Development of a Multiple Regression Model for Predicting The Length of Skirting for Buildings in Anambra State

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Abstract- This research aims to address the absence of a suitable multiple regression model for predicting skirting lengths in buildings, which leads to cost overruns, inaccuracies in estimates, and project cancellations. The study focuses on developing a regression-based model specifically tailored for predicting skirting lengths in Anambra State. The research objectives include identifying factors influencing skirting estimate accuracy, assessing the impact of skirting estimates on overall project estimates, and proposing a predictive model based on floor area and length of door openings. The study adopts a quantitative correlational research design, utilizing questionnaires and architectural floor plans as primary data sources. The research population consists of residential building architectural plans approved by the Anambra State Physical Planning Board within the last three years. Descriptive statistical analysis, Pearson correlation, and multiple regression analysis were conducted using SPSS version 23. The research findings indicate that the competence of quantity surveyors significantly influences skirting estimate accuracy. There is a strong positive correlation between skirting estimates and overall project estimates, suggesting their statistical significance. The generated regression model $Y = 12.424 + 0.472*\chi1 + 2.013*\chi2$ demonstrates a high R-squared value of 0.824, indicating that a substantial proportion of variance in skirting length can be explained by floor area and length of openings. Based on the findings, recommendations are made for future research, including the validation of the regression skirting model using independent datasets and a comparative analysis with existing skirting estimation methods. These steps would enhance the reliability and practical application of the developed regression model in real-world scenarios. The research contributes to filling the gap in the literature on skirting estimate accuracy and provides a foundation for further advancements in skirting estimation methodologies in Anambra State.

Index Terms- Building estimate, Cost estimating, Regression models, Skirting, and Value chain

1. Introduction

The construction industry is plagued by issues such as cost overruns, overestimations, underestimations, and project cancellations, which impact project stakeholders significantly. These challenges highlight the necessity of accurate cost estimations and emphasize the demand for reliable prediction models. Stakeholders expect meticulousness, accuracy, and careful consideration in the delivery of cost estimations, as they directly influence project initiation and overall success (Zhu, Feng, and Zhou, 2010; AACE, 2004). At the project conception stage, one of the first things that come to mind is cost, as clients want to know what financial commitment will be required to make their project brief a reality. Additionally, the complexity of the construction industry and the individuality of every project demand the need for an accurate quantity estimate and cost prediction, which are crucial factors for the success of a project (Richa, Vivekanada, Monica, and Sanket, 2016). Thus, before site acquisition and a commitment to build, Clients seek the expertise of quantity surveyors, who play a pivotal role in assessing project feasibility and forecasting the contract sum, thereby facilitating informed decision-making (Lowe, Emsley, and Harding, 2006).

Quantity surveyors during estimation, particularly at the project's early stage, are faced with obstacles of insufficient time, inadequate preliminary information, and larger uncertainties as a result of the engineering solution (AACE 2004; Chen 2002). Also, clients require rapid and satisfactory responses to all aspects of project management; hence, in the face of competition and a glaring opportunity to win over a potential client, estimators dive into producing cost estimates within a limited timeframe. Anecdotal evidence opines that building a cost estimate is time-intensive, as the bulk of its process involves repetitive numerical activity during quantification (Rush and Roy, 2001). Subsequently, estimators in a need to meet clients' demands in a fast-paced industry like construction had concerns that stemmed from the consistency and accuracy of the available cost estimating techniques. Quantity take-off, a must-do exercise in cost estimation, is said to consume about 50–80% of the total time used in preparing the estimate (Wong et al., 2014). Anecdotal evidence suggests that estimating models are useful at the preliminary design stage of a project as they offer the benefits of increased accuracy, time savings, better performance yield, and the elimination of repetitive measurement processes (Richa et al., 2016; Kim et al., 2004). As a result, there is an alarming need for a rise in models that are user-friendly, cost-effective, and easy to use and manage.

Researchers, in a bid to add value to clients and estimators, began to develop models capable of predicting buildings' costs by carrying out extensive studies of the design parameter-cost relationship (Holms, 2005). According to Jacoby (2005), value is any activity that increases the market form or function of the product or service, and in today's construction industry, there is a need to maximize the value of every process in estimating. Scholars, by examining relationships between different building elements, began to introduce the use of parametric models (such as quantification models, software, and cost models) as an innovative and alternative estimation approach to attaining a competitive edge in terms of accuracy, speed, and commercial potential. Despite the importance of accurate cost estimation and prediction, there is a lack of comprehensive studies specifically addressing skirting estimate in buildings in Anambra State. Skirting estimate refer to the estimation of resources needed to accurately complete a wall finishing during a construction project. These resources which include materials, labour and equipment plays a significant role in determining the skirting costs. According to Omange and Udegbe (2000), materials alone can account for up to 60 percent of a project cost, hence an erratic quantity estimate can have a noticeable impact on a project outturn cost resulting in potential losses for the project owner.

The choice of Anambra State as the focus of this research is directly related to the memorandum of understanding signed between the state government and real estate developers (**Uzoma**, 2023). This partnership signifies a significant surge in construction activities and emphasizes the importance of accurate and efficient construction practices. Anambra State's transformation into a smart mega city necessitates the integration of advanced technologies, sustainable infrastructure, and aesthetically pleasing buildings. Skirting is a vital component of this process, as it directly influences the overall design coherence and functionality of buildings. This element under the ceiling, floor, and wall finishes in the revised edition of Building and Engineering Standard Method of Measurement, 4th Edition (BESMM4R), is done at the meeting point of a wall and floor to prevent seepage from its joints. The process of building a cost estimate is complex and involves a wide range of value-adding tasks such as quantification, market surveys and costing necessary to arrive at a feasible amount. According to Rush and Roy (2001), quantification consumes a substantial proportion of the total time required to prepare the estimate and involves repetitive numerical activity. By developing a multiple regression model specifically tailored to Anambra State's building context, the limitations that hampers the ability of quantity surveyors to provide accurate cost estimate capable of eliminating cost overruns, overestimation, underestimations and project cancellations can be addressed.

Against this background, this research aims to develop a multiple regression model for predicting skirting length for buildings in Anambra State, Nigeria, thereby facilitating the smooth realization of the state government's vision. The following objectives form the basis for achieving the aim of the study:

i. To determine the factors affecting the accuracy of a skirting estimate
ii. To determine the impact of skirting estimates on the overall project estimate
iii. To propose a predictive model for the relationship between floor area, length of doors opening, and length of skirting.

II. LITERATURE REVIEW

To address the first objective of the research, a desktop review of literatures similar to the research focus was reviewed. An expository study on the study framework, theoretical studies on areas such as cost estimate, estimating methods, regression analysis, and an empirical study highlighting similar and closely related quantification models developed by other researchers was also spelt out in the study, thus answering the research objective.

2.1 Theoretical Framework

Porter's definition of the "value chain," first used in 1985, serves as the theoretical foundation for this study. Jacoby (2005) defined value chain as the total series of value-adding activities required to bring a product from its initial input to its final destination. Porter (2012) opines that the value chain is made up of all internal procedures or tasks that a business carries out "to create, produce, promote, distribute, and support its product." All value-added activities in an industry have a similarity which is the ability to generate competitive advantages. Value creation, in the opinion of Kothandaraman and Wilson (2001), is a result of the capacity to provide high performance on the benefits that are significant to the client. In this study, the client is the project financier, who needs an accurate cost estimate at the outset of the project to help him decide how much money to contribute. Thus, a quantity surveyor is expected to generate a consistent and precise cost estimate in order to match his needs despite the limited schedule. According to Chan and Park (2005), the process of creating a cost estimate is complex and involves a wide range of value-adding tasks that are necessary to take a product (a cost estimate) from its initial input (quantification), through various production stages (pricing and costing), to its final market destination (project financier). The employment of innovative and alternative estimation approaches, such cost and quantification models, is suggested by construction researchers as a way to achieve a competitive edge in terms of accuracy, speed, and commercial potential. Furthermore, Thompson, Gamble, and Strickland (2005) opines that the value chain focuses on the actions that provide value, and it will improve the activities that don't add value for the clients, which enhances the delivery of services. In the same manner, this research focuses on improving the estimating process by adding a skirting model to the floor, wall, ceiling, and roof finishing quantification tasks in an effort to increase speed and accuracy.

2.1 Cost Estimate

Cost means diverse things to diverse individuals. To an economist, it is the utility that would have been derived from a foregone alternative; to a businessman, it is the fiscal value of all the inputs utilized or lost in the manufacture of a good or service; in the general sense, it is the monetary value of a good or service. But in the construction industry, cost is defined in terms of the expectations and objectives of the participants, because the industry is made up of diverse professionals (Yaman and Taş, 2007). Regardless of how the cost is defined, it remains one of the most important parameters throughout the lifecycle of a project, and it's the driving force behind its success. A cost estimate shows the summed-up amount in figures for actualizing a building project. This estimate covers the cost of executing a building's construction from the substructural phase to its substructural phase and finishes. According to the Washington State Department of Transportation (2015), cost estimation is the process of predicting the project resource cost and price needed for the project's actualization in terms of its scope to manage the project budget and ensure the project is delivered to scope without accruing extra expenses.

The preparation of a cost estimate involves a multifaceted process that requires the consideration of many factors for an accurate prediction by the estimator. These factors need to be assessed thoroughly at the early stage of construction planning to establish a more accurate baseline for the project cost at the different stages of work. Some of these factors include project value and size, project complexity, project team competency, previous experience of the contractor, project information, tendering duration, location, design parameters, and contract periods. It is recommended that a proper consideration of all associated factors be done to establish a precise and accurate estimate, as cost estimation is a prerequisite to attaining success in project actualization.

2.2 Estimating Methods

Estimating techniques can be utilized at different stages of a project's development. The method chosen by the estimator is dependent on several factors, such as his need, purpose, budget, familiarity, ease of usage, speed, and desired accuracy of his output. Based on studies, there are diverse estimating techniques in existence and accessible for use by the estimator depending on his needs. Researchers such as Brandon (1994), Raftery (1994), and Seeley (1996) identified functional units, superficial areas, superficial perimeters, the cube method, storey enclosures, approximate quantities, elemental analysis, interpolation, resource analysis, and cost engineering as some examples of estimating methods. Eventually, more techniques began to evolve to address the uncertainty, ambiguity, and disadvantages of the available techniques. Hence, building on previous studies, more techniques were identified, such as approximate estimating and detailed estimating (Ajator, Ugochukwu, and Ogunsina, 2015); analytical methods, parametric methods, and analogy methods (Challal and Tkiouat, 2012); conceptual cost estimates, semi-detailed cost estimates, and detailed cost estimates (Elbeltagi, 2014); deterministic and stochastic (AACE International, 1997); vendor analysis (Thomas, 2010); expert judgment (Roy and Rush, 2001); and project management software.

An estimator at the initial stage of project planning can prepare an estimate drawing from past experiences and available project information. This technique is known as an approximate or conceptual estimating method. Although filled with uncertainty and inaccuracy, quantity surveyors can judge project feasibility based on previous historical information and expertise. For projects where complete design and specification details are provided, a detailed estimating technique can be utilized. This technique involves building an estimate by considering every component that makes up the project, including its element, quantity, and unit rate, and summing them to get the overall project estimate. To effectively determine the quantity of each element and the appropriate work breakdown structure, the quantity surveyor refers to the standard method of measurement outlined in the BESMM4R by the Nigeria Institute of Quantity Surveyors (NIQS). Each section is then finalized by multiplying the derived quantity by the unit rate obtained via the market survey to produce the estimate. All work section estimates are summed together to attain the total estimate for the construction and execution of the proposed project. The detailed estimating technique, although time-consuming, is highly accurate as its output can be easily cross-checked and endorsed by other professionals involved in the project. Also, to overcome the burden of time and accuracy, estimators have adopted the use of cost-estimating relationship models and estimating software such as QSEM, Planswift, CostX, and Autodesk Bluebeam.

2.3 Concept of Skirting

Skirting is a linear item under the floor, wall, ceiling, and roof finishings (1.28.14.1.1.1) work section of the BESMM4R. It is either a tile, board, or metallic covering that runs along the border between the interior wall and floor. Skirtings, when installed on a wall, serve purposes such as aesthetics, joint seepage prevention, hardwearing baseline protection for interior walls, elimination of gaps and furniture marks, and hiding of electrical wiring in some cases. Delongchamps (2012) suggests that skirting "is so much part of our architectural vernacular that we only notice it if it is not there at all". Skirting, when installed, usually covers a height of about 100mm to 230mm when measured from the ground level upwards and takes up the entire length of the room, less its floor openings such as doors and arches. This finishing item can be installed with the use of a tile adhesive, bolt, or cement mortar, depending on the type of material used. The choice of material for skirting purposes is dependent on the client's preference, budget, usage, and availability. Materials such as metals, ceramics, marble, vinyl, granite, and boards are perfect for skirting activities. Skirting serves the same purpose and is easy to maintain, irrespective of the material, design, or installation method used.

To estimate the cost needed for the installation of skirting in a building, the quantity of material for the work is computed against its unit rate, which consists of the cost of material, labour, percentage waste, profit, and overhead. According to the BESMM4R, the length of skirting in a room can be established by measuring the total girth of the room minus its floor openings, i.e., 2(L + B)-openings. For example, a quantity surveyor is required to establish the quantity of skirting for a bedroom of 20m in length and 20m in width that has two door openings of 1.8m and 0.90m. Using the mathematical representation, he can compute the figures to arrive at the skirting length, i.e., (2(20+20)) - (1.8+0.9) = 77.3m. It is worth noting that when inputting the total skirting length in the bill of quantity, a proper description of the intended skirting material, the skirting installation height, and the installation method should be included to give the client and contractor a clear specification.

2.4 Regression Analysis

Traditionally, statistical methods have been used to develop cost estimation models; this approach consists of mathematical models based on a set of theories, relationships, and assumptions to generate data capable of answering the purpose for which it was created. Statistically, there are various types of regression methods identified by researchers; they include linear regression, multiple regression, logistic regression, and polynomial regression. A linear regression models the relationship between linear variables and answers questions such as "How do these variables relate?" and "To what extent do the variables relate?" On the contrary, multiple regression analysis is a powerful analytical and predictive statistical tool that can be used to examine the contribution of potential new items to the overall estimate of reliability (Aviral, Akshay, and Amita, 2017).

Regression cost models gained popularity amongst construction scholars for their advantage of providing a well-defined mathematical framework and for their ability to measure how well the framework addresses the problem for which it was developed. The proposed model in the study will be generated using a multiple regression analysis generally represented in the form of $Y = C + b_1X_1 + b_2X_2 + \bullet \bullet \bullet + bnXn$, where y is the dependent variable, $X_{1,} X_{2,...} X_n$ is the independent variable that will help in estimating Y, and C is the estimated constant. To generate the skirting model, three variables will be used: skirting length (the dependent variable), total length of wall openings (the independent variable), and floor area (the independent variable).

2.5 Empirical Studies

Several researchers since the 1950s have embarked on the invention of cost models for predicting various work items. These models were characterized based on their historical development, variables, and specific characteristics. The first-generation models were derived from the functionality of building elements in the late 1950s. Afterward, in the mid-1970s, the second-generation model evolved from regression models, progressively giving way to the third-generation model, which has its roots in Monte Carlo simulation techniques (Yaman and Tas, 2007). These models, with their framework of theories, principles, relationships, and processes, are developed to capture the questions and answers needed to satisfy the purpose for which they were created.

Diverse statistical tools have been deployed to predict the models ranging from linear regression, multiple regression, and Chi-square to mention but a few**.** This research area is inexhaustible as a building is made up of several components. This is evidenced by the works of Mohsin and Nuaimi (2013), Ogunsina, Ugochukwu, Josiah, and Agu (2019), Lowe, Emsley, and Harding (2006), Ganiyu and Zubairu

(2010), Ugochukwu, Ogunsina, Udoka, and Enenmoh (2020), Al-zwainy, Rasheed and Ibraheem (2012) and Juszczyk and Leniak (2019). For example, Mohsin and Nuaimi (2013) developed a regression model for estimating the construction cost of villas in Oman. The model took into account four factors affecting the villa cost namely, the built-up area, number of toilets, number of bedrooms, and the number of stories. The developed equations showed a good correlation between the selected variables and the actual cost with R2 = 0.79 in the case of conceptual estimate and R2 = 0.601 for preliminary estimate. Also, Ugochukwu, Ogunsina, Udoka, and Enenmoh (2020) developed an algorithmic equation for estimating the cost of painting works using Anambra and Enugu as a study area. Al-zwainy, Rasheed and Ibraheem (2012) using a back-propagation algorithm neural network generated a model for estimating construction project productivity. In this research, A model was generated for marble finishing works productivity forecasting using Artificial Neural Network (ANN). The study showed that the ANNs have the ability to predict the finishing work productivity with a degree of accuracy of the coefficient of correlation ® of 89.55% and an average accuracy percentage of 90.9%. Additionally, Ogunsina, Ugochukwu, Josiah, and Agu (2019) establish a model for regression-based approximate quantities models for the quantification of electrical cables for residential building construction in Nigeria.

Despite the available research on estimating models in construction and engineering literatures, no specific research has been conducted on the development of a predictive model for skirting length. Most existing studies centralize their focus on overall cost estimation without specifically addressing skirting**.** Furthermore, there is no known acceptable skirting model established by the Nigeria Institute of Quantity Surveyors or any other authoritative body. This lack of a standardized model further emphasizes the need for research in developing a reliable and accurate method for estimating skirting length needed to arrive at its cost. The absence of a recognized model can lead to inconsistencies and variations in skirting estimates, potentially resulting in cost overruns and project delays**.**

III. METHODOLOGY

This section describes the procedures adopted by the study to address the research aim and objectives. More specifically, it outlines the research design, study population, sampling techniques, instrument for data collection, and the method of data analysis.

This research carried out in Awka, Anambra State, Nigeria, adopted a quantitative correlational design. The selected design is best suited because it allows the researcher to effectively examine the relationship between the dependent variable (skirting) and the independent variables (floor area and openings). The study population comprised architectural plans of residential buildings in the state approved by the Anambra State Physical Planning Board (ANSPPB) within the last three years (2020–2022). This population represents a comprehensive dataset of residential buildings that have undergone the official approval process during 2020 and 2022. Also, questionnaire and architectural floor plans were used as the study data collection instrument to extract building specific information and also gather insights from participants.

For this research, non-probabilistic sampling techniques consisting of snowballing and convenient sampling techniques were utilized to source data. A convenient sampling technique was used to obtain the architectural drawings needed for objectives 2 and 3, and a snowballing sampling for objective 1. The convenient sampling was chosen based on the accessibility and availability of the required drawings, while the snowballing technique was selected as it allowed the researcher to recruit quantity surveyors based on referrals from other identified subjects. The study adopted a sample size using data collected from the Anambra State Chapter of the Nigeria Institute of Quantity Surveyors (NIQS) and the Anambra State Physical Planning Board (ANSPPB). To determine the factors affecting the accuracy of a skirting estimate, the population size for this objective was defined as the total number of members within the Anambra State Chapter of NIQS. Thus, the research adopted a sample size of 69 professional quantity surveyors comprising 45 corporate members and 14 probationer members, to whom the questionnaire needed to tackle objective 1 of this study was distributed. To achieve objectives 2 and 3, the study chose a convenient sample size of 50. This decision was influenced by the researcher’s inability to estimate the total number of approved buildings by ANSPPB between the period of 2020 and 2022, as well as other factors such as convenience, availability, and accessibility to registered builders, planners, and architects in Anambra State.

A face and content validity check were carried out to measure the degree to which the data collection instruments measured what they were supposed to measure. Also, the consistency at which the instruments measure the constructs when repeatedly measured under the same construct was ascertained using Cronbach's alpha reliability test. To achieve objective 1, the study made use of the reviewed literature, and for objective 1, a descriptive statistical analysis was conducted, which involves the use of the mean. Objectives 2 and 3 were analyzed using Pearson correlation, while the model was developed using multiple regression analysis. Descriptive statistics give a quantitatively detailed summary of the collated data using mean, median, percentages, frequencies, and standard deviation. Pearson correlation is utilized to show if a linear relationship between the quantitative variable exists and the strength of that relationship if any.

Afterward, a correlational analysis was carried out to determine the impact of the skirting estimate on the overall project estimate as well as the relationships between the dependent and independent variables. To compute the skirting estimate and overall project estimates, fifty (50) architectural floor plans were quantified to obtain floor areas, skirting lengths, and the total length of door openings.

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A market survey amongst tilers and builders in Anambra State was carried out to obtain an average cost per linear meter for ordinary ceramic tile skirting installation and a cost per square meter for constructing a residential building in the Awka region. The research made use of N150/m for skirting installation (i.e., **skirting estimate** = skirting length x N150) and N80,000/sqm for the cost of construction (i.e., **overall project estimate** is: total floor area x N80,000). All costs obtained will be multiplied by their respective values to get the overall skirting cost and project cost for the fifty-floor plans. Finally, the model was generated using multiple regression analysis. All data analysis was carried out using the Statistical Package for Social Science (SPSS) version 23, and the resulting output was presented in tabular form.

IV. RESULTS AND DISCUSSION

Factors Affecting the Accuracy of a Skirting Estimate

Table 1. Questionnaire administration and response rate

Questionnaire	Frequency	Percentage (%)
Total no of copies of the Questionnaire administered	69	-
No. of valid copies received	57	82.6
No. of invalid & not received copies	12	17.4
Total		100%

Source: Research's field survey (2023)

Table 1 shows that A total of sixty-nine questionnaires was distributed to quantity surveying professionals in the Anambra state chapter of the Nigerian Institute of Quantity Surveyors, a total of fifty-seven (57) questionnaires were completed and returned. This corresponds to a response rate of 82.6%. As stated by Okolie (2011) "a range of response rates of 30-94 percent in the field of organizational research is acceptable." Accordingly, the response rate of this study falls within the acceptable rate. The others were either not properly filled or not returned.

Table 2. Reliability Test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.804	0.803	9

Table 2 reveals a Cronbach's alpha level of 0.804 > 0.75; we, therefore, conclude that the questionnaire instrument is reliable and the variables represented on the 5-point Likert scale are positively related to each other, thus further statistical analyses may be conducted (Nunnally, 1978).

Table 3. Factors Affecting the Accuracy of a Skirting Estimate

Factors	SA	A	N	D	SD	$\bar{X} \pm Std$	Rank
Experience level of the Quantity Surveyor (Competence)	25	18	7	3	4	4.00±1.195	**1**
Availability of complete drawings and specifications	32	10	5	1	9	3.96±1.476	**2**
Project information, scope, and specification	17	20	7	7	6	3.61±1.320	**3**
Availability of taking off tools	12	22	11	7	5	3.51±1.212	**4**

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Complexity of design	14	15	11	14	3	3.40±1.252	**5**
Unethical practices	5	17	12	16	7	2.95±1.202	**6**
Tendering duration	9	11	10	16	11	2.84±1.373	**7**
Level of remuneration	4	18	8	18	9	2.82±1.241	**8**
Client's financial status	6	11	12	17	11	2.72±1.278	**9**
Cluster Mean	**24.2%**	**27.7%**	**16.2 %**	**19.3 %**	**12.7 %**	**3.31±1.28**	

Nb: SA= Strongly Agree, A=Agree, N=Neutral, D= Disagree, SD= Strongly Disagree
Source: Researcher's field survey (2023)

A total of nine variables obtained via desktop review on cost estimation were analyzed using descriptive statistics to identify and rank the factors that affect the accuracy of a skirting estimate. Table 3 presents the responses of 57 professional quantity surveyors in the Anambra state chapter of the Nigerian Institute of Quantity Surveyors in a ranked order. At a glance, the results indicate that the experience level of the quantity surveyor (competence) and availability of complete drawings and specifications, with mean scores of 4.00 and 3.96, are the factors with the most effect on the accuracy of the skirting estimate. This result reinforces Jari and Bhangali (2013) finding which opines that an 'insufficient experience of quantity surveyors in estimation methods contributes to incorrect cost projections.' These factors are closely followed by project information, scope, and specification (3rd), availability of taking off tools (4th), the complexity of design (5th), unethical practices (6th), tendering duration (7th), level of remuneration (8th), and clients' financial status (9th), with mean scores of 3.61, 3.51, 3.40, 2.95, 2.84, 2.82, and 2.72. Insufficient or unreliable data on skirting materials, prices, installation methods, or labour costs can introduce biases and inaccuracies into the estimate. Also, the survey suggests that errors in measuring skirting dimensions, overlooking specific skirting components, or incorrectly calculating quantities can result in significant estimation discrepancies. Failure to accurately measure and consider these dimensions can lead to inaccurate cost projections.

All listed factors have an impact on the accuracy of a skirting estimate, as indicated by the cluster mean of 3.31 (above 2.5) and the accompanying standard deviation of 1.28. Other factors identified by respondents were inaccurate or wrong dimensioning, waste control, and the carelessness of the quantity surveyor. From the aforementioned, the study is likely to conclude that quantity surveyors ought to pay close attention during skirting estimation to ensure that the utmost level of accuracy is attained during the quantification and estimating processes.

The Impact of Skirting Estimate on the Overall Project Estimate

Table 4. Descriptive Statistics of Skirting Estimates and Overall Project Estimates

	Observations	Mean	Std. Deviation
Skirting estimate	50	25576.1100	12476.36681
Overall project estimate	50	16383856.0000	9340664.70064

Source: Author's computation using SPSS 23

Table 4 reveals the mean and standard deviation for the values of the fifty tabulated architectural floor plans. The skirting estimates have a mean of 25,576.11 with a standard deviation of 12,476.37, while the overall project estimate has a mean of 16,383,856.0 with a standard deviation of 9,340,664.7. The mean gives an overview of the average of the total estimate for the skirting and project total cost, respectively, while the standard deviation is a measure of the differences between each estimate and the mean.

Table 5. Pearson Correlation Analysis of the Skirting Estimate and Overall Project Estimate

Variables	Skirting Estimate	Overall Project Estimate
Skirting Estimate	1	0.841** (0.000)
Overall Project Estimate	0.841** (0.000)	1

**. Correlation is significant at the 0.01 level (2-tailed).
Notes: The value reported in the parenthesis is the significant level (2-tailed).
The number of observations is 50
Source: Author's computation using SPSS 23

As seen in Table 5, a Pearson correlation analysis was used to measure the strength of the linear relationship between the skirting estimate and the overall project estimate. A Pearson correlation is statistically significant if its corresponding p-value is less than 0.05. This analysis reveals a Pearson correlation coefficient of 0.841 with a significant value (P-value) of 0.000 > 0.01 (α) exists between the skirting estimate and the overall project estimate. Thus, the strong positive correlation between a skirting estimate and an overall project estimate is deemed statistically significant. This, therefore, implies that as the skirting estimate increases, the overall project estimate increases accordingly. This result resonates with Ullah's (2020) findings that even small cost changes in factors such as labor-related cost variables or construction material cost-related variables can highly influence the cost overrun or time overrun in construction projects. Hence an accurate estimation of skirting is crucial as it directly influences the overall project cost.

Predictive Model for the Relationship between Floor Area, Length of Doors Opening, and Length of Skirting

Table 6. Descriptive Statistics of Floor Area, Skirting, and Openings
Source: Author's computation using SPSS 23

	Observations	Mean	Std. Deviation
Floor Area	50	204.7982	116.75831
Skirting	50	170.5074	83.17578
Openings	50	30.4978	15.93952

All computed variables for the fifty-sample size required to develop the predictive model were subjected to a descriptive analysis to determine their mean and standard deviation. Table 6 reveals that floor area has a mean of 204.782 and a standard deviation of 116.758, skirting length has a mean of 170.51 with a standard deviation of 83.18, and door openings have a mean of 30.50 with a standard deviation of 15.94.

Table 7. Correlation Analysis for Floor Area, Skirting, and Openings

Variables	Floor Area	Skirting	Opening
Floor Area	1	0.841** (0.000)	0.462** (0.001)
Skirting	0.841** (0.000)	1	0.692 (0.000)
Opening	0.462** (0.001)	0.692 (0.000)	1

**. Correlation is significant at the 0.01 level (2-tailed).
Notes: The value reported in the parenthesis is the significant level (2-tailed).
The number of observations is 50
Source: Author's computation using SPSS 23

Table 7 represents the result obtained from the correlational analysis carried out to determine the level of significance between the length of skirting and door openings, the length of skirting and floor area, and the floor area and door openings. This result outlined in the hypotheses reveals that all variables are significantly related.

Hypothesis 1

H_0: There is no significant relationship between the length of skirting and door openings.

H_1: There is a significant relationship between the length of skirting and door openings.

Conclusion: From Table 7, the correlation between the length of skirting and door openings is 0.692, with a significant value of 0.000 < 0.01. We, therefore, conclude that the variables are significantly related, so this research rejects the null and accepts the alternative hypothesis.

Hypothesis 2

H_0: There is no significant relationship between the length of skirting and floor area.

H_1: There is a significant relationship between the length of skirting and floor area.

Conclusion: From Table 7, the correlation between the length of the skirting and floor area is 0.841, with a significant value of 0.000 < 0.01. We, therefore, conclude that the variables are significantly related, so this research rejects the null and accepts the alternative hypothesis.

Hypothesis 3

H_0: There is no significant relationship between the floor area and door openings.

H_1: There is a significant relationship between the floor area and door openings.

Conclusion: From Table 7, the correlation between floor area and door openings is 0.462, with a significant value of 0.001< 0.01. We, therefore, conclude that the variables are significantly related, so this research rejects the null and accepts the alternative hypothesis.

Conclusively, the research deduces that all the variables are significantly related and that no case of multicollinearity was found; thus, the data could be used for regression analysis. Furthermore, the data were tested for normality to determine whether the values were normally distributed.

Model Generation:

This section explains the model generated from the relationship between floor area, length of doors opening, and length of skirting and further presents the variables for the predictive skirting model using multiple regression analysis: $Y = \alpha + \beta 1\chi 1 + \beta 2\chi 2$

Where; α, $\beta 1$, and $\beta 2$ are correlation coefficients.

Y = Length of skirting (Dependent variable)

$\chi 1$ = Length of door openings (Independent variable)

$\chi 2$ = Floor Area (Independent variable)

Table 8. Coefficients for the Model Generation

Variables	Unstandardized Coefficients Coefficient	Std. Error	Standardized Coefficients Coefficient	T-statistics	Sig.
Constant	12.424	12.037		1.032	0.307
Floor Area	0.472	0.049	0.663	9.615	0.000
Openings	2.013	0.360	0.386	5.595	0.000
Model Generation			**ANOVA Table for the Test of Model Significance**		
R	0.908[a]		F-statistics	110.276	
R Square	0.824		Sig	0.000	
Adjusted R Square	0.817		Degree of Freedom	2 (Regression) 47 (Residual) 49 (Total)	

*Predictors: (Constant), OPENINGS, FLOOR AREA
Source: Author's computation using SPSS 23

As shown in Table 8, the coefficient of determination 'R^2'' which measures the proportion of variation in the dependent variable, is 0.824. The research further deduces that 82.4% of the total variations that occur in the dependent variable can be explained or caused by the independent variables. Also, Table 8 indicates that the model is adequate and can be used for any generalized term, as revealed by the significant value (0.000) when compared with the α level of 0.05.

From the interpretation of the coefficient generation table, the developed model for predicting the skirting lengths of buildings in Anambra State is:

$Y= \alpha + \beta_1\chi_1 + \beta_2\chi_2$;

Where $\alpha = 12.424$, $\beta_1 = 0.472$, and $\beta_2 = 2.013$.

Thus, $\mathbf{Y= 12.424 + 0.472*\chi_1 + 2.013*\chi_2}$

Where;
Y = skirting length, χ_1 = length of door opening, and χ_2 = floor area.

V. CONCLUSION AND RECOMMENDATIONS

The main goal is to develop a predictive model for estimating the length of skirtings for buildings in Anambra state. Building on the framework of Porter's value chain, this research proposed the use of multiple regression analysis to develop a skirting model capable of providing the value of time, reduced repetitive quantification activities during cost estimation, and accuracy to the project financier. Skirting plays a crucial role in the aesthetics and functionality of a building and accurately estimating its costs is essential for project planning and budgeting. However, the factors affecting the accuracy of a skirting estimate and the specific influence of a skirting estimate on the overall project cost remains unexplored, leaving a significant gap in the literature. Also, the absence of a recognized model can lead to inconsistencies and variations in skirting estimates, potentially resulting in cost overruns and project delays. Thus, closing these gaps through this research would enhance the understanding of skirting estimation, contribute to more accurate project cost estimates, and enable better decision-making in construction projects in Anambra State

The study findings indicate that the quantity surveyor's level of experience (competence), the availability of complete drawings and specifications; project information, scope, and specifications are the factors with the most impact on the accuracy of a skirting estimate. The study further reveals that a significantly strong positive correlation exists between a skirting estimate and the overall project estimate. This implies that as the skirting estimate increases, the overall project estimate increases accordingly. Additionally, skirting length, floor area, and door openings were found to be significantly related, and no case of multicollinearity. Using multiple regression analysis, the study presented Y $\mathbf{= 12.424 + 0.472*\chi_1 + 2.013*\chi_2}$; (Where: Y=length of skirting; χ_1=Floor area; and χ_2=length of openings) as the predictive model thus fulfilling the research aim of develop a multiple regression model for predicting skirting length for buildings in Anambra State.

Overall, the development of a multiple regression model for predicting the length of skirting for buildings in the Anambra state will bridge the existing gap in knowledge, provide a systematic approach to skirting design, and contribute to the advancement of construction practices in the Anambra state. By developing the predictive skirting model, construction professionals can enhance the accuracy of skirting estimates, minimize cost overruns, and improve decision-making in construction projects. The predictive model $Y = 12.424 + 0.472*\chi1 + 2.013*\chi2$ can be utilized by estimators during the preliminary cost estimating stage of a project and also can be used by tradesmen for quotation purposes at the tiling phase of a building project. Additionally, a quantity surveying expert can use this model to quickly quantify the total skirting length in a room during interim valuations in order to make payment to tilers who are paid per linear meter. This research therefore recommends a validation of the skirting regression model by other researchers to assess its reliability and effectiveness in real-world scenarios and also suggests a comparative analysis with existing skirting estimation methods be done to gain insights on the strength and weakness of the predictive model as against the traditional approach, rule-of-thumb guidelines, or expert-based estimations.

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