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Building Security Cost Determinants within the Built-environment

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Authors' contributions

This work was carried out in collaboration between both authors. Author AOM designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript and managed literature searches. Author IS reviewed and facilitated the final shape of paper. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: Building cost more currently, and a significant amount of such cost may be caused by increased expenditure on building security. However, various factors constituting the cost of building security are yet to be established. This lack of knowledge has led to an investigation to discover the determinants of building security cost within the built-environment.
Study Design: The study used quantitative phase of sequential exploratory research and employed phenomenological research design for it data collection and analysis.
Place and Duration of Study: This study is part of an ongoing PhD research project in School of Housing Building and Planning, Universiti Sains Malaysia, between 2013 and 2015. Field work was conducted in Nigeria between October 2013 and March 2014.
Methodology: The study employed quantitative research technique and relies on questionnaires to source 297 samples at 88% response rate, primarily from respondents. The validation was carried through panel of experts, while analysis of data was conducted with the aid software package for social science (SPSS 20).
Results: The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of all items met the

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minimum requirement of 0.5, and the diagonal measure of sampling adequacy (DMSA) for all items under each factor were greater than 0.5. The Cronbach's alpha value ranges from 0.6 to 0.8 and above, while skewness and kurtosis were within the stipulated given ranges of ±2.0 and ±10.0 respectively. The results indicate that the instrument is reliable and the data depicts reasonable normality.

Conclusion: Therefore, this study has gone to some extents in enhancing the understanding of determinants factors of building security cost. It reveals that building security cost is influenced by security measures and building characteristics. It provides an evidence that evaluation and control of building security cost relies on giving due consideration to security measures and building characteristics.

Keywords: Building security cost; determinants factors; factors analysis; reliability; normality.

1. INTRODUCTION

Crime is an economically important activity which is almost completely neglected by economists [1]. This neglect however makes the economics of crime a relatively new field for economic investigation into the outstanding increase in criminal activities [1-3]. Building cost more currently, and a significant amount of such cost may be caused by increased expenditure on building security. Recently conducted study from an ongoing research project explores the factors influencing building security cost within the built-environment in Nigeria as a result of frequent escalation in the cost of maintaining security in houses using qualitative research technique. Consequently, this has demanded for further investigation on cost factors of building security using quantitative research technique. Ref [4], affirmed that security devices fitted to properties lower the risk and generally prevents domestic burglary. Ref [5], stated that security related costs arise from security design principles applied to both newly constructed and modified buildings. Incarcerated offenders responded to critics among the criminologist on cost of situational crime prevention. Evidence has shown that criminals reported higher fear of getting caught rather than the details of the punishment they would potentially receive if caught [6]. Therefore, increasing the risks of being caught is the key category of the situational crime prevention theory. However, various factors constituting the cost of building security are yet to be established. This lack of knowledge has led to an investigation to discover the determinants of building security cost within the built-environment. The realization of this objective will help in the control of expenditure and forecast of probable future cost of building security.

1.1 Previous Related Studies from an Ongoing Research Project

The objective of this study stirred from an ongoing research project. One of the previous conducted studies is an exploration into cost-influencing factors of building security. The study explores the cost-influencing factors of building security using qualitative research technique. Phenomenological research design was used for both data collection and the analysis. Two main categories having direct relation to building security cost were identified to sort the responses to the questions. Thus, eleven factors emerged from the categories. The results of the severity index analysis conducted on the factors revealed no significance gap exist between the factors. Intruder detection was ranked the highest on the table of ranking with S.I value of 94%, while Aesthetics was the least with S.I value of 72%. However, high relative importance index depicted by all factors when compared with the previous researchers' were significantly influence building security cost [7].

On the other hand, a pilot study was conducted on a sample data to examine the validity, reliability and normality of the instrument used in the study. The study used 39 questionnaires at 78% return rate. The reliability and normality of the instrument was tested using Cronbach's alpha and skewness and kurtosis scores, respectively. The results of reliability show that building characteristics, building security cost and two other dimension of security measure were within the range of 0.7 to 0.8 Cronbach's alpha value, and the remaining two dimensions of security measure were at 0.6 Cronbach's alpha value. The normality test results revealed the skewness values ranged from -2.039 to 0.736, and the kurtosis scores ranged from -2.084 to 9.145, which were considered normal based on the assumption made by [8] given the ranges of ±2.0 for skewness and ±10.0 for kurtosis. Therefore, these results and the established benchmark show that the entire construct is reliable. Similarly, they are considered normal based on the assumptions made by [9].

2. METHODOLOGY

This study employed quantitative research technique and relies on questionnaires to source relevant information primarily from respondents. According to [10], a survey questionnaire is perhaps the best technique in collecting original data that is too large to observe directly. Likewise, [11], stated that questionnaire is an efficient data collection instrument when the researcher knows what exactly he needs and how to measure it. In addition, questionnaire is described as an excellent technique for collecting clear, accessible, informative, and brief data, to answer research questions and to support or reject hypotheses [10,12]. Therefore, a total of 333 questionnaires were distributed for the purpose of this study. The sample was stratified into five stratums to cover built environment professionals, namely: Architects, Builders, Quantity Surveyors, Urban and Regional Planners, and Estate Surveyors and Valuers. However, out of 333 questionnaires distributed in this research, 300 were returned, and only 293 were usable, resulting to 88% response rate. This response could be regarded as better and acceptable one when compared with the previous research studies conducted in Nigeria, by [13,14], with 88% and 80% response rate respectively. Based on these, the 88% response rate achieved in this study is very good and acceptable. In order to validate the instrument used for this study, some PhD holders who were also lecturers and experts in various professions from construction sector and those that are familiar with the construction industry activities were contacted to check the clarity of the instrument used for this study. Their comments and suggestions were integrated in the improvement of the contents and the wordings of the questions. Below is sample of the suggestions as amended:

i) The wordings of the Likert scale were; strongly disagree, disagree, neutral, agree, and strongly agree. But it was suggested that 'neutral' should be replaced, which was replaced with 'neither disagree nor agree'.

The reliability and normality of the instrument were tested using Cronbach's alpha, Skewness and kurtosis respectively.

3. RESULTS AND DISCUSSION

3.1 Validating the Research Instruments: Factor Analysis

It has become imperative in this study to use factor analysis for exploring theoretical structure. Thus, the theoretical questions about the underlying structure of factors influencing building security cost within the built environment were explored and empirically tested using factor analysis. Factor analysis is employed in this study to eliminate or identify items for improvement. The sample size for this study is 293, good for factor analysis. The strength of relationship among the items was recommended by [15], as correlation matrix of greater than 0.3 coefficients. That is if few correlations were found above this level, factor analysis may not be appropriate. Furthermore, the factorability of the data can also be check using Bertlett's test of sphericity with the maximum value being 0.05 or less for factor analysis to be considered appropriate, while the index range from 0 to 1, with the minimum value of 0.6, were considered as a good factor analysis for the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy [15]. However, [16] revealed that 0.5 can be the minimum acceptable value. Therefore, a lowest communality value less than 0.3 and lowest pattern loadings value less than 0.5 were used to eliminate items from the research instrument [17]. In addition, eigenvalues were used to indicate the amount of variance each factor accounted for. Therefore, factor analysis was conducted on the following factors: (a) Security measure comprising of (i) Access prevention, (ii) Intruder detection, (iii) Perimeter fence protection and security house, (iv) Security lighting, while (b) Building Characteristics includes (i) Location of building, (ii) Height of building, (iii) Use of building, (iv) Size of building, (v) External wall openings, (vi) Plan shape and (vii) Aesthetics, and Building security cost (Devices). Nonetheless, [18] stated that there is no significant way of calculating the meaning of the factors: they are what one sees in them and the interpretation of factor loadings is largely subjective.

The factor analysis for all factors as presented in Table 1, shows that the diagonal measure of sampling adequacy (DMSA) for all items under each factor were greater than 0.5. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of all items met the minimum requirement of 0.5. Security lighting had the lowest KMO value of 0.592. KMO for Access prevention, Use of building and Aesthetics were at the average coefficient value ranges between 0.644 and 0.692, while Intruder detection, Perimeter fence protection and security house, Location of building, Height of building, Size of building, External wall openings, Plan shape and Building security cost (Devices) had the highest coefficient value ranges between 0.725 and 0.785. Also, the Bartlett's tests of sphericity for all factors were significant at 0.000 values. Furthermore, selections and dropping of items were based on criteria of eigenvalues greater than 1.0, and communalities and pattern matrix loadings. In accordance with the previous researchers such as [19-21], a coefficient of 0.60 is considered as having an average reliability. Furthermore, a studied on exploratory studies conducted by [22] revealed that a value of Cronbach's alpha exceeding 0.5 are considered as satisfactory. However, [23] adopted a Cronbach's alpha of 0.5 as the criterion of acceptability for the index of learning styles. Likewise, [24] also used a Cronbach's alpha of 0.5 as the criterion of acceptability for assessing factors influencing rework cost. Therefore, this study also adopted Cronbach's alpha of 0.5 as criterion of acceptability for factors influencing building security cost, since it is a factor assessment. Moreover, [25] states that if a test consists of a strong internal consistency measurement experts agreed that it should reveal only moderate correlation among items. Also, if correlation items are too low, it is probably measuring different traits and hence, they should be excluded in a test that is meant to measure only one trait. Likewise, if item correlations are too high, it is possible that some of the items are redundant and therefore should be removed from the test.

3.2 Reliability and Normality Test

This study presents the analysis conducted to attain the research question that asked: what are the determining factors of Building security cost within the built environment in Nigeria? Its objective was to establish the determinants of cost-influencing factors of building security cost within the built environment in Nigeria. This objective was achieved through the use of reliability and normality test. This method was employed because [8,26] used the technique to assessed the determinants of customer behavioural responses and the determinants of ICT acceptance among the construction realm respectively. Furthermore, the skewness values ranges between ±2.0 and kurtosis values ranges between ±10.0 were considered reasonably normal [8]. Hence, this study accepted the assumptions with a confirmation test using normal P-P plot, while a Cronbach's alpha of 0.5 was set as benchmark for this analysis, since [23] affirmed that a Cronbach's alpha of 0.5 or greater is acceptable. Therefore, the results of the analysis for this objective are as follows:

Table 1. Results of the factor analysis

Factors	DMSA (> 0.5)	KMO	Bartlett's Test of Sphericity	Eigenvalue (> 1.0 explaining)	No of item	Item dropped
Access protection	0.627-0.727	0.656	0.000	1 @ 54.96%	6	2
Intruder detection	0.689-0.841	0.770	0.000	1 @ 63.69%	5	Nil
Perimeter fence protection and security house	0.648-0.808	0.767	0.000	2 @ 84.13%	6	1
Security lighting	0.535-0.669	0.592	0.000	2 @ 70.73%	5	Nil
Location of building	0.686-0.899	0.761	0.000	2 @ 67.39%	8	2
Height of building	0.667-0.808	0.727	0.000	1 @ 57.26%	7	2
Size of building	0.705-0.827	0.755	0.000	1 @ 61.01%	6	2
Use of building	0.536-0.815	0.644	0.000	1 @ 50.37%	6	Nil
External wall openings	0.698-0.847	0.764	0.000	2 @ 63.49%	8	Nil
Plan shape	0.675-0.784	0.725	0.000	1 @ 46.23%	6	1
Aesthetics	0.545-0.764	0.692	0.000	2 @ 56.96%	7	Nil
Building security cost (Devices)	0.546-0.885	0.785	0.000	3 @ 64.98%	17	Nil

Table 2 presents the reliability test with (cronbach's alpha), and normality test with (skewness and kurtosis) for Building Security Cost determinant; *Security Measures*. The dimensions studied under security measure were access prevention with 4 items, intruder detection with 5 items, perimeter fence protection and security-house with 5, and security lighting with 5. In addition, access prevention had a Cronbach's alpha value of 0.720 which was *good* with skewness value of -0.300 and kurtosis value of -0.706 which was also *normal*. The Cronbach's alpha for intruder detection was *good* with a value of 0.855, similarly the skewness value -0.898 and kurtosis value 2.164 was also normal. Also perimeter fence protection and security-house had a Cronbach's alpha value of 0.826 which was *good* with skewness value of -0.543 and kurtosis value of -0.385 which was also *normal*. Lastly, security lighting had a Cronbach's alpha value of 0.624 which was *good* with skewness value of -0.030 and kurtosis value of -1.087 which was also *normal*. Furthermore, in Fig. 1 the P-P plot values were also very close to the reference line which showed a very little deviation. This is an indication that the data was normally distributed and reliable.

Table 3 presents the reliability test with (cronbach's alpha), and normality test with (skewness and kurtosis) for Building Security Cost determinant; *Building Characteristics*. The dimensions studied under building characteristics were location with 6 items, height with 5 items, size with 4 items, use with 6 items, external wall openings with 8 items, plan shape with 5 items and aesthetics with 7 items. In addition, location of building had a Cronbach's alpha value of 0.758 which was *good* with skewness value of 0.005 and kurtosis value of -0.888 which was also *normal*. The Cronbach's alpha for height was *good* with a value of 0.782, likewise the skewness value -0.270 and kurtosis value 0.299 was also normal. Also size of building had a Cronbach's alpha value of 0.762 which was *good* with skewness value of 0.076 and kurtosis value of -0.225 which was also *normal*. Use of building had a *good* cronbach's alpha value of 0.792, likewise the skewness value 0.128 and kurtosis value -0.311 signified *normal*. Also external wall opening was high with a Cronbach's alpha value of 0.829 which was *good* with skewness value of -0.053 and kurtosis value of -0.951 which was also *normal*. Plan shape had a Cronbach's alpha value of 0.691 which was *good* with skewness value of 0.079 and kurtosis value of -0.881 which was also *normal*. Lastly, aesthetics had a Cronbach's alpha value of 0.749 which was *good* with skewness value of -0.366 and kurtosis value of 0.368 which was also *normal*. Furthermore, the P-P plot values were also very close to the reference line which showed a very little deviation as given in Fig. 2. This is an indication that the data was normally distributed and reliable.

Table 2. Building security cost determinants assessment result: Security measures

S/N	Dimensions	Number of items	Reliability test	Normality test	
			Cronbach's Alpha	Skewness	Kurtosis
1	Access prevention	4	0.720	-0.300	-0.706
2	Intruder detection	5	0.855	-0.898	2.164
3	Perimeter fence, protection and security house	5	0.826	-0.543	-0.385
4	Security lighting	5	0.624	-0.030	-1.087

Table 3. Building security cost determinants assessment result: Building characteristics

S/N	Dimensions	Number of items	Reliability test	Normality test	
			Cronbach's Alpha	Skewness	Kurtosis
1	Location of building	6	0.758	0.005	-0.888
2	Height of building	5	0.782	-0.270	0.299
3	Size of building	4	0.762	0.076	-0.225
4	Use of building	6	0.792	0.128	-0.311
5	External wall openings	8	0.829	-0.053	-0.951
6	Plan shape	5	0.691	0.079	-0.881
7	Aesthetics	7	0.749	-0.366	0.368

Table 4 presents the summary of reliability test and normality test, which measures the determinants of building security cost. The results revealed that security measures: (access prevention, intruder detection, perimeter fence protection security-house and security lighting) and building characteristics: (location, height, size, use, external wall openings, plan shape and aesthetics), were acceptable as building security cost determinants. Likewise, the normality test revealed that the items of security measures and building characteristics were in normal condition to determine the building security cost. In addition, the normality of the determinants factors were further proven by normal P-P plot with all the points closer to the reference line signifies that the results were normal. However, this supported the skewness and kurtosis results. Therefore, these findings stirred this study to evaluate the magnitude of effect of the established building security cost determinants factors as the following analysis pursued.

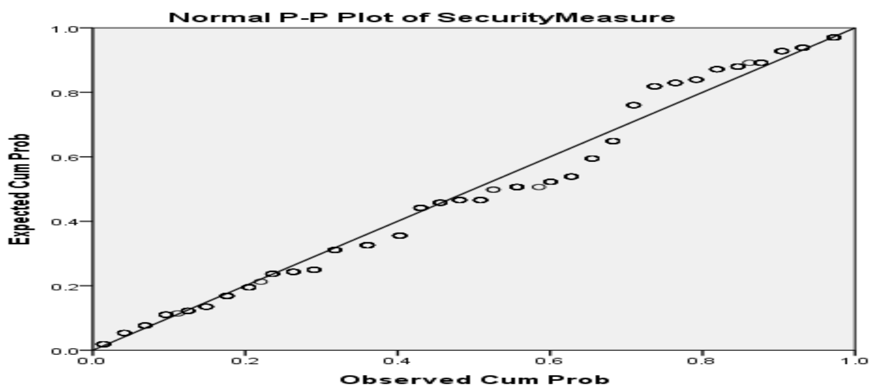

Fig. 1. Normal P-P plot for security measures

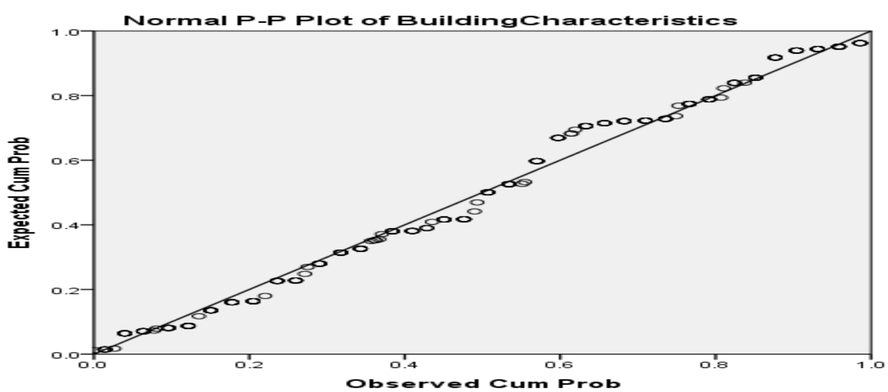

Fig. 2. Normal P-P plot for building characteristics

Table 4. Summary of building security cost determinants

Test	Method	Security measure				Building characteristics						
		AP	ID	PFPSh	SL	LOB	HOB	SOB	UOB	EWO	PS	Aes
Reliability	Cronbach's	A	A	A	A	A	A	A	A	A	A	A
Normality	Skewness	N	N	N	N	N	N	N	N	N	N	N
	Kurtosis	N	N	N	N	N	N	N	N	N	N	N
	P-P Plot	Close to the reference line				Close to the reference line						

Key: A = Acceptable, N =Normal; AP = Access prevention, ID = Intruder detection, PFPSh = perimeter fence protection security-house and security lighting, LOB = location, HOB = height, SOB = size, UOB = use, EWO = external wall openings, PS = plan shape, Aes = aesthetics

3.3 Discussion

This study is set out with the aim of assessing the factors that determines cost of building security within the built-environment in Nigeria. In order to answer the research question that asked: what are the determining factors of building security cost in Nigeria? The previous study on exploration into cost-influencing factors of building security produced two main factors, as presented in the Proceeding of management in construction researchers' associations (MiCRA 2014, International Islamic University Malaysia). The two major factors identified are: security measures and building characteristic, these are considered as the main construct. The items considered under security measures are: access prevention, intruder detection, perimeter fence protection and security-house, and security lighting. The items considered under building characteristics are: location of building, height of building, size of building, use of building, external wall openings, plan shape, and aesthetics. Hence, the study supported the established factors with reviewed related literatures on crime prevention, factors influencing building cost as well as building security.

To answer the current research question reliability and normality test were employed. The reliability result is all about the internal consistency measured by Cronbach's alpha coefficient [19,27]. It depicts the degree at which the items are measuring the underlying construct. Consequently, the items for security measures show a very good internal consistency with Cronbach's alpha more than 0.7, except for one 'security lighting' at 0.6 which is also good. However, the results indicate that all items are measuring the same construct "security measures". Similarly, normality test for the items is in agreement with the assumptions made by [8], that skewness of between ±2.0 and kurtosis of between ±10.0 can be described as reasonably normal, as depicted by the P-P plot. Therefore, based on normality test items of security measures indicates normal. As a result, all items of security measures can be consider as good factors to measure building security cost. This objective produced a result that is in line with the finding of [28] which states that every individuals are taking precautionary measures to prevent or deny the criminals from getting access into their buildings. Therefore, security concern of the private individuals is expressed through the provision of adequate measures to protect against the criminals' attacks in their building.

The items under building characteristics, presented a very good internal consistency with Cronbach's alpha more than 0.7, meaning that they are all measuring the same construct "building characteristics". Likewise, normality test for building characteristics indicates normal. Thus, the results are in line with the assumption made by [8] that skewness of between ±2.0 and kurtosis of between ±10.0 can be described as reasonably normal. In addition, the normal P-P plot shows a reasonable straight line to further proved normality of the results. This is an indication that all factors included as building characteristics need to be taking into consideration when planning or estimating the cost of building security. These results are in agreement with [5] that security related costs arise from security design principles applied to newly constructed buildings and modification of government structures. Similarly, [29] states that it is important to evaluate the security requirement of each type of building and at different level of the project, as this will ensure balance between security requirement and other aspects of the building such as architectural expression of the buildings which is in accordance with the result of this objective.

However, positive relation between levels of crime and precautionary measures is found in some of the previous studies conducted by [30-32]. Also, a related literature, has shown that policies aimed at directly changing victim behaviour rather than building in security measures have been inactive [33]. On the other hand, the cost implication of such intervention and adequate knowledge of the factors involves were not detailed. Therefore, the findings for this objective were definitely successful, as they were able to answer the research question by identifying the factors that determines building security cost within the built-environment in Nigeria. To includes: security measures such as access prevention, intruder detection, perimeter fence protection and security-house, and security lighting; building characteristics are location of building, height of building, size of building, use of building, external wall openings, plan shape, and aesthetics. Although, these might not be the only factors influencing building security cost, but in wide view they could be the most important ones. However, if co-variables other than those emerged from this study are considered in a different approach, a more suitable result or otherwise may emerge.

4. CONCLUSION

This study has gone to some extents in enhancing the understanding of determinants factors of building security cost. It reveals that building security cost is influenced by security measures and building characteristics. It provides an evidence that evaluation and control of building security cost relies on giving due consideration to security measures and building characteristics.

Hence, building characteristics as a determinants factor of building security cost might have varying influence on building security cost with respect to the following variables but not limited to: location of building, height of building, size of building, use of building, external wall openings, plan shape, and aesthetics.

Also, it would creates awareness to criminologist and policy maker of a need to give due consideration to building characteristics when carrying out evaluation on crime preventive measures in buildings. Finally, the findings of this study when developed into a model would assist in procurement and supply of security equipment, and forecasting of probable future cost of building security.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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