Analysis of Relationship between Costs of Built-in Security Components and Some Physical Characteristics of Buildings in Nigeria: Case Studies of Abuja and Minna

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Abstract
The development of houses for human residence, commercial and other types of buildings have responded to the need to fortify them to forestall the commitment of crimes. However, private individuals express their security concerns through the provision of built-in security components in their houses. This paper aimed at determining the relationships that exist between some physical characteristics of buildings and the costs of providing security in building projects. The study intends to achieve this by determining the relationships that exist between the total costs of built-in security components and physical characteristics of building. Further objectives are to derive the line or curve that best fits the relationship. The paper employs a survey approach, by utilizing a data collection proforma to capture eighteen (18) different variables spread over various elements in building and security components. Only the analysis that tested the influence of numbers of external openings returned a statistically significant result (R^2 = 13.3%, P0.05 = 0.01). The study concluded that, the number of external openings might warrant further investigation as a possible variable to be used to predict the total cost of built-in items of security. The paper recommended that other statistical techniques in conjunction with regression analysis should be used in order to develop a statistical model to predict costs of built-in security items.

Keywords: building cost, crime prevention, built-in security components, housing.

1.0 Introduction

The historical background of housing developments cannot be divorced from criminal activities committed within houses, usually following forceful entry by the perpetrators. However, crimes committed within residential and commercial buildings appear to be on the increase. Such crimes include burglary, breaking and entering, and armed robbery, as reveal in the works of (Ogbunugafor, 1995; Gashash, 1996; and Ikoro, 1997). According to Anthony and Paul (1992), the development of houses for human residence, commercial and other types of uses have responded to the need to fortify them to forestall the commitment of crimes. The increasing importance of infrastructure security against the backdrop of well documented threats such as vandalism, fire outbreaks, armed robbery, burglary and terrorism contrasts sharply with the reality that empirical relationship and comparison between infrastructure facility characteristics and costs implications of security concerns are non-existent. This paper is focused on deriving and explaining such relationship in the case of buildings devoted to residential, commercial and institutional uses. Anifowose and Oke (2008) established that the security concerns of private individuals are expressed through the provision of built-in security components in their houses. Such components are intended to fortify the buildings against external attacks by criminals, which include the provision of burglar proofing, perimeter fencing, guard huts and external floodlighting. Other security devices such as anti-burglar alarms are usually not within the financial reach of the majority of low and medium income owners of houses. Anifowose (2003; 2007) has tried to establish the proportions of total building costs that are devoted to security-related components in buildings. Such works have been based on an arbitrarily selected residential building type which limits its applicability to buildings devoted to other uses.

1.2 Aim and Objectives of the Study

This study aimed at examining the impact of physical characteristics of buildings (independent variable) on the costs of providing security in building projects (dependent variable). The study intend to achieve this by meeting the following objectives; determining the relationships that exist between the total costs of built-in security components, (i.e. costs of burglar

proofing, fencing, external electrification, gatehouse, and anti-burglar alarms) and (1) Area of enclosing walls, (2) Area of all external openings, (3) Number of all external openings, and (4) Total floor area of the buildings.

1.3 Hypotheses

This study is based on the following null hypotheses that no significant linear relationship exists between the following pairs of variables:-

H_{o1}: the total cost of security components and the Area of enclosing walls

H_{o2}: the total cost of security components and the Area of all external openings

H_{o3}: the total cost of security components and the Numbers of all external openings

H_{o4}: the total cost of security components and the Total floor area of the buildings.

1.4 Scope of the Study

The scope of this paper is however limited to those components that are included in building for their security characteristics, and are built in as the building work progresses. Security systems external to the building, not forming an integral part of it, such as guard patrols are not covered by this paper.

1.5 The Study Area

The study areas of this paper covered Abuja the federal capital territory and Minna the capital of Niger state. The two areas are interrelated both in terms of culture and the indigenous tribe (the GWARI) that are predominant in the areas. Abuja is the federal capital of Nigeria and the seat of Government of the federal republic of Nigeria. It was created in the year 1976 and it is strategically located at the centre of the country, with a land mass of 8,000 square kilometer and a population of over 7 Million. Abuja is reputed to be the fastest growing city in the world. The city enjoys warm tropical climate all year round as a result of its location. Abuja offers a serene and conducive environment for human settlement and business activity. Minna is the capital of Niger state. Niger state belongs to the second generation of states in the political evolution of the country. It was created in 1976 during the General Murtala Mohammed's military regime and also became a functional entity in the same year. The state is located between Latitude 8^0 20'N and 11^0 30'N and between Longitude 3^0 30'E and 7^0 20'E. It lies wholly within the physical and cultural zone of transition described as the middle or the North central Geo-political zone of Nigeria. The state covers a landmass of about 76,000 square kilometers and consists of twenty five local government areas with growing population of about 122,031 in 1991 and growth rate of about 3.92 per cent in 1995 and projections of 3.63 and 3.36 per cent in year 2000 and 2004, respectively. Minna is located about 200 kilometres north-west of Abuja (see Map 1).

Figure 1: Map of Nigeria (the study area is shown hatched)

1.6 Related Works

According to Faruqee, (1994), Crimes and criminal activities escalated in Nigeria following the Nigerian civil war {1967-1970}. This escalation became a national embarrassment in the year following the collapse of the Nigerian economy {1980-1981}.The harsh effects of the various prescriptions for recovery also fuelled this escalation. New forms of criminal activities gained prominence in structural adjustment programme (SAP) and post structural adjustment programme (SAP) years {1985 – date}. Thus, armed robbery, drug trafficking and advance fee fraud {419} became celebrated crimes. Drastic measures to curb the expansion of criminal activities such as the application of the death penalty do not have the desired effect. Data available on criminal activities from statutory authorities show that crimes committed at residences of the victims have escalated also. A table of figures showing the historical profile of trends in breaking and entering/burglary crimes in Niger state over the period of (2002-2006) is provided below.

Table .1: Trend in burglar breaking & entering crimes in Niger state (2002-2006)

OFFENCES	2000	2001	2002	2003	2004	2005	2006	TOTAL
ARMED ROBBERY	14	101	15	189	57	147	25	548
THEFT & OTHER STEALING	157	410	192	418	571	547	557	2852
HOUSE BREAKING	67	311	152	71	178	735	440	1954
STORE BREAKING	52	100	45	27	10	27	290	551

Source: Nigerian police, state command, Niger state (2008)

Property security is an important research topic; security in this respect covers the incidence rate of fire in residential buildings, which in Saudi Arabia accounts for 69% of all building fires. Al-Homoud and Khan (2004) carried out a field assessment of current safety issues for residential buildings in Saudi Arabia to identify common safety deficiencies. The survey showed that most residents are ignorant of many safety aspects in their homes. Abrahamsen and Williams (2006) established that Security Sector Reform (SSR) has

become a central part of development policy, between security and development. They observed however that following a traditional weberian conception of the state, such reform programmes are almost exclusively focused on the public security sector, neglecting the extent to which people in developing countries have come to rely on private security providers for their day-to-day security needs.

Theoretical writings on security have tended to explore the increasing connections between capital and security. Neocleous (2007) does so by first exploring the rise of the security industry in the context of the current 'war on terror', before linking this to the rise of a parallel industry in policing and incarceration. These three dimensions of the security industry have tended to be understood through the notion of privatization and instead of taking this route, Neocleous (2007) tries to understand the security industry through the concepts of commodification and fetishism. A further feature of recent writings on security is the idea of a convergence of internal and external security (no doubt influenced by the notion of the world as a global village). Lutterbeck (2005) considers that in post-Cold War-era Western Europe the dividing line between internal and external security has become increasingly obsolete. This convergence of internal and external security agendas point to a militarisation and externalisation of policing, and an internalisation and 'policisation' of soldiering: while police forces are taking on military characteristics, and are extending their activities beyond the borders of the state, military forces are turning to internal security missions, and are adopting certain police features. Moreover, agencies which have traditionally been located at the interface between police and military forces, i.e. gendarmerie-type or paramilitary forces, are assuming an increasingly important role.

Terms such as "terrorism" and "anti-terrorism" have been thrust into modern vocabulary following post-9/11 conservative political agenda that has fuelled attempts to blur the boundaries between dissent or even crimes of property and what the state defines as acts of given an increasing recognition of the links terrorism, particularly when these involve progressive movements (Wekerle and Jackson, 2005). Violence impedes human freedom to live safely and securely, and can sustain poverty traps in many communities. A key challenge for academics, policy-makers and practitioners working broadly in programmes aimed at poverty alleviation, including violence prevention, is the lack of reliable and comparable data on the incidence and nature of violence. Violence and poverty are inextricably linked, although the direction of causality is contested if not circular (Diprose, 2007). Olavarria-Gambi's (2007) study estimated that the economic cost of crime in Chile, using the accountancy method, is $1.35 billion as at 2002, equivalent to 2.06% of Chile's GDP. Crimes included in the estimation are murder, robbery, larceny-theft, burglary, wounding, rape and sexual assaults, domestic violence and economic felonies such as fraud, forgery and so on. Consequential costs are the most important, representing 68% of the total cost of crime. Government spending represents 23% of the total and anticipatory cost account for the remaining 9%.

2.0 Research Methodology

This paper employs a survey approach to the study of security-related construction costs of commercial buildings. A data collection proforma was designed to capture eighteen (18) different variables comprising physical characteristics of the buildings as well as costs of erecting the various elements of the buildings. The research instrument employed compares with those adopted by Al-Homoud and Khan (2004) in their study of safety design practices in residential buildings in Saudi Arabia, and Diprose (2007) in her work on internationally comparable indicators of violence, which relied on a questionnaire to elicit relevant information.

2.1 The Type and sources of Research Data

Data for this research work was sourced from quantity surveyors by a convenience sampling method that was supported by a snowballing methodology. Attempts were made to collect

all of the available data that was relevant in line with the research design. Quantity surveyors were asked to suggest the names of others of their colleagues who might possess further relevant data. This technique (snowballing) resulted in the sourcing of a fair sized number of projects that had official documents (mainly bills of quantities) from where the research data could be extracted. Only 19 building projects that had data suitable for analysis were obtained in Minna. Inclusion of Abuja as a part of the study area resulted in the sourcing of an additional 30 building projects. This brought the total sample size to 49 buildings which were used for the statistical analysis in this paper. These were buildings that had complete information on security-related costs, detailed in an elemental format. Line graphs of the data were plotted, in order to allow trends be examined visually. Quantification of the proportion of variation in the dependent variable (security-related costs) related to variations in the independent variables (total floor areas, and total areas of openings requiring protection such as doors and windows) were effected through the use of simple regression analysis.

2.2 Method of Analysis

The research data was analysed using descriptive techniques of analysis in order to reveal any apparent patterns of location or dispersal of the data around the mean values as shown in table 2. The results of such data using regression analysis are presented in table 3. In addition, graphs were produced which provide visual evidence of patterns within the data. The proportion of costs to each item of built-in security components were shown in figure 1, while in figure 2, the positive co-relationship that exist between the total contract sum and the total costs of built-in security was established.

2.3 Data Presentation and Analysis

Table2: Descriptive Summaries of the research Data

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	statistic	Statistic	statistic	statistic	statistic	statistic	statistic	statistic	statistic
TFA	49	2102	50	2152	445.78	438.431	192221.471	2.319	.340	6.147	.668
OpgArea	49	359	12	371	104.35	85.838	7368.148	1.297	.340	1.301	.668
WallArea	49	1081	71	1152	343.67	250.727	62863.849	1.456	.340	1.538	.668
OpgNum	49	114	6	120	37.94	29.151	849.767	1.525	.340	1.702	.668
ContractSum	49	66194497.87	1264479.38	67458977.25	10698979.4837	11713317.48403	137201806481755.300	3.031	.340	11.430	.668
TotalSecurity	49	4950000	0	4950000	238579.90	715887.272	512494586925.511	6.212	.340	41.138	.668

Source: Author's analysis of field work data, 2008

Table 3: Summary of Results Based on Simple Regression Analysis

Ex No	Variables		Type of Model	Observations					Inferences		
	X	Y		Regression Equation	R^2	F_{cal}	F_{tab}	P_{value}	Strength of Relationship	Rmk	Action on hyp
1	Area of Enclosing walls	Total costs of Security	Linear	Total costs of security = -3756.55 + 705.14 (area of enclosing walls)	6.1 %	3.053	4.08	0.087	Very weak	NS	Accept H_{01}
2	Area of all external openings		Linear	Total costs of security = 146369.7 + 883.688 (area of all external openings)	1.1 %	0.534	4.08	0.469	Very weak	NS	Accept H_{02}
3	Number of external openings		Linear	Total costs of security = -100918 + 8948.57 (number of external openings)	13.3%	7.20	4.08	0.010	Very weak	SS	Reject H_{03}
4	Total floor areas of building		Linear	Total costs of security = 102097.3 + 306.164 (total floor areas of building)	3.5 %	1.713	4.08	0.197	Very weak	NS	Accept H_{04}

Key: SS = Statistically Significant
NS = Not Significant

Source: Author's analysis of field work data, 2008

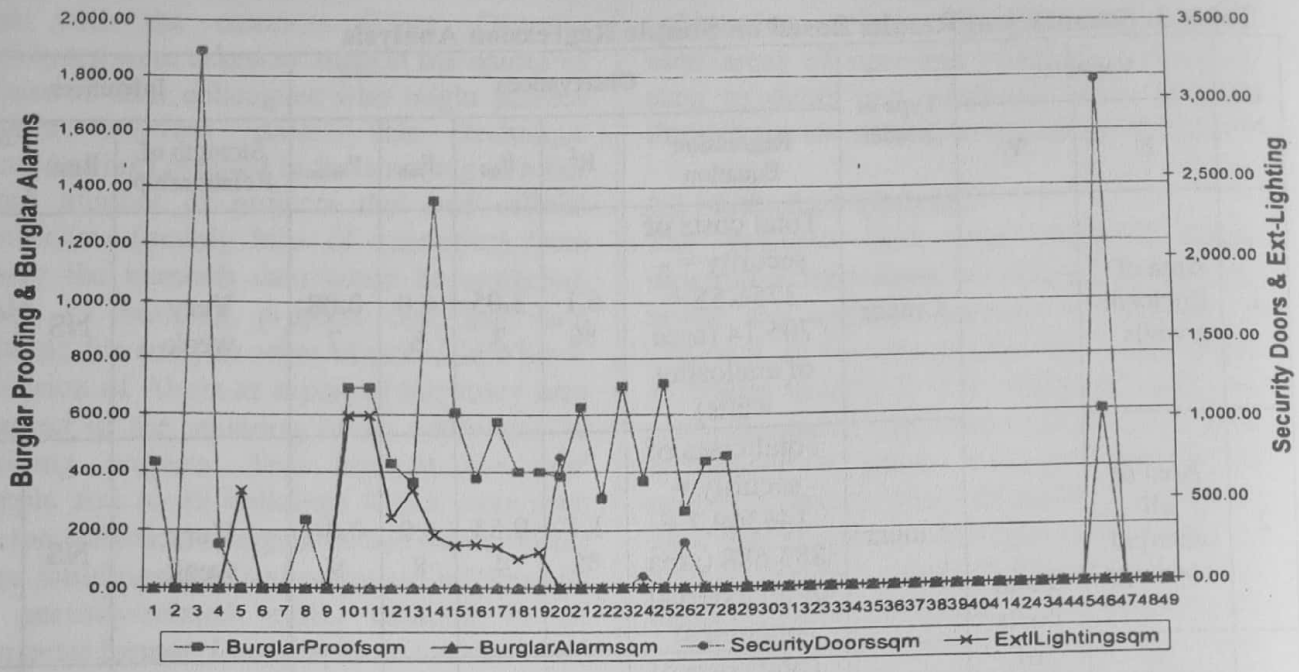

fig.1: Trends in Costs of Built-in Security Components per sqm

Source: Author's analysis of field work data, 2008

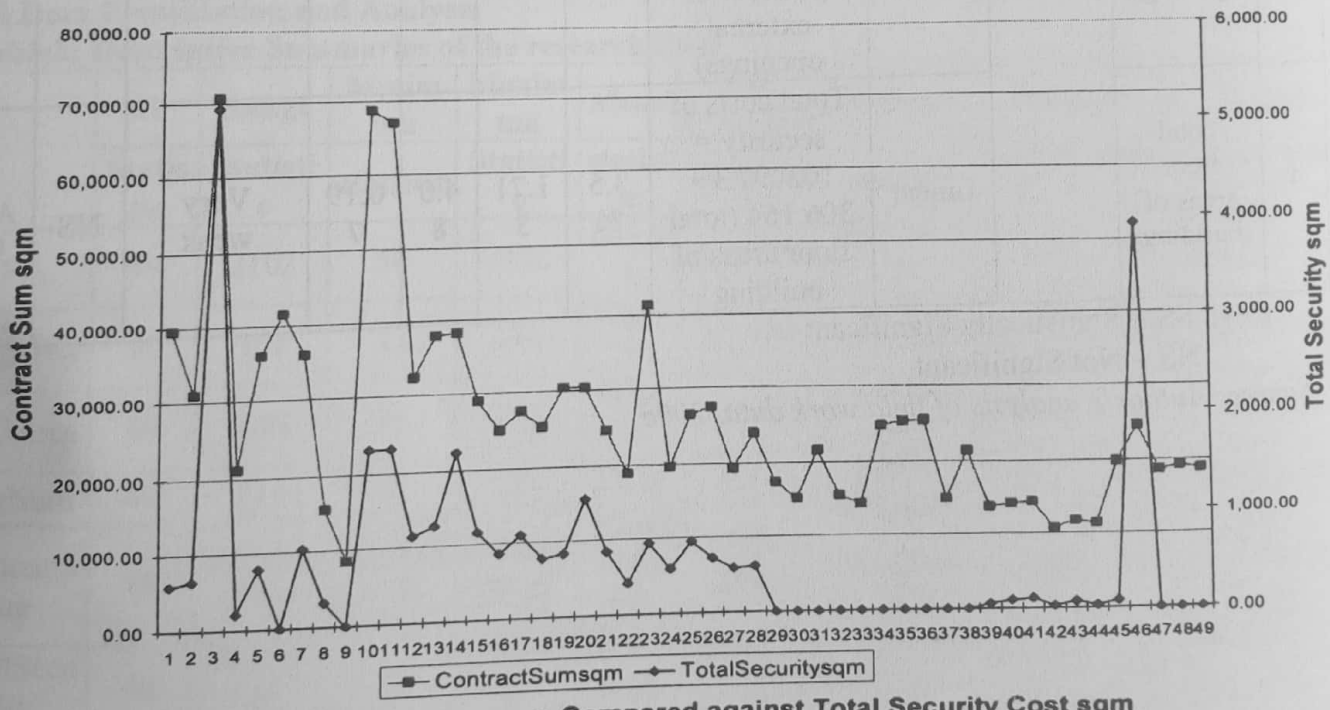

fig.2: Contract sum sqm Compared against Total Security Cost sqm

Source: Author's analysis of field work data, 2008

3.0 Discussion of Results of the Analysis

The results of the simple regression statistical technique employed by the study in testing the validity or otherwise of hypotheses H_{o1} to H_{o4} are provided in Table 2 below. Thus, the following four variables were employed as independent variables for the experiments: Area of enclosing walls, Area of all external openings, Numbers of all external openings, and the Total floor areas of the buildings.

The area of enclosing walls compared with the total costs of security, the regression analysis yielded a positively correlated linear regression equation, which however possessed a very low R^2 value of 6.1%. The calculated value of the F statistic was lower than the $F_{0.05}$ critical value (3.053 compared to 4.08). The $P_{0.05}$ value was higher than the 0.05 threshold. Null hypothesis H_{o1} was thus accepted for this analysis and pair of variables.

Similarly, the area of all external openings compared with total costs of security, the regression analysis yielded a positively correlated linear regression equation, which however possessed a very low R^2 value of 1.1%. The calculated value of the F statistic was lower than the $F_{0.05}$ critical value (0.534 compared to 4.08). The $P_{0.05}$ value was higher than the 0.05 threshold (0.469). Null hypothesis H_{o2} was thus accepted for this analysis and pair of variables.

Moreover, when the total floor areas of buildings compared with the total costs of security, the regression analysis yielded a positively correlated linear regression equation, which however possessed a very low R^2 value of 3.5%. The calculated value of the F statistic was lower than the $F_{0.05}$ critical value (1.713 compared to 4.08). The $P_{0.05}$ value was higher than the 0.05 threshold (0.197). Null hypothesis H_{o4} was thus accepted for this experiment and pair of variables.

However, in the case of number of all external openings and total costs of security, the regression analysis yielded a positively correlated linear regression equation, which however possessed a very low R^2 value of 13.3%. The calculated value of the F statistic was higher than the $F_{0.05}$ critical value (7.20 compared to 4.08). The $P_{0.05}$ value was lower than the 0.05 threshold (0.01). Null hypothesis H_{o3} was rejected for this analysis and pair of variables, based on the results of the linear regression analysis carried out.

3.1 Main Findings from Analysis

The following constitute the main findings from the analysis of data carried out thus far by this study.

1. Total costs of built-in security of buildings can be modeled using regression analysis, but the results obtained are not of sufficient accuracy to permit the prediction of security costs.
2. The number of external openings in buildings has been discovered to be the most promising parameter for estimating the total costs of built-in security of buildings. This was based on the fact that the only experiment that yielded statistically significant results included the parameter. However, the very low R^2 values observed might be improved upon if a larger sample size were obtained.

4.0 Conclusions and Recommendations

Only the analysis that tested the influence of numbers of external openings returned a statistically significant result (R2 = 13.3%, P0.05 = 0.01). The results of the regression analysis reveal that the models thus derived cannot be used to predict with reasonable accuracy the total cost of built-in security of a building, when other parameters such as the numbers and areas of external openings, areas of enclosing walls, and total floor area of the building are known.

This study makes the following recommendations:-

1) To provide a larger sample size, additional data on the type and specification of required cost items, should be acquired before preliminary estimate are made. Knowledge of the total cost of built-in security of a building alone will not

provide a reasonably accurate predictive model that might be used to estimate the costs of individual items of built-in security, such as cost of burglar proofing, fencing and external lighting.

2) The number of external openings might warrant further investigation as a possible variable to be used to predict the total cost of built-in items of security. It is recommended that other statistical techniques in conjunction with regression analysis should be used in order to develop a statistical model to predict costs of built-in security items.

4.1 Strategies for Implementations

The above recommendations can be implemented in the following ways;

1) Integration of two or more statistical tools might further improve the results of this study and yield a reasonable model for predicting cost of security items.

2) The actual costs of the components of the buildings, which would have been provided in a statement of final account, might yield results that would be different from that of this study.

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