction will be realized.

The model for predicting the average rental values of commercial properties along the arterial roads was equally derived from Fig. 4 and shown as Eqn. 4

$$\beta_{mean} = (214.2)\ \mu_{mean}^{2} - (235.7)\ \mu_{mean} + 3800 \quad \textbf{…Eqn. 4}$$

β_{mean} = the average of the maximum and minimum rental value (in Naira per square metre)

μ = number of years considered in predicting future average rental values.

The model is fitted for predicting future average commercial property values with coefficient of determination being 0.999, implying that *ceteris paribus* there is very high probability that the such prediction will be realized.

From these, the model for predicting range of mean rental values of commercial properties was derived as shown in Eqn. 5:

$$\beta_{mini} < \beta_{mean} < \beta_{maxi} \quad \textbf{…Eqn. 5}$$

Furthermore, the model for predicting specific mean rental values is given as:

$$\delta = \beta_{mini} + \gamma \quad \textbf{…Eqn. 6}$$

where,

δ = expected mean rental values;

β_{mini} = prevailing minimum rental values;

γ = difference between maximum and minimum ÷ 2

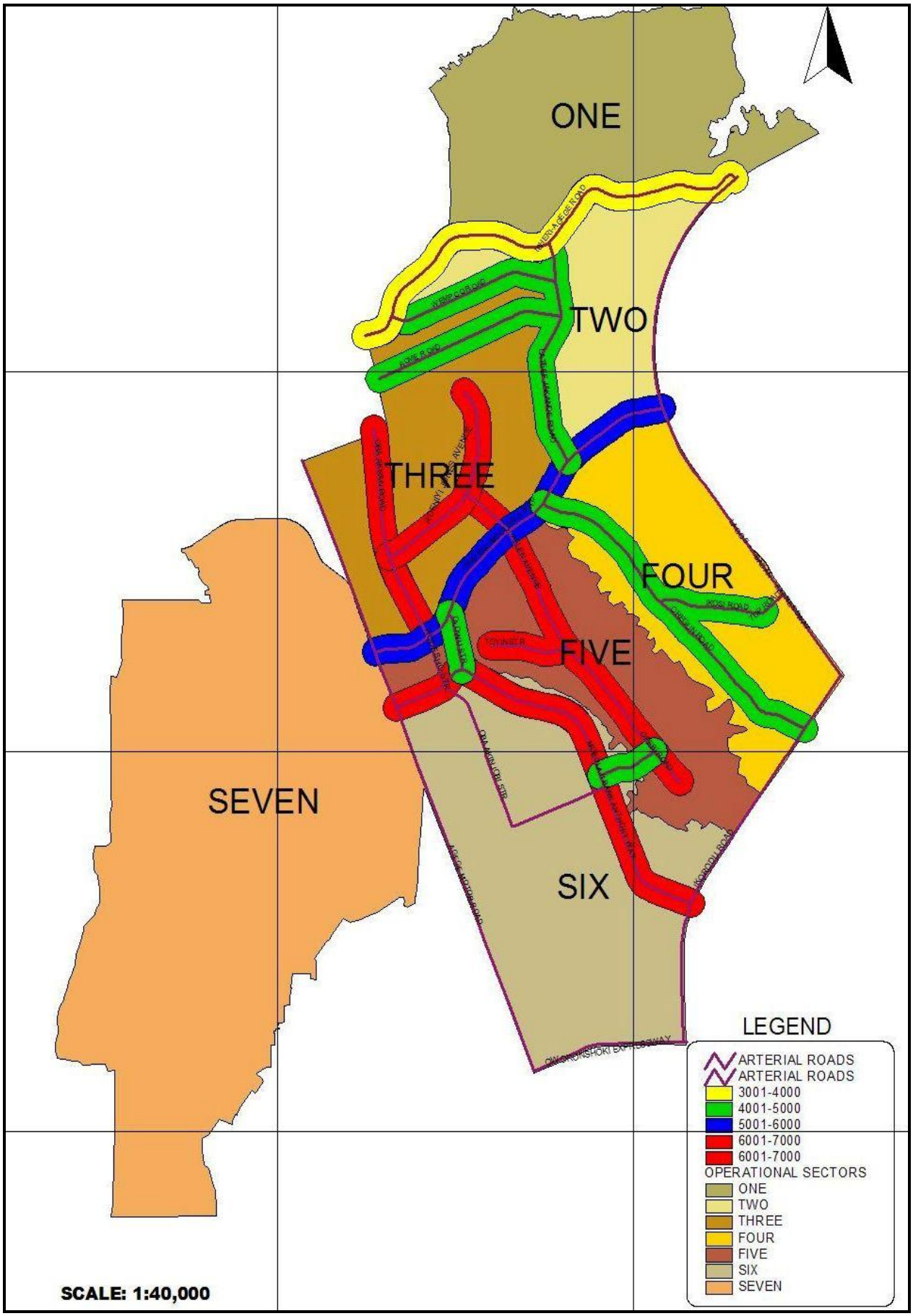

Fig. 3: Value Map Showing Spatial Pattern of Commercial Property Values in Ikeja

Research Findings and Discussion

The study shows that the highest mean rental values (in Category A) are concentrated around the central portion of the study area. Category B follows a little distance away from the central area, and Category C is found farther away while Category D are found at the remote and outlying precincts of the study area. This finding is consistent with earlier theorists (Haig, 1926; Goldberg, 1970; Downing, 1973; Kivell, 1993; Sivitanidou, 1996; Henneberry, 1998; and McQuaid and Grieg, 2003) relating distance to rental value that rental values decreases as distance from the central business district increases, increases in demand triggering property value, and clustering of business activities significantly affecting property values.

The regression analysis gave rise to predictive model useful to forecast likely mean rental values of commercial properties along the arterial roads in the study area. This means that if knowledge is derived of probable average of the mean rental values of commercial properties within the study area, say, in the next twenty (20) years (i.e. year 2022), the model will be $\beta = (115.3)\ \mu^2 + (405.3)\ \mu + 2950$; where, $\mu = 20$. Therefore, the predicted average of mean value of commercial properties for year 2022 will be $\beta = 115.3\ (20)^2 + 405.30\ (20) + 2950$; $\beta = 46{,}120 + 8{,}106 + 2{,}950\beta$ = N57, 176 /m^2 per annum. This indicates that the unit space in commercial properties along arterial roads in the study area will be at the average rate of N57, 176 /m^2 p.a. in year 2022.

In addition, the research showed that the minimum rental value of commercial properties along arterial roads in the study area could be determined using the model $\beta_{mini} = (214.2)\ \mu_{mini}^2 - (685.7)\ \mu_{mini}$. For instance, in 20 years' time (by year 2022 i.e. 20 years from 2003), the minimum rental values of the properties is expected to be: $\beta_{mini} = (214.2)(20)^2 - (685.7)(20) + 3500$; $\beta_{mini} = (214.2)(400) – (685.7)(20) + 3500$; $\beta_{mini} = 75, 466/m^2$ p.a.

Also, it was revealed that maximum rental value of commercial properties along

arterial roads in the study area would be determined using the model $\beta_{maxi} = (214.2)\ \mu_{maxi}^{2} + (214.2)\ \mu_{maxi} + 4100$. Thus, in year 2022, the maximum rent expected to prevail in the study area is $\beta_{maxi} = (214.2)(20)^{2} + (214.2)(20) + 4100$; $\beta_{maxi} = (214.2)(400) + (214.2)(20) + 4100$; that is, β_{maxi} = N94, 064/m^2 p.a.

From the illustrations, the range of commercial property values along arterial roads in the study area revealed is $\beta_{mini} < \beta_{mean} < \beta_{maxi}$. By substituting for β_{mini}, β_{mean}, and β_{maxi} in Eqn. 5, the range of mean values of commercial properties expected to prevail by year 2022 would be N75, 466/m^2 p.a. < N84, 765/m^2 p.a. < N94, 064//m^2 p.a. This shows that commercial property values in 2022 will most likely range between N75, 000 and N95, 000/m^2 p.a. The model in Eqn. 5, is summarized as $\delta = \beta_{mini} + \gamma$, the expected average of the mean rental value of commercial properties along the arterial roads by year 2022 will, *ceteris paribus*, be

$$\delta = N75,\ 000 + \frac{(N95,\ 000 - N75,\ 000)}{2}$$

Therefore, the expected average of the mean rental value of commercial properties along the arterial roads in year 2022 will be N85, 000/m^2 p.a.

When considered on annual basis, the polynomial trend analysis still showed continuous rising trend from year to year. The resulting model for predicting commercial property values in relation to road network pattern is $\beta = (115.3)\ \mu^{2} + (405.3)\ \mu + 2950$. This implies that for every year ($\mu = 1$) the mean commercial property value (β) in the study area will increase by N3, 470.60/m^2 p.a., $R^2 = 0.96$. The R^2 of 0.96 indicates very high probability of attaining this prediction. This model will be useful for development appraisers, estate surveyors and valuers, and financiers in expressing opinions about the average annual increase in commercial property values and assists them in forecasting the feasibility and viability appraisals of investments in commercial property values in the study area.

Finally, the model for predicting minimum rental value of commercial properties along arterial roads in the study area is $\beta_{mini} = (214.2)\ \mu_{mini}^{2} - (685.7)\ \mu_{mini} + 3500$. This

means that for every year (μ_{mini}=1) the minimum rental value will be N3, 028.50/m^2. The model for predicting the maximum rental value was also developed, which is $\beta_{maxi} = (214.2) \mu_{maxi}^2 + (214.2) \mu_{maxi} + 4100$ indicating that for every year the expected maximum rental value is N4, 528.40/m^2 p.a. From the foregoing, the findings showed that r^2 for $\beta_{mini} = 0.986$, β_{mean} $r^2 = 0.999$, and β_{max} $r^2 = 0.997$ indicating that the predictive models have almost hundred percent probability of been achieved, all things been equal.

Concluding Remarks and Recommendation

The paper has attempted to determine the relationship between the explanatory variables of road network in the presence or absence of established property value determinants, while attempt was made to derive models for predicting trends of minimum, maximum and mean commercial property values along the arterial roads in the study area. There is need to put into use these models and also give opportunity for further research. It is hoped that the findings will go a long way in assisting the Estate Surveyors and Valuers, Developers and Financiers of commercial property projects make projections and determine values with some level of confidence.

Presently in the study area, there has been an increase in demand for commercial properties by banks and corporate bodies. Many firms and corporate bodies are relocating their head offices to Ikeja from Lagos Island where accessibility and ease of vehicular movements are impeded, causing traffic congestion coupled with rising rental values and cost of transportation. It is therefore envisaged that, all things been equal, the models are attainable and will be highly useful tools in predicting trend in commercial property values along arterial roads in the study area. Opportunity for similar research in other parts of the wider Lagos metropolis will enable metropolitan-wide comparison and deductions to be made.

Furthermore, the study has shown that accessibility is an important explanatory

variable in road network and that its impact on commercial property values in the study area is significant. Government at all levels should therefore increase funding of road improvements including construction, maintenance, and rehabilitation of the entire arterial road network that delivers the accessibility. When commercial property values are enhanced through their occupation by willing and able tenants, the amount of property tax will increase and revenue available for such road improvements will concomitantly increase.

It suffices to recommend that Chartered Surveyors should consider accessibility, demand, and supply as major consideration in the valuation of commercial properties in the study area for their opinions of value to be reliable. Lastly, the explanatory variables may not have equal degree of impacts on commercial property values. There is therefore opportunity for further research to establish the relative contributions of each variable to variability in commercial property values through. Researchers should be encouraged to discuss such studies during the Continued Professional Development programmes, Seminars, Workshops for the benefit of practitioners.

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APPENDIX 1

Table 5.1: Accessibility Indices of Arterial Roads in Ikeja Metropolis

NP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	-	1	2	3	2	3	4	4	5	5	6	6	7	8	9	8	6	7	6	5	4	3	2	1	2	3	4
2	1	-	1	2	1	2	3	3	4	4	5	5	6	7	8	7	6	8	6	5	4	3	3	2	3	4	5
3	2	1	-	1	2	3	3	2	3	4	5	4	5	6	7	6	6	7	7	6	5	4	4	3	4	5	6
4	3	2	1	-	1	2	2	1	2	3	4	3	4	5	6	5	5	6	6	5	4	3	4	4	5	5	5
5	2	1	2	1	-	1	2	2	3	3	4	4	5	6	7	6	5	7	5	4	3	2	3	3	5	4	4
6	3	2	3	2	1	-	1	2	3	2	3	4	5	6	7	6	4	6	4	3	2	1	2	3	4	3	3
7	4	3	3	2	2	1	-	1	2	1	2	3	4	5	6	5	4	6	4	3	3	2	3	4	5	4	4
8	4	3	2	1	2	2	1	-	1	2	3	2	3	4	5	4	4	5	5	4	4	3	4	5	6	5	5
9	5	4	3	2	3	3	2	1	-	1	2	1	2	3	4	3	3	4	4	3	4	4	5	6	7	6	5
10	5	4	4	3	3	2	1	2	1	-	1	2	3	4	5	4	3	5	3	2	3	3	4	5	6	5	4
11	6	5	5	4	4	3	2	3	2	1	-	1	2	3	4	3	2	4	2	1	2	3	4	5	5	4	3
12	6	5	4	3	4	4	3	2	1	2	1	-	1	2	3	2	2	3	3	2	3	4	5	6	6	5	4
13	7	6	5	4	5	5	4	3	2	3	2	1	-	1	2	1	1	2	2	2	3	4	5	6	6	5	4
14	8	7	6	5	6	6	5	4	3	4	3	2	1	-	1	1	2	2	3	3	4	5	6	7	7	6	5
15	9	8	7	6	7	7	6	5	4	5	4	3	2	1	-	2	3	3	4	4	5	6	7	8	8	7	6
16	8	7	6	5	6	6	5	4	3	4	3	2	1	1	2	-	2	1	3	3	4	5	6	7	6	6	5
17	6	6	6	5	5	4	4	4	3	3	2	2	1	2	3	2	-	2	2	1	2	3	4	5	5	4	3
18	7	8	7	6	7	6	6	5	4	5	4	3	2	2	3	1	2	-	2	3	4	5	6	6	5	6	5
19	6	6	7	6	5	4	4	5	4	3	2	3	2	3	4	3	2	2	-	1	2	3	4	5	5	4	3
20	5	5	6	5	4	3	3	4	3	2	1	2	2	3	4	3	1	3	1	-	1	2	3	4	4	3	2
21	4	4	5	4	3	2	3	4	4	3	2	3	3	4	5	4	2	4	2	1	-	1	2	3	3	2	1
22	3	3	4	3	2	1	2	3	4	3	3	4	4	5	6	5	3	5	3	2	1	-	1	2	3	2	2
23	2	4	5	4	3	2	3	4	5	4	4	5	5	6	7	6	4	6	4	3	2	1	-	1	2	1	2
24	1	2	3	4	3	3	4	5	6	5	5	6	6	7	8	7	5	6	5	4	3	2	1	-	1	2	3
25	2	3	4	5	5	4	5	6	7	6	5	6	6	7	8	6	5	5	5	4	3	3	2	1	-	1	2
26	3	4	5	5	4	3	4	5	6	5	4	5	5	6	7	6	4	6	4	3	2	2	1	2	1	-	1
27	4	5	6	5	4	3	4	5	5	4	3	4	4	5	6	5	3	5	3	2	1	2	2	3	2	1	-
28	5	6	7	6	5	4	5	6	6	5	4	5	4	5	6	5	4	4	2	3	2	3	3	4	3	2	1
29	6	7	8	7	6	5	5	6	5	4	3	4	3	4	5	4	3	3	1	2	3	4	4	5	4	3	2
30	7	8	9	7	8	6	6	7	6	5	4	5	4	4	5	3	4	2	2	3	4	5	5	6	5	4	3
31	6	7	8	7	8	7	7	6	5	6	5	4	3	3	4	2	3	1	3	4	5	6	6	5	4	5	4
32	3	4	5	6	5	5	6	7	8	7	6	7	6	6	7	5	6	4	4	5	4	4	3	2	1	2	3
33	4	5	6	7	6	5	6	7	7	6	5	6	5	5	6	4	5	3	3	4	3	4	4	3	2	3	2
34	5	6	7	8	7	6	7	7	6	7	6	5	4	4	5	3	4	2	4	5	4	5	5	4	3	4	3
35	7	7	6	5	6	5	5	4	3	4	3	2	1	2	3	2	1	1	1	2	3	4	5	6	6	5	4

NP - nodal point; AI - accessibility

APPENDIX 2

Table 5.4: Connectivity Indices of Arterial Roads in Ikeja Metropolis

NP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2	1	-	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	1	-	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	1	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
7	0	0	0	0	0	1	-	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	1	0	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	1	-	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	1	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	1	-	1	0	0	0	0	0	0	0	1	0	0	0	0	0
12	0	0	0	0	0	0	0	0	1	0	1	-	1	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	1	-	1	0	0	1	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1	1	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	-	0	1	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	-	0	0	1	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	-	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	1	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	-	1	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1	0	0	0
22	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1	0
24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	1
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0

CI – connectivity index