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A QUANTITATIVE INVESTIGATION OF BUILDING SECURITY COST IN NIGERIA

ANIFOWOSE, M. O.
Department of Quantity Surveying, FUT Minna

ABSTRACT *Private individuals express their security concerns through the provision of built-in security components in their houses, such as burglar proofing, perimeter fencing, guard huts and external floodlighting. The aim of this paper is to establish a parameter/model for predicting probable cost of security for middle-income buildings (e.g. four bedrooms flat residential bungalow building), and derive the line or curve that best fits the relationship. The paper employs a survey approach, by utilizing a data collection proforma to capture nine (9) different variables comprising three solid elements in building (i.e. substructure, wall and roof), and security components (i.e. anti-burglar proofing, gate house, fence, and external lighting). As % of total cost of construction, fence had 26.5% maximum and 8.7% minimum, while external lighting had the least percentage of 2.1% maximum and 0.1% minimum. Conclusions were reached that, costs of built-in security components increases as the Total Cost of Building increases. Finally, the study established a parameter for determining the costs per m² of Building Gross Floor Area, which comprises of average cost, minimum and maximum cost of various components sampled in this study. This would go a long way in projecting a probable cost of security components.*
Keywords: building, costs, crimes, gross floor area, residential, security components, model,

INTRODUCTION

The development of houses for human residence have responded to the need to fortify buildings to forestall the commitment of crimes. Thus, 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 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, and include the provision of burglar proofing, perimeter fencing, guard huts and external floodlighting, supported by (Anifowose, 2003; 2007). 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. Dikko (2002), examined the process of developing a basis for estimating cost of projects, or portions of a project or services by reducing all key variables and inputs into a formulae could simply be referred to as cost modeling. In his study, it was established that the key property of a good cost model is its ability to predict future project cost within predetermined range of accuracy and also its responsiveness to changes in any of the key variables built in.

However, this study aimed at establishing a parameter/model for predicting probable cost of security for a proposed four bedroom residential bungalow building, through a quantitative analysis of the costs of built-in security component in middle-income residential building. The paper intend to achieve this by meeting the following objectives; (1) comparing the cost per m² of gross floor area (gfa) of a standard 4-bedroom bungalow building, (2) relating the cost of each security component, (i.e. anti-burglar proof, gatehouse, perimeter fence, and external electrification), to the Total Building Cost, and relating overall cost of built-in security components to the Total Building Cost. (3) Drawing conclusions on how the perceived differences in cost, can be effectively used as cost data for built-in security component of residential building in future. Further objectives of the paper include the derivation of the line or curve that best fits the relationship between building characteristics and costs of security-related components.The study is based on the following null hypotheses that no significant linear relationship exists between the following pairs of variable:-

Ho_1: the costs of anti-burglar proofing and the total building cost.

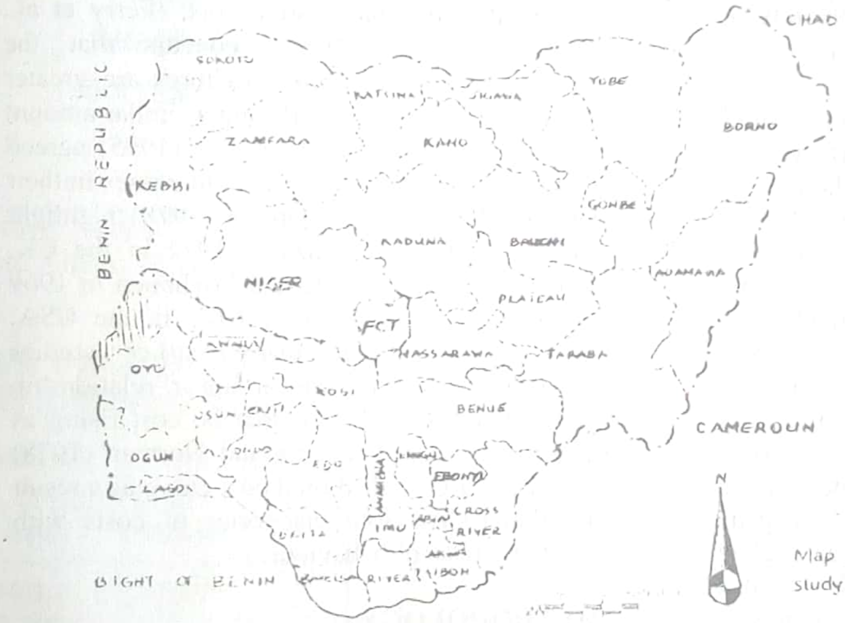
Ho_2: the cost of constructing a gatehouse and the total building cost.

Ho_3: the costs of providing a perimeter fence and the total building cost.

Ho_4: the costs of installing external lighting and the total building cost.

Ho_5: the total costs of security component and the total building cost.

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. The data utilized by this paper was sourced from buildings of a residential nature constructed within the study area, which cover Kwara state. Kwara state is situated between parallels $11^{0}7'$ and $11^{0}45'$ north latitude and $2^{0}45'$ and $6^{0}40'$ east longitude. It has an elongated shape running from west to east and covering an area of about 31,000 square kilometers. It occupies a strategic position in the country as it is situated about mid-way between the north-west and the along its northern and eastern margins and shares a common internal boundary with Niger state in the north, Kogi state in east, Oyo, Ondo and Osun state in south and an international boundary with the Republic of Benin in the west, Oyebanji, (1993). (See map below). The monetary values of security components employed by the study refer to projects proposed and executed between 2003 and 2007, and are expressed in Naira. The average official rate of exchange over this period of time was about 125 Naira to 1 US Dollar.



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

Pilot Survey

A preliminary survey of crimes committed at victims' residences helped in the development of the research hypotheses. Specifically, data on breaking and theft crimes in all local go /ernment areas of Kwara State for a five-year period (2003-2007) was obtained from the state command of the Nigerian Police.

Table 1. Trend in burglary breaking & entering crimes in Kwara state {2003-2007}

YEAR	NO. OF CRIMES COMMITTED.
2003	180
2004	227
2005	261
2006	479
2007	419
Total	1566

Source: Nigerian police, state command, Kwara state {2008}.

This data definitely shows that steady increases in crimes committed at victims' residences have been occurring. This might provide justification for the attention house owners have been devoting to built-in security measures such as fences, anti-burglar screens to openings, gatehouses and external lighting.

Related Works

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) postulated that Security Sector Reform (SSR) has become a central part of development policy, given an increasing recognition of the links 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.

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%. While literature searches will provide evidence that security of persons and property are important to both individuals and government, works on empirical relationships between infrastructure costs and security-related costs have not received detailed research attention. By contrast, as far back as three decades ago, the relationship between the height of buildings and their cost of construction was already the subject of intense research. Conventional wisdom in the construction industry suggests that for the same areas of accommodation, tall buildings are more expensive to construct than low-rise buildings. A paper by Flanagan and Norman (1978) focused on this issue, and Bathurst and Butler, (1980) opined that generally the cost of building per square metre of floor area can be expected to increase with the addition of extra storeys. Tall buildings are invariably more expensive to build than two- or three-storey buildings offering the same accommodation; and the taller the building the greater the comparative cost, (Ferry et al., 1999). Ashworth (1994) concurs that the construction costs of tall structures are greater than low-rise buildings offering a similar amount of accommodation, while Seeley (1995) agreed that costs of buildings rise with increases in their height. Flanagan and Norman (1978) highlight various studies: Tregenza in 1972 in the UK, separate studies by Jarle and Pöyhönen in 1969 in Finland, and Steyert in 1972 in the USA. They reported that many earlier studies suggested that there was a linear relationship between height and cost; that is, cost rising as height increases. Flanagan and Norman (1978) postulated a U-shaped total cost curve as a result of adding their four categories of costs with varying modes of behaviour.

METHODOLOGY

Building plan of a chosen architectural design for a middle-income class residential building consisting of; four numbers combined bedroom, toilet and bath, one number standard living room and dining, kitchen and store was employed as a basis for pricing.

Cost of construction of the chosen design was obtained using a Bill Of Quantity (BOQ) divided into eleven elements, following SMM of building classification. The elements contained in the BOQ are further grouped into major and minor cost heading as shown below:-

Table: 2. List Of Cost Headings In A Bill Of Quantities

	MAJOR HEADING	MINOR HEADING.
A	SUBSTRUCTURE	Excavation, concrete work, block work
B	WALLS	Block work, concrete work
C	ROOF	Carpentry, sheet metal works
D	DOORS	Door leaves, lintels, frames **Burglar proofing**.
E	WINDOWS	Window panels, lintels, **Burglar proofing**.
F	FITTING & FIXTURES	Wardrobes, cabinets.
G	SERVICES	Pipe work, sanitary appliances, cabling, and Electrical fittings.
H	FINISHING	Rendering, floor screeding, ceiling work, tiling
J	PAINTING	Emulsion work, gloss finishing
K	DRAINAGE	Pipe work, block work, concrete work
L	EXTERNAL WORKS	**Fence**: - Block work, concrete work, rendering, Gate **Gatehouse**: - Block work, concrete work, roofing, openings **External lighting** - Cabling, electrical fittings

Source: Author's analysis of field work 2008.

Note: - Items of interest security wise highlighted in **bold**.

RESULTS AND DISCUSSIONS

Table 3: Descriptive Summaries of the Research Data.

Parameter	TCB	ABP	Gate house	Cost of fence	External electrification	Total cost of built-in security	Cost of substructure	Cost of walls	Cost of roof
Mean	8568691	237401	179620	1347181	43787	1807989	962319	664850	1380395
Median	8760716	151167	183810	1250942	17948	1765305	987895	673455	1429692
Standard Deviation	1326617	219673	29276	290958	54992	361865	137301	118912	405971
Maximum	10632180	982000	241075	1916679	171040	2586438	1203410	892804	2134225
Minimum	5642253	93600	135940	882350	12000	1315850	731975	392460	238943

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

To obtain tender prices for the work items contained in the elements above, for use in data analysis, 45 copies of the BOQ were circulated, to Quantity surveyors in consultancy firms, ministry of works and housing, and some contractors, all in Kwara state. Thus, only 30 copies were receipt and used for the analysis.

Presentation and Analysis of Data

Graphical analysis of the costs of security components are displayed in fig 1 below. Cost of perimeter fence was the highest compare with the other security components, followed by gatehouse but at a very close range with anti-burglar protection, while external electrification was clearly the least. Table 4, below shows the various security costs involved in the building as % of Total Cost of Construction. While table 5, shows the same but as % of the Total Cost of Security. Also, table 6, shows the Total Cost of Security components as % of Cost of Structural Elements (i.e. substructure, walls and roofing). Lastly table 7, shows the cost per m^2 of Building Gross Floor Area (gfa) for various components employed for the purpose of the study.

Upon receipt of the priced BOQ, total cost of building and cost of each security component (i.e. Anti-burglar proofing, Gatehouse, Fence, and External-Electrification), were extracted. Statistical treatment of these totals was carried out, mainly of descriptive nature.

A further series of analysis were carried out to establish, statistically, the relationship between the cost of various security components and the total building cost. Linear regression and analysis of variance (ANOVA) were employed in this experiment. The results of the analysis were shown in the table 8, below.

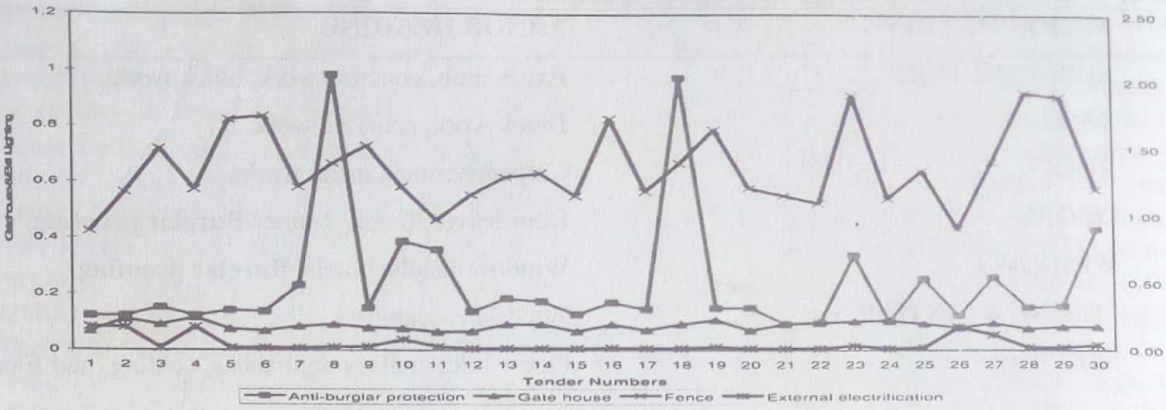


Fig.2: Trends in Costs of Building Security Components

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

Table: 4. [As % of Total Cost of Construction]

	Anti-burglar protection	Gate house	Fence	External Lighting	Total Cost of Security
Mean	2.8	2.1	16.2	0.5	21.5
Median	2	2.1	15.2	0.2	21.1
Minimum	0.9	1.5	8.7	0.1	13.1
Maximum	10.3	2.9	26.5	2.1	31

Table: 5. [As % of Total Cost of Security]

	Anti-burglar protection	Gate house	Fence	External Lighting
Mean	12.4	10.2	74.8	2.6
Median	9.1	10.0	77.5	1.0
Minimum	6.5	6.9	53.7	0.4
Maximum	38.0	15.1	85.5	12.9

Table: 6. [Total Cost of Security as % of Cost of Structural Elements]

	Substructure	Walls	Roofing
Mean	189.0	286.9	152.5
Median	178.2	281.1	141.1
Minimum	132.9	175.4	78.2
Maximum	279.6	418.5	622.0

Table : 7. [Costs per M2 of Building gross floor area]

	Total Cost Of Building	Anti-burglar protection	Gate house	Fence	External Lighting	Total Cost Of Security	Substructure	Walls	Roofing
Mean	34197.3	949.6	718.7	5389.3	173.3	7233.0	3853.3	2618.7	5521.6
Median	34000.0	604.7	740.0	5020.0	80.0	7061.2	3960.0	2640.0	5718.8
Minimum	22560.0	374.4	560.0	3520.0	40.0	5280.0	2920.0	1560.0	955.8
Maximum	42520.0	3928.0	960.0	7680.0	680.0	10345.8	4800.0	3560.0	8536.9

Source: Table 4-7 above are computed from field survey data by Author (2008)

Table: 8. Summary of Results Based On Simple Regression Analysis

EXP NO.	Variables		Type of Analysis	OBSERVATION					INFERENCE	
	X	Y		Regression Equation	R^2 %	F.cal	F.tab	P.Value	54rength of relation-ship	RMKS
1	TCB	ABP	Linear	ABP= -204.3865+0.0338 TCB	4.2	1.21	4.20	0.2799	Weak	NS
2	TCB	GATE HOUSE	Linear	GH=279.6513+0.0128 TCB	36	15.63	4.20	0.0005	Fair	SS
3	TCB	FENCE	Linear	FENCE=5714.3482 -0.0095 TCB	0.2	0.05	4.20	0.8202	Weak	NS
4	TCB	EXT ELECT	Linear	EXTELECT= -136.0207+0.0091 TCB	4.8	1.41	4.20	0.2448	Weak	NS
5	TCB	TCS	Linear	TCS=5613.9667+0.0474 TCB	3.2	0.87	4.20	0.3587	Weak	NS

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

Discussion of Result

Only one of the five experiments carried out was statistically significant. R^2 values for all the experiments did not exceed 36%. This appears to indicate that the components of built-in-security considered in the experiments did not constitute significant items of cost that might be used for cost planning of similar proposed buildings, except for Gatehouse with R2 value of 36% and P-value of less than (0.05) degree of freedom, which constitute a significant relationship with the Total Building Cost.

As % of Total Cost of Construction, fence had 26.5% maximum and 8.7% minimum of the Total Cost of Construction. followed by Anti-burglar protection with 10.3% maximum and 0.9% minimum, while Gatehouse and External Electrification had the least percentage of (2.9%,2.1%) maximum and (1.5%,0.1%) minimum. Similarly, fence had percentage ranging from 53.7% to 85.5%, but as % of Total Cost of Security. While all other security components were below 40%. These results however, indicate that cost of fence relative to aggregate cost of security and total cost of construction was expensive, while other security components were cheaper. Hence, for cost planning purposes, cost of fence and Gatehouse need to be planned and expected to provide a valid result.

Moreover, the study went further and compared the Total Cost of Security As % of Cost of Structural Elements, (i.e. substructure, walls and roofing).thus, substructure had 132.9% minimum and 276.6% maximum, walls had 175.4% minimum and 418.5% maximum and roofing had 78.2% and 622% maximum. These results indicate that the costs of all security components are very small compared with the cost of Structural Elements.

CONCLUSIONS

The importance of the results of the regression analysis is that there is a positive correlation in all the analysis except in fencing. It thus, shows that increase in Total Cost of Building (TCB) will definitely lead to increase in cost of the security components (i.e. anti-burglar proof, gate-house, external electrification, and even the Total Cost of Security (TCS), while the increase in Total Cost of Building (TCB), might not have a serious effect on the cost of fencing.

Finally, the study established a parameter for determining the costs per m^2 of Building Gross Floor Area, which comprises of average cost, minimum and maximum cost of various components. As this would go a long way in projecting a probable cost of security components.

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