

# The Effects of Variations on the Final Cost of Selected Public Building Projects in Akanu Ibiam Federal Polytechnic, Unwana from (2010-2020)

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**Abstract:** Most executed public building projects in Nigeria have a difference between their tender/initial contract sum and final contract sum, and this difference is often caused by variations. Where not properly handled, variations lead to delays, dispute and sometimes project abandonment. The effects of cost of variations on the delivery of public building projects in Nigeria have long been a source of concern to stakeholders. In view of this, the study examined the effects of variations on building costs of selected building projects in Akanu Ibiam Federal Polytechnic, Unwana (AIFPU) executed within the period (2010-2020), with the purpose to determine their effects on cost of building projects. Historical research design was adopted. Secondary data were used in the analysis. Data on ten (10) completed projects of varying characteristics were collected from the institution's physical planning unit using purpose sampling. SPSS version 20 tool was used in descriptive analysis of the estimate of the mean, percentage and standard deviation. E-view 8 tool of inferential statistics of regression and correlation were used in the analysis and testing of the hypothesis. The result indicates that increase in cost of variation will lead to 0.881 increase in contract sum. Results also indicate that significant positive relationship exist between variations and final cost of projects with coefficient of determination ( $R^2$ )=0.602987 tested at 0.05 level. This result indicates that cost of variation has an impact on the final cost of building project and should be guarded against. It was recommended that there should be detailed and continuous planning including costing of a project right from the inception of the project to the completion, involvement of professionals and contactors at the initial stage in order to reduce variations in the project, timely advance payment for procurement should be made among others in others to guard against the impact of variation on public building projects.

**Keywords:** Effects, Variation, Final Cost, Building Project

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## 1. Introduction

A Sharp increase in the price of the input to construction such as materials and components is often experienced at relatively short notice. This in the long run tends to result in increase in the cost of construction project. This is because any increase in cost will subsequently lead to an increase in the amount the client will eventually pay for the erection of the building). Hanna, Calmic and Peterson indicated that variations which occur on given projects are unique and can be linked to the extent of time and money made available for

planning [9]. Hanna et al. opined that increase in scope and changes in work condition have great impact on productivity [9]. Moselhi, Charlse and Fazio added that increase in scope and changes in work conditions can result in labour efficiency decline [18]. This change in work conditions as stated by Hanna et al [9] was defined as any modification to the contractual guidance provided to the contractor by the owner, owner's agent [8].

Construction projects are becoming more and more complex due to new standards, advance technologies and changes in the owner desires. In any construction project,

significant additional costs can be experienced by the contractor and the client due to increases/reductions in taxes, general economic trend as well as alteration or modification of design. Every construction project begins with an idea, a deep concept that could be transformed into reality. This reality demands an early extensive planning and cost control, starting from clients brief through design stages which will culminate into feasibility and viability studies, preparing engineering designs from which the cost of the proposed structure or infrastructure would be determined. According to Bromollow, variation is the extent to which the contract is varied between the time it is let and the time the certificate of practical completion is issued [5].

Over the years, Ebonyi State has been the state in South East with the least allocation, as captured by National Bureau for Statistics (NBS) in 2021. With that in mind, the effect of variation on public building projects needs to be guarded against in order to maximize resources utilization by the government. From the federal allocation to the 36 states and the FCT in 2020, [15], Ebonyi state ranked the 27<sup>th</sup> position in terms of the amount allocated to the states amounted to ₦43. 96bn; this makes it the least state in South East in terms of allocation hence a reliance on internally generated revenue. This is why it is important to address the issue of variation in State institutions in order to help the state maximize their resources and reduce cost arising from variation in their public building.

## 2. Literature Review

### 2.1. General Concept of Variation in Construction Project

Variation is the alteration or modification of the design, quality or quantity of the works as shown on the contract drawings described by or referred to in the contract bills. Variations are perhaps the most vexatious area of contractual relationship in the construction industry today. In contractual agreement, variation is limited to the correction of an inconsistency, but if there is no contractual requirement for variation, whether expressed or implied, it would not be practicable for the contractor to execute the variation order within the contract period. The contractor is entitled to an extension of time if any variation attracts delay to the

contract and eventually the contract period and the cost, which will obviously attract time extension. Variation is generally inevitable [16] and it occurs to all type of projects [2]. Such changes can occur at either design or construction stage. Many other research have confirmed this and thus, hardly can a project proceed from beginning to the completion stage without having some changes either at level of planning or construction phase [24].

According to Ijaola and Iyagboa variation is an alteration, addition omission and substitution in terms of quantity, quality and schedule of work [12]. In the contract document by the Joint Building Council clause 26 deals with variations and it defines term “variation” to mean the alteration or modification of the design, quality or quantity of the works. These provisions should contain detailed arrangements on how the changes are to be made, but also who will be vested with the power to decide the changes. The parties will be able to adjust to future contingencies thus secure performance and continuation of the contract. Therefore the response has been to generate ways to prevent or limit the occurrence of variations. The only variations thereby allowed are those that fall clearly within the contractual terms. If the desired change is not covered by those terms it can only be affected properly by fresh agreement. In this connection, care should be exercised to ensure that the new agreement is in itself a valid contract.

A variation order is any modification to the contractual guidance provided to the contractor by the client’s representatives [3]. Success in managing variation results in uninterrupted construction operations and agreed project costs as well as duration [6]. Variation often involves additional cost and disruption to work already under way, leading to cost and time overruns. Some projects that experienced variations incurred more than 58% time delay and cost increased when compared to those with no variation [14]. The magnitude of variation and fluctuation varies from one project to another. Though there have been cases where variation and fluctuation cost accounted for as much as 100 percent of the budgeted funds. Studies have revealed the significant reduction in both cost increase and time as a result of a complete design before commencement of works on site resulting in the prevention of variations [13].

Table 1. Causes of variation orders.

| S/N | Causes of variation                          | Client | Consultant | Contractor | Others |
|-----|--|--------|------------|------------|--------|
| 1   | Change of plans or scope                     | •      |            |            |        |
| 2   | Change of schedule                           | •      |            |            |        |
| 3   | Clients financial problem                    | •      |            |            |        |
| 4   | Inadequate project objectives                | •      |            | •          |        |
| 5   | Replacement of materials or procedures       | •      |            |            |        |
| 6   | Impediment in prompt decision making process | •      |            |            |        |
| 7   | Obstinate nature of the client               | •      | •          | •          |        |
| 8   | Change in specifications                     | •      | •          |            |        |
| 9   | Change in design by the consultant           |        | •          |            |        |
| 10  | Error and omission in design                 |        | •          |            |        |
| 11  | Conflict between contract documents          |        | •          |            |        |
| 12  | Inadequate scope of work for contractor      |        | •          |            |        |
| 13  | Technology change                            |        | •          |            |        |

| S/N | Causes of variation  | Client | Consultant | Contractor | Others |
|-----|--|--------|------------|------------|--------|
| 14  | Value engineering  |        | •          |            |        |
| 15  | Lack of coordination   |        | •          |            |        |
| 16  | Design complexity  |        | •          | •          |        |
| 17  | Inadequate working drawing details                                 |        | •          |            |        |
| 18  | Inadequate shop drawing details                                    |        | •          |            |        |
| 19  | Consultants lack of judgment and experience                        |        | •          | •          |        |
| 20  | Lack of consultants knowledge of available materials and equipment |        | •          |            |        |
| 21  | Honest wrong beliefs of consultant                                 |        | •          |            |        |
| 22  | Consultants lack of required data                                  |        | •          |            |        |
| 23  | Ambiguous design details   |        | •          |            |        |
| 24  | Design discrepancies   |        | •          |            |        |
| 25  | Non-compliant design with government regulations                   |        | •          |            |        |
| 26  | Non-compliant design with owners requirement                       |        | •          |            |        |
| 27  | Lack of contractors involvement in design                          |        |            | •          |        |
| 28  | Unavailability of equipment  |        |            | •          |        |
| 29  | Unavailability of skills   |        |            | •          |        |
| 30  | Contractors desired profitability                                  |        |            | •          |        |
| 31  | Differing site conditions  |        |            | •          |        |
| 32  | Defective workmanship  |        |            | •          |        |
| 33  | Unfamiliarity with local conditions                                |        |            | •          |        |
| 34  | Lack of a specialised construction manager                         |        |            | •          |        |
| 35  | Fast track construction  |        |            | •          |        |
| 36  | Poor procurement process   |        |            | •          |        |
| 37  | Lack of communication  |        |            | •          |        |
| 38  | Long lead procurement  |        |            | •          |        |
| 39  | Honest wrong beliefs of contractor                                 |        |            | •          |        |
| 40  | Lack of strategic planning   |        |            | •          |        |
| 41  | Contractor's lack of required data                                 |        |            | •          |        |
| 42  | Weather conditions   |        |            |            | •      |
| 43  | Health and safety considerations                                   |        |            |            | •      |
| 44  | Change in government regulations                                   |        |            |            | •      |
| 45  | Change in economic conditions                                      |        |            |            | •      |
| 46  | Socio-cultural factors   |        |            |            | •      |
| 47  | Unforeseen problems  |        |            |            | •      |

Source: Adapted from Arain and Pheng (2006)

Table 1 shows the causes of variations grouped under different sources as shown in the table.

Further significant cause of variation based on the available literature was summarized presented in the table 2.

**Table 2.** Citations of previous authors indicating causes of variation.

| s/n | Most significant cause of variation   | Citation                                |
|-----|---|---|
| 1   | Noncompliance of design with government regulation, change of scope, change in design, design discrepancies, changes in specification | Gbdegi S. A. 2002                       |
| 2   | Additional work and inflation   | Remon 2013                              |
| 3   | External factors  | Sun and Meng 2009                       |
| 4   | Managerial problem, design errors, constraints in resource delivery   | Arain F. M <i>et al.</i> , 2004         |
| 5   | Inadequate project objectives   | Jospalet <i>et al.</i> , 2010           |
| 6   | Design variation, inadequate working detail, change of plan   | Ijaola&lyagbo 2012, Richard & Kofi 2013 |
| 7   | Plan error, change in design mistakes, unclear specification  | Kimani 2004                             |
| 8   | Aesthetic cost, substitution of materials, change of plan   | Mohammed <i>et al.</i> , 2010           |

## 2.2. Provision for Variations in JCT Standard Form of Contract

To find clause concerning variations incorporated in most building contracts today is now common. The condition which allows for such changes as defined in clause 13.1.1 of the JCT standard form of building contracts “definition of variations” is usually termed “variation clause”. Without such a provision the contractor would have to agree to erect the building shown on the drawings and represented in the contract bill for the stipulated contract sum and any minor alterations that the employer or his Architect wishes to make,

later in the cause of the project would mean that the contract will become void and a new one drawn up covering all the new features of the projects. This could lay the employer open to breach of contract each time, a change is made to the original design from which the contract bills were prepared and later the procedure of drawing up a new contract each time a change is made will not only be expensive and tedious but also ethical.

- i. Variations in building contracts will where necessary originated from any of the following possible sources.
- ii. The Architect
- iii. The Client

- iv. Statutory regulation
- v. The Quantity Surveyor

The JCT form of building contract largely adopted in practice specifies the circumstances under which variations may arise as:

- i. When the architect needs or wishes to vary the design or the specification.
- ii. When there is discrepancy in or divergence between the contract drawings and the contract bills (clause 2.3).
- iii. When there is alteration or modifications of design quality or quantity of the works.
- iv. When there is compliance with acts of parliament regulation or bye laws (clause 6.1.2).
- v. When there is error or omissions in the bills of quantities.
- vi. Instructions relating to finding of antiquities or other objects of interest or value on the site.

### 2.3. Empirical Review of Literature

Balogun described variation as occurrence at the construction stage due to unforeseen situation [4]. Thus variation may be referred to as alteration or modification of the design, quality or quantity of the work as shown on the contract drawings and described by or referred to, in the contract bills and it includes, addition, omission or substitution of any work, the alteration of the kind of standards of any materials/equipment's to be used in the work the cost of cement as of four years ago is cheaper as of 2021 hereby affecting the erection of a building construction.

Abioma defined variations as the most vexatious area of the contractual relationship in the construction industry today [1]. Many projects in Nigeria were abandoned others suffered failure due to multiple causes. Variation is primarily caused by managerial problem, design errors and logistics problems due to constraint in the resources delivery, consequently leads to high level of dissatisfaction rising from variation in contract sum.

According to Obiegbu construction projects involve extensive use of materials [21]. Nwachukwu explained that in most capital projects, materials amount for work is more than 50% of their production cost, the total cost of construction and subsequently housing supply is no small measure [20]. Central Bank of Nigeria (CBN) in 2002, stressed that inflation is a social malady as well as a pervasive economic process whose effects are felt to some degree by every citizens and in all sectors of the economy.

In contractual agreement, variation is limited to the correction of an inconsistency, but if there is no contractual requirement for variation, whether expressed/implied, for the contractor to execute the variation order within the contract period, the contractor is entitled to an extension of time if any variations attract delay to the contract and eventually the contract period and the cost which will obviously attract time extension. In order for a project team to utilize beneficial variations when the change arises without unreasonable fear of negative effects, they need to have a clearer view of their causes and also controls.

Past experiences helps the project team to make better decisions for effective management of variations order. However, this can only be achieved with a clearer and more inclusive view of clauses their effect and probably controls based on past events. Unfortunately, because construction projects involve complex operations which cannot be accurately determined in advance, variation occur. Arguably, variation cannot be avoided completely [17]. Ssegawaet *et al.* asserted that the presence of variation clauses in contracts amounts to admitting that no project can be completed without changes [24]. Even if carefully planned, it is likely that there will be changes to the scope of the contract as the work progresses [10]. Hanna *et al* indicated that variations occur given the uniqueness of each project and the limited resources of time and money available for planning [9]. Various authors intimate that variations are common to all types of projects [22]. Ssegawaet *et. al.* added that it is hardly possible to complete a construction project without changes to the plans or the construction process itself due to the complexity of construction activities [24]. Variation occur due to a number of reasons ranging from finance, design, aesthetic, geological, weather conditions to feasibility of construction, statutory changes, product improvement, discrepancies between contract documents [9, 24, 10]. Further, the human behaviour of parties to the contract cannot be predicted. Variation orders may arise from changes in the minds of parties involved in the contract. Variation may be initiated either by clients or by [10].

Most contracts these days must make provisions for possible variations given the nature of building construction [25, 7]. A degree of change should be expected as it is difficult for clients to visualise the end product they procure (Love, 2002). Unforeseen conditions may arise which require measures that have not been provided for in the contract (Finsen, 2005). However, the disadvantage of the variation clause is that architects tend not to crystallise their intentions on paper before the contract is signed because they know the variation clause will permit them to finalise their intentions during the term of the contract [25]. An unfortunate aspect of the variation clause is that it tends to encourage clients to change their minds and embark on building projects without having properly thought through their project requirements [7]. Traditionally, the client's primary perceived requirements include functionality, durability and optimality. In order to achieve these requirements, clients appoint a consultant team to advise them on design and optimum use of resources. On the other hand, contractors concern themselves predominantly with construction costs and their reduction. Little attention is given to the fact that the clients or their agents may be sources of increase in construction costs. Clients and consultants typically forget that issuing numerous variation result in higher construction costs. For example, a client who targets a completion date may want works to start on site while the design is still at a sketchy plan stage. In some cases, the construction works may overlap the design where the contractor will have to wait for the detailed design. As a result, some works are put on hold and others are subject to

abortion or demolition.

Arguably, the costs for aborted works are wastage of resources and are typically transferred to the client. They contribute to higher construction delivery costs.

According to Skoyles and Skoyles, one of the reasons for higher than necessary costs lies in the lack of awareness [23]. The construction industry does not grasp that the reduction of the occurrence of variability may optimally lower construction delivery costs. Ibbs concluded that the greater the amount of change the greater the negative impact on both productivity and cost [11].

From the observations made by different researchers about the subject area, in a research conducted by Akomah et al., stated that many building projects initiated by government and state institutions usually exceed their completion time and cost [26]. Undoubtedly there have been studies carried out on variation and its impact on construction, but there is little or no study on this topic in recent times in Ebonyi state using public tertiary institution. There is need to carry out this study using government institutions in Ebonyi state because the state is currently the receiving the least allocation among other states in the south east zone from the federal government and it is currently sitting on the 27<sup>th</sup> position among all states [19], as studies in this area has not been sufficient. The researcher seeks to fill this gap in this study to help the public institutions in reducing the occurrence of variation in building projects in future.

### 3. Research Methodology

The research design employed in this research was a historical research design. The population was drawn from projects executed by Akanu Ibiam Federal Polytechnic, in Afikpo LGA, in Ebonyi State from 2010-2020. A total number of ten (10) completed projects executed within the stated period, funded from internal generated revenue (IGR) of the polytechnic were selected. The Purposive Sampling (PS) was adopted where each element of the frame has an equal probability of selection.

The source of data a collection used by the researcher herein is the primary and secondary source. Data generated were subjected to both descriptive and inferential analysis, Simple percentage, mean, E-views8 and SPSS version20 tool were used for analysis, also known as Pearson correlation. One-sample test was used to analyse the hypothesis. Micro soft excel 2013 was used for plotting of graph. The presentation of data was done using tables, graphs and charts.

The value of the coefficient ranges from 0 to 1.

0=indicates that the independent variable does not explain the variation of the dependent variable, (no impact).

1=indicates that the independent variable perfectly explain the variation in the dependent variable, (great impact).

### 4. Findings and Discussion

*What is the impact of variation on final cost of selected building projects in AIFPU?*

**Table 3.** Cost data/projects information on selected completed projects in aifpu (2010-2020).

| S/N        | Name of project               | Commencement period | Completion Period | Initial contract sum (₦) | Variation (₦) | Final contract sum (₦) |
|------------|-------------------------------|---------------------|-------------------|--------------------------|---------------|------------------------|
| Project 1  | Classroom building A          | November 2010       | December 2011     | 107,643,010.15           | 2,905,358.34  | 110,548,368.49         |
| Project 2  | School of business            | December 2010       | January 2012      | 117,126,294.85           | 3,015,670.10  | 120,141,964.95         |
| Project 3  | Lecture theatre               | June 2011           | January 2014      | 54,367,451.82            | 3,098,700.19  | 574,661,52.01          |
| Project 4  | Classroom building B          | January 2011        | February 2012     | 103,347,433.80           | 5,110,210.33  | 108,457,644.13         |
| Project 5  | Classroom building C.         | September 2012      | September 2013    | 17,181,667.65            | 3,432,339.05  | 20,614,006.70          |
| Project 6  | Environmental design building | November 2012       | October 2013      | 270,486,174.00           | 5,097,899.75  | 275,584,073.75         |
| Project 7  | Ict complex                   | January 2012        | July 2013         | 163,086,935.80           | 7,548,395.90  | 170,635,331.70         |
| Project 8  | New lecture theatre           | April 2014          | January 2015      | 248,903,625.60           | 9,309,795.55  | 258,213,421.15         |
| Project 9  | School of science phase A     | March 2016          | May 2019          | 235,826,209.50           | 8,764,100.07  | 240,044,310.50         |
| Project 10 | School of science phase B     | November 2017       | August 2018       | 220,008,896.90           | 4,218,101.00  | 224,226,997.90         |

Source: Researchers field survey, 2021

**Table 4.** Variation increment over the initial contract sum in aifpu (2010-2020).

| S/N        | Initial contract sum (₦) | Variation (₦) | Final contract sum (₦) |
|------------|--------------------------|---------------|------------------------|
| Project 1  | 107,643,010.15           | 2,905,358.34  | 110,548,368.49         |
| Project 2  | 117,126,294.85           | 3,015,670.10  | 120,141,964.95         |
| Project 3  | 54,367,451.82            | 3,098,700.19  | 574,661,52.01          |
| Project 4  | 103,347,433.80           | 5,110,210.33  | 108,457,644.13         |
| Project 5  | 17,181,667.65            | 3,432,339.05  | 20,614,006.70          |
| Project 6  | 270,486,174.00           | 5,097,899.75  | 275,584,073.75         |
| Project 7  | 163,086,935.80           | 7,548,395.90  | 170,635,331.70         |
| Project 8  | 248,903,625.60           | 9,309,795.55  | 258,213,421.15         |
| Project 9  | 235,826,209.50           | 8,764,100.07  | 240,044,310.50         |
| Project 10 | 220,008,896.90           | 4,218,101.00  | 224,226,997.90         |
| Total      | 1,537,977,700.07         | 52,500,570.28 | 1,827,819,297.53       |

SOURCE: Researchers field survey, 2021.

From table 4 above, the cost of variation increased over the initial contract sum. This is due to the variation arising from different causes of variation.

*Table 5. Descriptive Statistics.*

| Residuals Statistics <sup>a</sup> |                 |                 |                |                |    |
|-----------------------------------|-----------------|-----------------|----------------|----------------|----|
|                                   | Minimum         | Maximum         | Mean           | Std. Deviation | N  |
| Predicted Value                   | 101475824.0000  | 257489392.0000  | 158593227.1280 | 59472294.92340 | 10 |
| Residual                          | -93699192.00000 | 120697432.00000 | .00000         | 65345980.82427 | 10 |
| Std. Predicted Value              | -.960           | 1.663           | .000           | 1.000          | 10 |
| Std. Residual                     | -1.352          | 1.741           | .000           | .943           | 10 |

a. Dependent Variable: Final contract sum

From the result of the table of descriptive statistics above shows the residual of the dependent variable (Final contract sum) and the independent variable (Variation), from the result, the minimum value in the series is 101475824.0000; the maximum value is 257489392.0000; the mean is 158593227.1280 and the standard deviation ie 59472294.92340. The total number of the observed projects are 10.

*Table 6. Regression analyses aimed at estimating the impact of variation on final cost of selected building projects in AIFPU.*

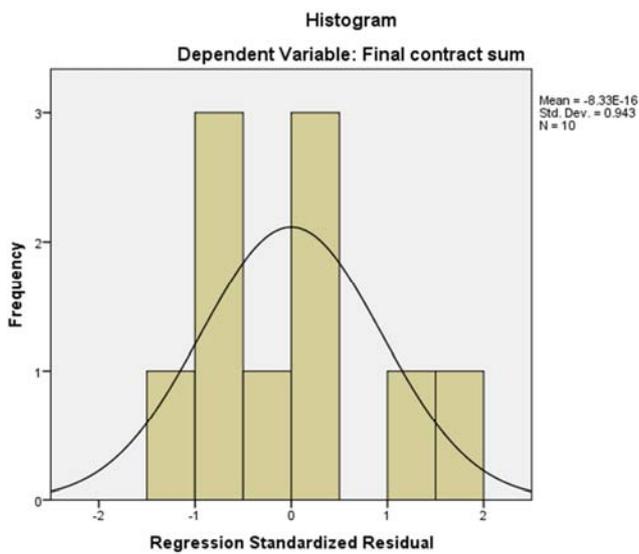
| Y=a + bX                   |             |                       |             |          |
|----------------------------|-------------|-----------------------|-------------|----------|
| Dependent Variable: FCSBP  |             |                       |             |          |
| Method: Least Squares      |             |                       |             |          |
| Date: 08/04/21 Time: 14:27 |             |                       |             |          |
| Sample: 1 10               |             |                       |             |          |
| Included observations: 10  |             |                       |             |          |
| Variable                   | Coefficient | Std. Error            | t-Statistic | Prob.    |
| C                          | 56717944    | 1.70E+08              | 0.333723    | 0.7472   |
| VAR                        | 0.146672    | 0.947445              | 0.154808    | 0.8808   |
| R-squared                  | 0.602987    | Mean dependent var    |             | 79979176 |
| Adjusted R-squared         | 0.591640    | S. D. dependent var   |             | 2.37E+08 |
| S. E. of regression        | 2.51E+08    | Akaike info criterion |             | 41.69779 |
| Sum squared resid          | 5.05E+17    | Schwarz criterion     |             | 41.75831 |
| Log likelihood             | -206.4889   | Hannan-Quinn criter.  |             | 41.63140 |
| F-statistic                | 0.023966    | Durbin-Watson stat    |             | 2.303105 |
| Prob (F-statistic)         | 0.880807    |                       |             |          |

Source: Eviews Computation

Where,

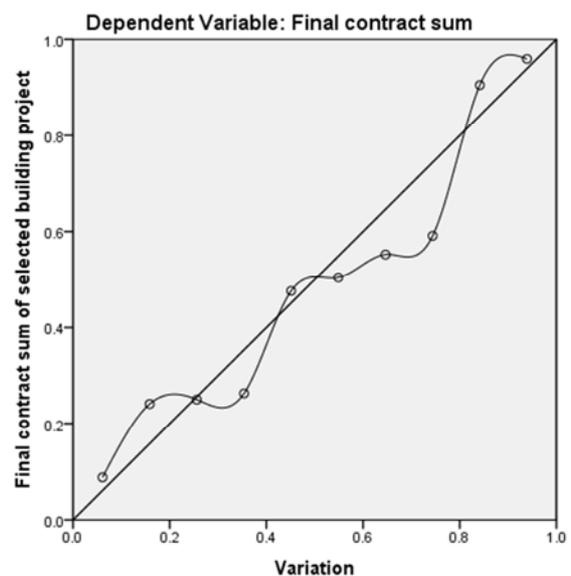
X=VAR=Variation (Independent variable)

Y=FCSBP=Final cost of selected building project (dependent variable)



*Figure 1. Histogram Plot showing how the residual are normal distributed around the mean value.*

*Normal P-P Plot of Regression Standardized Residual*



*Figure 2. Normal P-P plot of Regression Standardized Residual.*

*Evaluation of Regression Results*

The variables employed for the regression analysis are final cost sum as the dependent variable, and variations as the independent variables. The estimated coefficient value for the parameters;  $\beta_0$ , and  $\beta_1$ , from the result are 56717944 and 0.146672 respectively.

The constant term ( $b_0$ ) is estimated at 56717944 which implies that the model passes through the point 56717944 mechanically, if the independent variables (Variations) equal to zero, final cost of selected building project would be equal to 56717944.

The estimated coefficient for variation ( $b_1$ ) is 0.146672 and this implies that if other variables affecting the final cost of selected building project are held constant, a unit increase in variation will bring about a 0.146672 increase in the final cost of building project on the average. The result of coefficient of determination ( $R^2$ ) is given as 0.602987. This implies that

60.2987% of the increase in the final cost of building project is explained as a result of variation in the cost of project.

From the result of the histogram (figure 1) which shows how the residuals are evenly spread around the mean value. The table shows that the mean value of the residual is -8.33E-16; the standard deviation is 0.943 and the total number of the observed projects are 10. From the histogram plot, we can firmly believe that the residuals are evenly spread around the mean value of -8.33E-16.

The normal P-P plot of the regression standardized residual is confirmation of the normality of the residual as rightly indicated by the histogram plot. As we can see from the plot, the series of the residuals are fluctuating around the residual mean value which shows that the output of the regression output is a true representation of the reality. More so, it shows that the estimated parameters can be used for making future forecast.

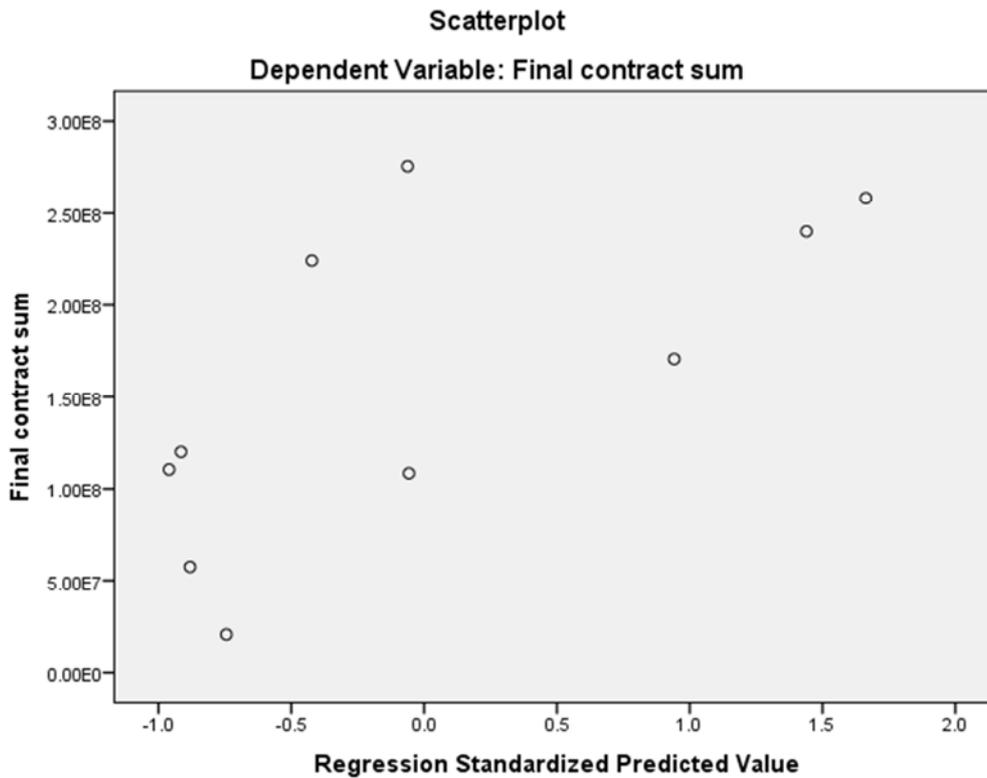


Figure 3. Scatter plot of the series of the dependent (Final contract sum) and independent variables (Variations).

The scatter plot above shows the spread of series on the selected project, there are 10 selected building projects, the plot above shows how the data of the selected projects are close to each other.

*TEST OF HYPOTHESES*

Table 7. One-sample test of the first hypotheses.

| One-Sample Test   | Test Value=0 |    |                 |                 |   |            |
|---|--------------|----|-----------------|-----------------|---|------------|
|   | T            | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference |            |
|   |              |    |                 |                 | Lower                                     | Upper      |
| Variation does not have any impact on the final cost of building project. | 0.049        | 9  | .014            | 17373.02000     | 16007.8096                                | 18738.2304 |

$H_0$ : Variation does not have any impact on the final cost of building project.

From the test of hypothesis above using one sample test t-statistics, based on the decision rule, accept null hypothesis if the value of the t-statistics is greater than 0.05, from the result; the value of the t-statistics (0.049) is below 0.05 hence we reject the null hypothesis and conclude that variation have impact on the final cost of building project.

**DISCUSSION OF FINDINGS**

The findings identified the factors affecting cost of building projects according to their order importance, analysis conducted from ten (10) number projects in AIFPU from 2010-2020 shows an impact of variation on final cost and a relationship between variation and final cost. From the analysis, the trend of the difference between the initial and final contract sum as a result of various variations in the projects has been revealed. This is in line with Akomah et al who found out in a research on impact of variation on building projects that 96.8% of variation was explained by the contract sum [26].

**5. Conclusion and Recommendation**

The assessment of the impact of variation on final cost of building projects in AIFPU (2010-2020) was carried out. Secondary source of data was used to gather the data using selected 10 completed projects in AIFPU. Variations account largely for wide disparity between the original/initial contract sum and the final construction cost. This is often a source of frustration of panning by investment managers. As variations are changes from a known data base which escalate cost of building project due to just a normal increase in price of material, labour, wages and plant.

The effect of variation have already been established in earlier chapters and there is specific need for all concerned to channel attention towards reducing or where possible eliminating the variation in building projects. Projected. It was revealed that variation has an effect on cost of building projects. Variations in building projects still remains one of the challenges facing the construction industry in developing countries.

There is a positive correlation final contract sum and variation cost.

Based on this study, some recommendations are given as follows in order to reduce variations in building contract.

- 1) Payment of contractors account on certificate must be made promptly by the client so that steady progress is not hindered by cash or liquidity squeeze on the part of the contractor and ensure that target completion times are always achieved, avoiding any delays and subsequent variations.
- 2) To further reduce the burden of variation, the client would make advance payment for procurement of materials, specialist equipment and machinery.
- 3) Prime cost and provisional sum items should be reduced to the barest minimum and assessed realistically after which they may be expanded without further recourse of the client, provided that the initial estimates are not exceeded.
- 4) Finally variations in design and construction method or sequence will greatly be reduced if the architect design is necessarily simple and efficiently detailed, functional, stable and appealing but yet less expensive.

**Appendix**

**Appendix 1. Information Collected from the Projects Used for the Research in Aifpu from 2010 – 2020**

|                       |                      |
|-----------------------|----------------------|
| <b>PROJECT 1</b>      |                      |
| Name of project:      | Classroom building A |
| Name of contractor:   | AUBRINO NIG. LTD     |
| Date of award:        | November 2010        |
| Contract duration:    | 48 weeks             |
| Initial contract sum: | ₦107,643,010.15      |
| Cost of variation:    | ₦2,905,358.34        |
| Final contract sum:   | ₦110,548,368.49      |
| <b>PROJECT 2</b>      |                      |
| Name of project:      | School of business   |
| Name of contractor:   | RENAM NIG. LTD       |
| Date of award:        | December 2010        |
| Contract duration:    | 48 weeks             |
| Initial contract sum: | ₦117,126,294.85      |
| Cost of variation:    | ₦3,015,670.10        |
| Final contract sum:   | ₦120, 141,964.95     |
| <b>PROJECT 3</b>      |                      |
| Name of project:      | Lecture theatre      |

|                       |                               |
|-----------------------|-------------------------------|
| Name of contractor:   | EMMA-ISIAGU INT'L LTD         |
| Date of award:        | June 2011                     |
| Contract duration:    | 36 weeks                      |
| Initial contract sum: | ₦54,367,451.82                |
| Cost of variation:    | ₦3,098,700.19                 |
| Final contract sum:   | ₦57,466,152.01                |
| PROJECT 4             |                               |
| Name of project:      | Classroom building B          |
| Name of contractor:   | EMMA-ISIAGU INT'L LTD         |
| Date of award:        | January 2011                  |
| Contract duration:    | 36 weeks                      |
| Initial contract sum: | ₦103,347,433.80               |
| Cost of variation:    | ₦5,110,210.33                 |
| Final contract sum:   | ₦108,457,644.13               |
| PROJECT 5             |                               |
| Name of project:      | Classroom building C.         |
| Name of contractor:   | RENAM LTD                     |
| Date of award:        | September 2012                |
| Contract duration:    | 24 weeks                      |
| Initial contract sum: | ₦17,181,667.65                |
| Cost of variation:    | ₦3,432,339.05                 |
| Final contract sum:   | ₦20,614,006.70                |
| PROJECT 6             |                               |
| Name of project:      | Environmental Design building |
| Name of contractor:   | AMBA NIG. LTD                 |
| Date of award:        | November 2012                 |
| Contract duration:    | 42 weeks                      |
| Initial contract sum: | ₦270,486,174.00               |
| Cost of variation:    | ₦5,097,899.75                 |
| Final contract sum:   | ₦275,584,073.75               |
| PROJECT 7             |                               |
| Name of project:      | ICT complex                   |
| Name of contractor:   | OBIS ASSOCIATE NIG. LTD       |
| Date of award:        | January 2012                  |
| Contract duration:    | 48 weeks                      |
| Initial contract sum: | ₦163,086,935.80               |
| Cost of variation:    | ₦7,548,395.90                 |
| Final contract sum:   | ₦170,635,331.70               |
| PROJECT 8             |                               |
| Name of project:      | New lecture theatre           |
| Name of contractor:   | AMBA NIG. LTD.                |
| Date of award:        | April 2014                    |
| Contract duration:    | 36 weeks                      |
| Initial contract sum: | ₦248,903,625.60               |
| Cost of variation:    | ₦9,309,795.55                 |
| Final contract sum:   | ₦258,213,421.15               |
| PROJECT 9             |                               |
| Name of project:      | School of science phase A     |
| Name of contractor:   | NESTOTI LTD.                  |
| Date of award:        | March 2016                    |

|                       |                           |
|-----------------------|---------------------------|
| Contract duration:    | 36 weeks                  |
| Initial contract sum: | ₦235,826,209.50           |
| Cost of variation:    | ₦8,764,100.07             |
| Final contract sum:   | ₦240,044,310.50           |
| <b>PROJECT 10</b>     |                           |
| Name of project:      | School of science phase B |
| Name of contractor:   | NEBTAS GLOBAL             |
| Date of award:        | November 2017             |
| Contract duration:    | 38 weeks                  |
| Initial contract sum: | ₦220,008,896.90           |
| Cost of variation:    | ₦4,218,101.00             |
| Final contract sum:   | ₦224,226,997.90           |

**Appendix 2. Federal Allocation to the 36 States and the FCT in 2020**

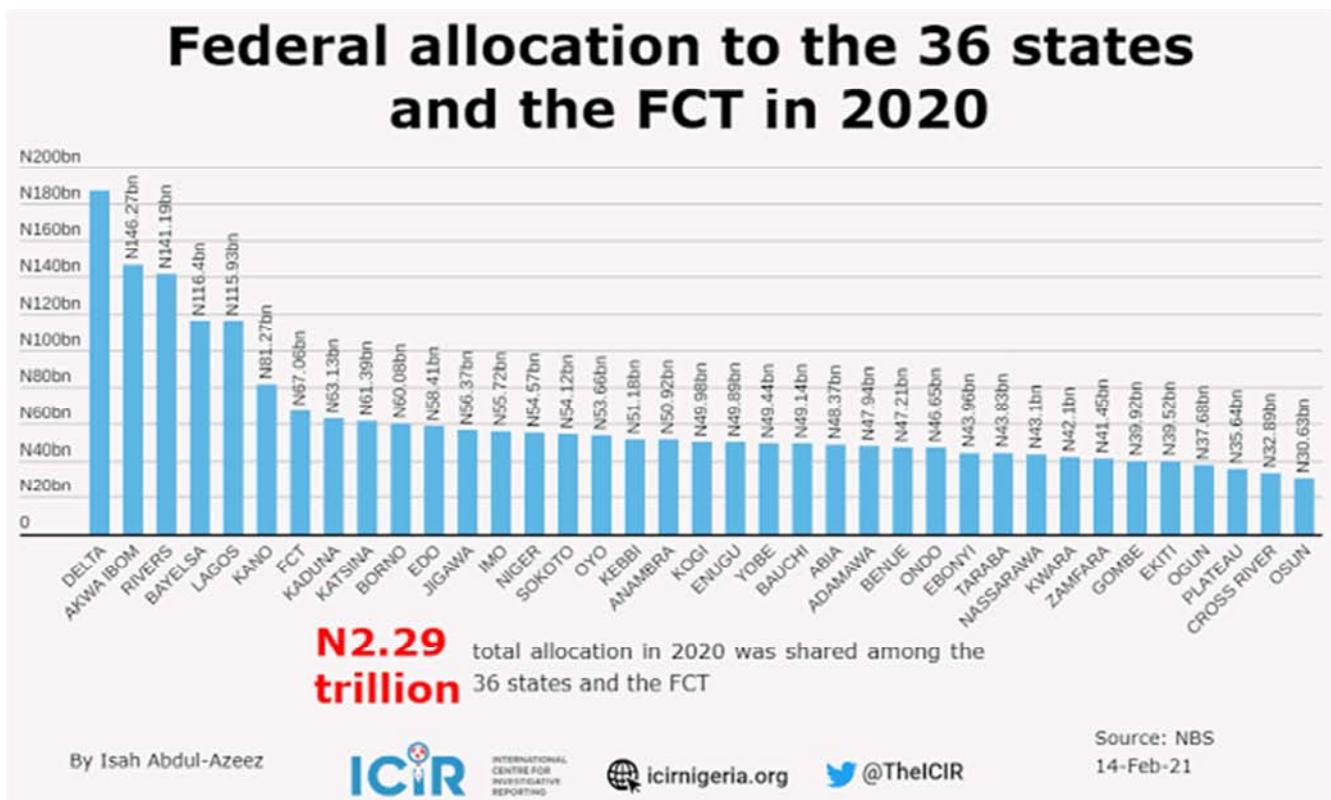


Figure 4. Federal allocation to the 36 states and the FCT in 2020.

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