INFRASTRUCTURE SECURITY-RELATED CONSTRUCTION COSTS: CASE STUDIES OF COMMERCIAL BUILDINGS IN MINNA AND ABUJA, NIGERIA

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Abstract

This paper views threats to infrastructure security (vandalism, fire outbreaks, armed robbery and terrorism) as contrasting sharply with the reality that the empirical relationship between infrastructure facility characteristics and costs implications of security concerns have not been established. Private individuals express their security concerns through the provision of built-in security components such as burglar proofing, perimeter fencing, guard huts and external floodlighting in their houses. The aim of this paper is to establish the exact proportion of building costs devoted to the security of commercial buildings, and derive the line that best fits the relationship. The paper employs a survey approach, by utilizing a data collection proforma to capture eighteen (18) different variables comprising physical characteristics as well as costs of erecting the various elements of the buildings. Conclusions were reached that costs of built-in security varies between 0.5% and 3.0% of the total cost of the building, and that total floor area and areas of access and ventilation openings individually explain only between 3.0% and 5.15% of the variations in the costs of built-in security of commercial buildings. The paper recommends that specific levels of expenditure on passive security, expressed as a proportion of the total cost of the building, should be included as a prerequisite for the approval of building plans under the National Building Code.

Keywords: Buildings, Commercial, National Building Code, Security, Total floor area.

Introduction

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 between infrastructure facility characteristics and costs implications of security concerns are non-existent. This paper is focused on deriving and explaining such relationships in the case of buildings devoted to commercial uses. Research into security has assumed a front-burner position following the events of September 11, 2001. The public sector commits enormous resources to the securing of strategic infrastructure facilities such as oil installations, traffic routes, as well as air and sea-port terminals against

terror attacks. The public sector is also burdened with the more conventional policing of urban and rural areas, in order to forestall the commission of crimes against persons and property. Up to 2% of the gross domestic products of developing countries have been estimated to be devoted to this fight against crime, (Olavarria-Gambi, 2007).

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. 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. Previous researchers such as Anifowose (2003, 2007) have 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. The motives of most crimes against property are economic; it thus follows logically that buildings devoted to commercial uses might be targeted even more than residential buildings. Such buildings would need to be well fortified against criminal attacks, with the implication that more funds might be expended in securing such commercial buildings.

It remains a puzzling research problem that the exact proportion of building costs devoted to the security of commercial buildings is yet to be established. This is what this study aims to determine. 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 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.

Review of Related Works

Over time in Nigeria, serious crime has grown to nearly epidemic proportions, particularly in urbanized areas characterized by rapid growth and change, by stark economic inequality and

deprivation, by social disorganization, and by inadequate government service and law enforcement capabilities. Most information services regard the published crime statistics as grossly understated; most of parts of the country are not policed as the police were concentrated in urban areas where only about 25 percent of the population lived and public distrust of the police contributes to underreporting of crimes. Annual crime rates fluctuated around 200 per 100,000 of the population until the early 1960s and then steadily increased to more than 300 per 100,000 by the mid-1970s. Total reported crimes rose from almost 211,000 in 1981 to between 330,000 and 355,000 during 1984-85. Although serious crime usually constituted the larger category, minor crimes and offences accounted for most of the increase. Crimes against property generally accounted for more than half the offences, with thefts, burglary, and breaking and entering covering 80 to 90 percent in most years. Assaults constituted 70 to 75 percent of all offences against persons, (Library of Congress, 1991)

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.

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 privatisation 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 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%.

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 (see figure 1). 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.

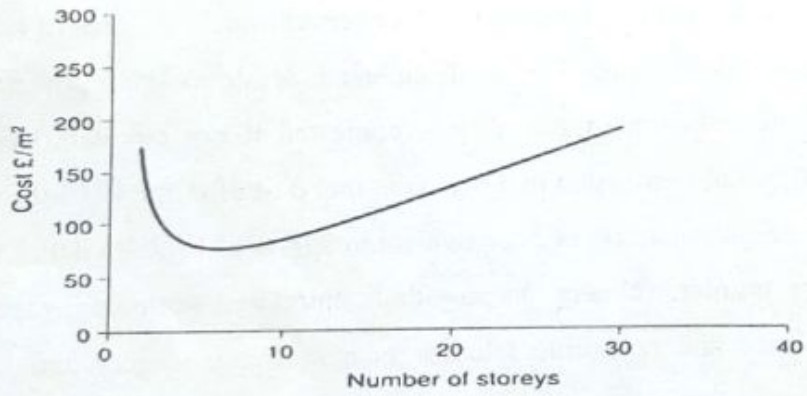

Figure 1 Cost £/m2 of gross floor area vs. number of storeys (source: Flanagan and Norman, 1978)

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.

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 to 49 buildings. However, only 44 building projects 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.

Pearson product-moment correlation was utilized in determining the level of association between the variables. Line graphs of the data were also 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.

Data Analysis and Discussion of Results

A description of the 44 building projects that were used for the statistical analysis in this paper is provided in table 1 below. The costs employed as costs of built-in security exclude costs of perimeter fencing, external lighting, fire and burglar alarms (except in the case of the banks).

Table 1: Distribution of sampled projects

Type of Commercial Building	Average Floor Area	Number sampled by study
Shops	582	12
Market administration buildings	269	2
Banks	257	2
Cold stores	459	2
Restaurants	449	3
Warehouses	1,972	1
Unspecified uses*	260	22
	Total	44

*Unspecified uses refer mostly to buildings planned as residential but converted to commercial uses.

Source: Field survey by researchers (2007)

Graphical analysis of the research data was undertaken by grouping the independent variables into categories, depending on the degree of dispersion or convergence of the data. The total floor area (TFA) was split into five (5) categories, while total opening area (TOA) yielded four categories. Two combination charts were plotted, using the independent variables in turn, along with the dependent variable (proportion of building cost devoted to security, in percentage terms). Figure 1 revealed that the proportion of building cost devoted to security reduces when the total floor area is higher than 400 square metres but less than 1000 square metres. For buildings less than 200 square metres about 2% of the total building cost was devoted to security.

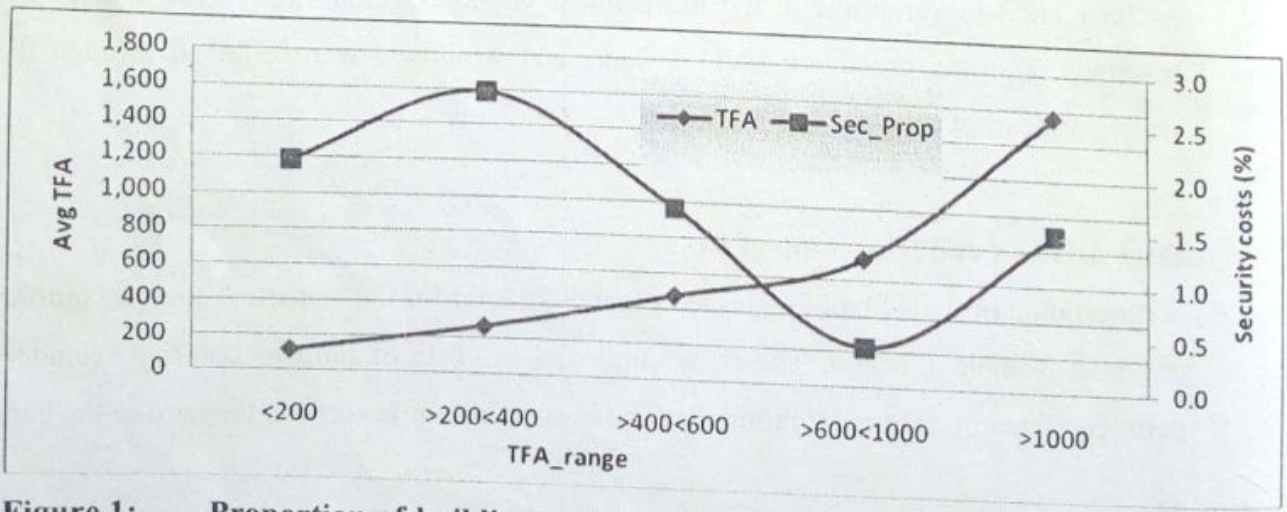

Figure 1: Proportion of building cost devoted to security categorized by the total floor areas of commercial buildings.

The shape of the TFA curve resembles one derived from a polynomial regression model. Confirmatory tests of the suggested relationship would however require more data than this study possesses. The proportion of building cost devoted to security reduces from about 3% when the total area of all access and ventilation openings is less than 50 square metres to 1% when such areas are more than 200 square metres. The cost of the buildings as reflected by the total floor area is probably a hidden influence, since this study did not keep floor areas constant while testing the areas of openings. These observations are displayed in figure 2 below.

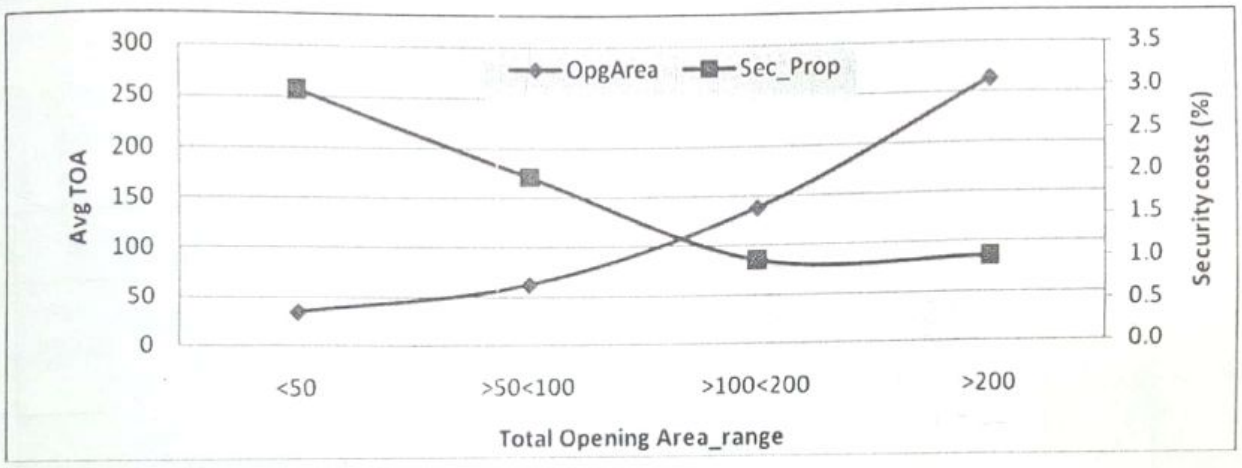

Figure 2: Proportion of building cost devoted to security categorized by the total areas access and ventilation openings of commercial buildings.

Although the proportion of buildings costs expended on built-in security behaves in certain ways relative to the sizes of the buildings and openings in the building, correlation analysis revealed that the independent variables are poor predictors of the behaviour of the costs of built-in security.

Table 2: Pearson Correlation analysis results

Exp No	X	Y	R-values	R^2-values (%)	P-value	Inference
1	Total floor area (TFA in square metres)	Costs of built-in security components	-0.188	3.53%	0.233	Statistically insignificant
2	Total opening area (TOA in square metres)	Costs of built-in security components	-0.227	5.15%	0.138	Statistically insignificant

Source: Computed from field survey data by researchers (2007)

Notwithstanding the very low values of r obtained, an interesting feature is the negative linearity observed in both experiments. Data sampling issues might be reviewed to provide explanations for the low values; Anifowose (2003) using a sample of 30 buildings had a low value of 3% when he compared the total cost of buildings to the total cost of security. An increase in the sample size might result in improved coefficient of correlation values. It is still however of interest to this study to determine, at the present low levels of accuracy, by how much costs of built-in security will vary when the floor areas and/or the areas of access/ventilation openings are varied. Simple linear regression analysis was employed, and the results obtained are displayed in Table 3 below.

Table 3: Simple regression analysis results

Exp No	X	Y	Model	Regression Equation	B	SE of B
3	Total Floor Area	Costs of built-in security	Linear	Costs of built-in security = -0.573 + 691.78 TFA	691.78	192.48
4	Total Opening Area	Costs of built-in security	Linear	Costs of built-in security = -1.969 + 668.50 TOA	668.50	164.13

Source: Computed from field survey data by researchers (2007)

The results in Table 3 showed that about 691.78 Naira was expended on built-in security in commercial buildings for every square metre constructed. Comparatively, security expenditures could be described in terms of the areas of openings secured, where 668.50 Naira would be spent for every square metre of openings (doors and windows) secured against criminal entry.

Implications of Findings

Based on the finding that the cost of built-in security varies between 0.5% and 3.0% of the total cost of the building, a temptation might exist to ignore the costs of security items during the planning stage of the building. Quantity surveyors might surmise (and this would be partially correct) that such costs can be conveniently settled out of the project contingency allowances. However, the following points must be borne in mind.

- This study has only covered costs of security that involve providing components that are built into the building itself. Most of the said components perform dual purposes (doors allow access, secure spaces and provide aesthetics. To provide a reasonably acceptable level of security, other types of costs not covered by this paper must be considered.
- This paper has considered only passive forms of building security. More recently available active forms of building security are highly information technology-dependent, and require an operating environment that most buildings in Nigeria would not be able to provide (for example, constant electric power supply). This would lead to increases in the cost of security.
- The fact that total floor area and areas of access and ventilation openings individually explain only 3.0% - 5.15% of the variations in the costs of built-in security of commercial buildings implies that current research has yet to unravel the influence factors that determine the variations in the costs of security in buildings.
- A final implication of this research work is that since the initial costs of securing a commercial building against unauthorised access are low (691.78 Naira/m^2), commercial building occupiers might spending more money on the running costs of security.

Conclusions and Recommendations

This paper had set out to discover the relationship that exists between building characteristics and the costs of built-in security costs within the buildings. The paper concludes as follows.

1. That the relationship between the area of accommodation provided (total floor area) and the cost of built-in security could be described using a first or second order polynomial regression model.
2. That cost of built-in security varies between 0.5% and 3.0% of the total cost of the building.
3. That where the areas of access and ventilation openings do not exceed 150 square metres, the relationship of cost of built-in security to the total cost of the building could be modelled using a linear function.
4. The total floor area and areas of access and ventilation openings individually explain only 3.0% - 5.15% of the variations in the costs of built-in security of commercial buildings.

5. Securing a commercial building against unauthorised access would costs less than one thousand Naira per every square metre of accommodation constructed (actually 691.78 Naira/m^2).

As part of efforts aimed at improving the security situation in Nigeria, it is recommended that research activities should be energised to provide empirical evidence-based perceptions of occupiers of commercial buildings with regards to how effective the protection provided by current levels of expenditure on security are. Such research must also establish actual levels of expenditure on the maintenance of security over the life of buildings. Finally this paper recommends that given the low proportion of total costs of buildings that is currently expended on built-in security, building economists (quantity surveyors) in consultation with the rest of the design team should consider security as a separate sub-element in the provision of services to the building. Funding of security can thus be justified at levels that would be higher than what is described in this paper.

Suggestions for Implementation

The security of lives and properties as well as the maintenance of law and order within national boundaries is a constitutional duty imposed on governments. However, given the rising importance of the private sector in security matters in contemporary times, this paper suggests that the following steps be taken to improve the security situation within the study area, with particular reference to commercial buildings.

(i) The provision of adequate levels of passive security in buildings should be included as a matter of law in the National Building Code. Specific levels of expenditure on security should be required from commercial building owner, as a requirement to obtain building approval. Such levels of expenditure should be expressed as a proportion of the total cost of the building.

(ii) Commercial building owners should be offered rebates on the construction tax, property tax and ground rents payable on their buildings, where it is ascertained that their expenditure on built-in security within such buildings significantly exceeds what is required under the National Building Code.

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