

PREVALENT CAUSES OF VARIATIONS AND THEIR IMPACTS ON CONSTRUCTION PROJECTS IN EBONYI STATE, NIGERIA

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ABSTRACT

Construction projects are one off unique projects executed within boundaries of the contract documents showing and expressing the works to be done and how it will be done. It is often carried out in an uncontrolled environment, the interplay of the environment, documents and various stakeholders' results in changes to agreed works. This study analyzed the causes and impact of variations on the construction project. This study adopted a descriptive survey design and a stratified random sampling technique was used to select 125 respondents. A structured questionnaire was designed and administered to construction professionals (Architects, Quantity Surveyors, Builders and Engineers) within the study area. The mean score tool was used to analyse the prevalence of the variation causes identified and the impact of variations. Findings revealed that the five most prevalent factors of variations are change in the scope of work to be carried out (0.87), change in specifications (0.84), inadequate working drawing details (0.82), change in design (0.80) and inadequate time for designs and documentation (0.72). Increase in the overall cost of the project (0.90), followed by delay in project giving rise to time overrun (0.88), demolition and rework (0.69) and logistics delays (0.45) were found to be the major impact of variations on construction projects in Ebonyi State. The study recommends that the client and his representatives (consultants) should exercise due diligence packaging of the contract at the early state of the project life cycle in a bid to reduce changes at the construction stage and the professional Quantity Surveyor should assess the impact of the variations on the project before the issuance of variation orders to ensure effective control of the cost within the financial capability of the client.

Keywords

Contract Documents, Changes, Causes of Variation, Variation Impacts,

INTRODUCTION

The construction industry plays a pivotal role in the socio economic development of any nation. This sector of the economy through planning, design, construction, maintenance and repair, and operations, transforms various resources into construction facilities (Isa, Jimoh & Achenu, 2013). The activities of the industry according to Onwusonye (2006) are essential in the provision of shelter (residential, commercial and institutional buildings), infrastructure (roads, railways, ports, dams, power plant, etc.) and creation of empowerment for citizen).

The client/owner/developer/promoter through their consultants are expected to crystallize all the ideas, concept, scope into set of construction document which forms the basis for the award and execution of the project (Arain, et. al.. 2004; Nwosu & Ozioko, 2013). The contract documents usually consist of articles of agreement, condition of contract, contract drawing, bills of quantities and specifications. However, due to the dynamism and complex nature of the operation, the interplay between the internal and external environment of the project, this ideal situation of having all information required for the complete execution of the project before the commencement can hardly be achieved, thereby incorporating variations or changes into the contract.

REVIEW OF LITERATURE

Variations

When there is a change in the basis for which the contract has awarded a variation is deemed to have occurred, the Joint Contract Tribunal (JCT) (1980) Standard Form of Contract defines variation as the alteration or modification of the design, quality or quantity of the works as shown upon the contract drawing and describe by or refined to in the contract bills and includes the addition, omission or substitution of any work, the activation of any kind or standard of any of the materials or goods to be used in their works and the removal from site of any work executed or materials or goods brought thereon by the contractor for the purpose s of the works other than works, materials or goods which are not in accordance with the contract.

A variation may originate from a number of clauses specified in the Joint Contract Tribunal (JCT) (1980) Standard Form;

1. Discrepancy in or divergence between the contract document (2:3)
2. Compliance with Acts of parliament, Regulation or Bye laws (6:1:2)
3. Alternation or modification of design, quality or quantity works (13:1:1)
4. Restoration works in making good damages resulting from five or other causes (22B:22)
5. Instruction relating to funding of antiquities or other object of interest or value on site (34:3)
6. Errors or omission in bills of quantity (2:2:2:2)

The Standard Forms of contracts authorizes the project manager or lead consultant to issue orders requiring variations in a contract. Once the variation order has been issued the contractor is bound to carry out the instruction which must be in writing or where oral, must be confirmed in writing within certain number of working days.

Causes of Variations

Variation has been found to be an integral part of construction projects. Various factors gave rise to variation of which some factors are internal or external to the project, others unforeseen and others are not. The following were identified as some of the remote causes of variations in construction projects according to Clough & Sears, 1994; Thomas & Napolitan, 1995; Akinsola, 1997; Cariappa, 2000; Ibbs, et. al. 2001; Harbans-Singh 2003; Arain, et. al.. 2004; Mohammed, 2005; Bhadmus, 2016 ; Kumaraswamy, et. al., 2010 and O'Brien, 2010.

- a. *Conflict Between the Contract Documents:* Discrepancy in one document or divergence between two document required reaffirmation of the actual requirement of the project. It is essential that the contract documents are clean, precise, unambiguous and consistent.
- b. *Inadequate Working Drawing Details:* The working drawing is expected to convey all the details required for the complete understanding and execution of the work. Inadequate working drawing can result in misinterpretation of the actual requirement for the project thereby causing variation in the project.
- c. *Design Complexity:* Complexity of the design impacts on the flow of construction activities while simpler and linear construction activities are easy to handle. Complex design often requires the use of special construction methods and expertise. The more complex a design is creates more chances of variations in the project.
- d. *Change in Design:* Once a project commences on the site any changes or improvement on the design is likely to alter the programme set in motion. The design team is expected to firm

their design before the commencement of works. Such changes affect the project in various ways depending on the timing of the change.

- e. *Change in Specification:* The changes in the kind or quality of materials or standard of workmanship are observed frequently in construction projects. Changes in specification results in variation to the project, leading to delays and increase in overall cost. The change in specification can be initiated by the client or consultants or government.
- f. *Changes in Scope of the Project:* Insufficient scope definition and planning during the conceptualization stage and lack of owners participations during design activities are one of the major factors causing variations. The expansion or contraction of the scope of work to be carried out varies the project.
- g. *Cashflow Problems:* The inability of the owner to mobilize the need of financial input as at when needed affect severally the quality and progress of the project. This problem can lead to changes in the work scheduled and specification affecting the quality of construction.
- h. *Changes in Project Schedule:* The project is expected to be delivered with a specified time frame. The change in schedule will result in the contractor either to endow with extra resources or also may cause keeping some resource inactive. Thus, it affects the direct and indirect cost of the project. Almost every construction project is faced with this challenge of change of schedule during the execution.
- i. *Compliance with Acts of Parliament:* The compliance with any Act of Parliament, Regulations or Bye law regarding the use of any material or process in the construction forces a change in the specification; this induces a variation in the project.
- j. *Unavailability of Plant/Equipment:* Unavailability of the equipment is a procurement problem that can affect the project completion. This creates a rethink of the process and method of work execution which results in variation.
- k. *Shortage/lack of Skilled Manpower:* Manpower is one of the major resources required for technological projects. The lack or shortage of expertise to carry out this work is a factor for variations and delays.
- l. *Safety Consideration:* Once the risks associated with a chosen methodology of work execution is considered high, it becomes imperative to change the method to avoid treat to life and failure which will be detrimental to the project.
- m. *Restoration Works due to Fire:* Fire outbreak in a project site results in damages of constructed components will require restoration works. These works so to be carried out are variations to the original work.
- n. *Instructions Regarding Finding of Antiquities:* Where objects of interest that requires preservation are identified on site may be in the course of work execution, it might result in some restrictions or even relocation of the project to another site with the attendant disruptions and costs.
- o. *Inadequate Time for Designs and Documentation:* Most clients are usually in a hurry once they commission a project, not allowing adequate time for the professional to produce comprehensive designs and documentation. This often gives rise to works becoming provisional (i.e. subjection to further detailing and re-measurement).

- p. *Errors and Omissions in Designs and Bills of Quantities:* Where an error of omission of any item of works is observed, the said error must be corrected and omissions are treated as deemed variations.

Impact of Variations on Project Delivery

The interaction of both the external and internal factors makes variation inevitable in construction projects. Variation impacts project delivering in terms of delay in project completion, increase in cost, causes reworks and demolitions, quality measures and impedes relationship among the stakeholders. From literatures, the following were identified as the impact of variations on construction projects delivery (Thomas & Napolitan, 1995; Akinsola, 1997; Cariappa, 2000; Ibbs, et. al. 2001; Harbans-Singh 2003; Arain, et. al.. 2004; Mohammed, 2005; Bhadmus, 2016 ; Kumaraswamy, et. al., 2010).

- a. *Delay in Progress:* The issuance of a variation order often inhibits the progress of work as the order needs to be studied and integrated into the projects. When the order requires additional works, demolition/reworking, reordering of materials, etc. the extra time needed or time lost need to be compensation for in the form of extension of time when the events are relevant or the contractor will be in default of non completion.
- b. *Increase in Project Cost:* Alterations or additions to the design or specifications during execution might result in demolition or rework of a project component, cancellation and reordering of resources and this will eventually lead to increase in the project cost. Furthermore variations, requires processing procedure, paper work and reviews before they can be implemented this processing and implementation would increase the overhead expense of the firms involved and by extension the project cost.
- c. *Demolition and Rework:* The extent of demolition, rework or otherwise resulting from a variation order is dependent on the level of work execution of the aspect of work. This requires the careful demolition of work done and remobilization of resources for the reconstruction in line with the variation.
- d. *Quality Degradation:* Variations affect the quality of work adversely. It was reported that the quality of work is frequently affected by variation because contractors may have to compensate for losses by indulging in unwholesome practices. Also the structural stability of the components may be affected by the demolition exercise.
- e. *Health and Safety Concerns:* The execution of variations may likely result in change in construction methods, materials and equipment, these may require additional health and safety measures, this will warrant the revision of health and safety consideration implementation in the construction site. The OHS (2003) clause 5.3(e) stipulates that where changes are brought about, sufficient health and safety, information and appropriate resources are to be made available to their contractor to execute the works safely.
- f. *Stakeholders Relationship:* The construction project team is usually made up of organizations and people from different backgrounds assembled to deliver the project. Dispute and misunderstanding may arise between parties to the contract with respect to the contractor/subcontractors not being satisfied with the determination of the value of variation by the client's consultants. Parties are left to argue over the cost, time effects and due compensation of a variation, this can be very damaging to the relationship between the representatives of all parties.

METHODOLOGY

The study used descriptive survey method with a well structured questionnaire as the instrument for data collection on the prevalent factors of variation and its impact on the construction project delivery. The questionnaire was administered to construction professionals (Architects, Quantity Surveyors, Builders and Engineers) 125 copies of the questionnaire well distributed randomly in the four stratified professions. Out of the 125 copies of questionnaire administered 83 were returned correctly filled and fit for analysis. According to Moser and Kalton (1971), the result of a survey could be considered as biased and of little value if the response was lower than 30-40%, the response rate for the research is 66.4% which indicate an unbiased and higher value of survey. The questions were rated on a 5 point Likert scale ranging from very high, to very low. The data collected were analyzed using mean score to determine the prevalence level of the causes and the impact of variation on construction project. It is mathematically expressed as equation 1

$$meanscore = \frac{\sum(FS)}{\sum F} \dots (1)$$

Where: $1 \leq MS \leq 5$

S = Score given to each factor by respondents and ranges depending on the ordinal scale (1-5)

F = Frequency of the respondent to each rating (1-5) from each factor.

RESULTS AND DISCUSSIONS

Table 1: Prevalent Causes of Variations in Construction Projects

Causes of variations in construction projects		VHP	HP	MP	LP	VLP	Index	Ranking
		5	4	3	2	1		
1	Conflicts in or between contract documents	22	20	17	13	11	0.67	8
2	Inadequate working drawing details	34	29	16	4	0	0.82	3
3	Design complexity and technology	21	25	20	10	7	0.70	6
4	Changes in design	31	27	19	6	0	0.80	4
5	Changes in specifications	36	31	14	2	0	0.84	2
6	Changes in project scope	41	32	10	0	0	0.87	1
7	Cashflow problems	20	21	17	15	10	0.66	9
8	Changes in project schedule	3	9	12	30	29	0.42	14
9	Compliance with Acts of Parliament	5	9	11	31	27	0.44	13
10	Unavailability of plant/equipment	15	17	22	15	14	0.61	10
11	Lack/shortage of skilled manpower	9	12	10	35	20	0.51	12
12	Safety considerations	13	15	20	18	17	0.57	11
13	Restoration works due to fire	0	1	12	29	41	0.33	16
14	Instruction relating to finding antiquities on site	0	3	12	30	38	0.35	15
15	Inadequate time for designs and documentation	24	22	21	11	5	0.72	5
16	Errors in designs or omissions in bills of quantities	21	19	23	13	7	0.68	7

VHP – Very High Prevalent, HP - High Prevalent, MP – Moderate Prevalent, LP – Low Prevalent, VLP – Very Low Prevalent

Table 2: Impacts of Variations on Construction Projects

Impacts of variations on construction projects		VHI	HI	MI	LI	VLI	Index	Ranking
		5	4	3	2	1		
1	Delay in project duration	45	25	13	0	0	0.88	2
2	Increase in cost	51	21	11	0	0	0.90	1
3	Demolition and Rework	22	21	19	15	6	0.69	3
4	Quality degradation	0	2	16	32	33	0.37	6
5	Health and safety issues	0	0	15	29	39	0.34	7
6	Straining stakeholders relationship	1	5	19	27	31	0.40	5
7	Logistic delays	4	6	23	24	26	0.45	4

VHI – Very High Impact, HI - High Impact, MI – Moderate Impact, LI – Low Impact, VLI – Very Low Impact

The result from table 1 shows that the five most prevalent causes of variations in Ebonyi State are change in the scope of work to be carries out (0.87), change in specifications (0.84), inadequate working drawing details (0.82), change in design (0.80) and inadequate time for designs and documentation (0.72). These findings are in agreement with Akinola (1997), Al-Hazmi et.al (2006) and Badamus et.al (2016) as causes ranked 1, 2 and 4 were featured among the top 5 causes of variations in the industry. Restoration work due to fire (0.33) and instruction relating to finding antiquities on site (0.35) occupies the bottom of the ladder of the causes of variations.

The study also observed from the analysis on table 2 that variation impacts on construction project in Ebonyi State is highest in terms of increase in the overall cost of the project (0.90), followed by delay in project giving rise to time overrun (0.88), demolition and rework (0.69) and logistics delays (0.45). Thomas & Napolitan (1995) and Cariappa (2000) highlighted cost and time overrun as the most significant impact of variations on construction project.

CONCLUSION AND RECOMMENDATIONS

This study had identified the prevalent causes of variations in construction industry project execution and delivery within Ebonyi State which centered on the need for firming the project scope, developing detailed designs/drawings/details/specification at the initial stage. The study also assessed the impact of variations on the project, prominent amongst them are increase in project cost and project time overrun. The recommends that the client and his representatives (consultants) should exercise due diligence in packaging of the contract at the early state of the project life cycle in a bid to reduce changes at the construction stage of the project where any change has consequences. The professional Quantity Surveyor should assess the impact of the variations on the project before the issuance of variation orders to ensure control of the cost within the financial capability of the client.

REFERENCES

- Abdul Rahman, H., Berawi, A.R., Mohamed, O., Othman, M. &Yahaya, I.A. (2012). Delay mitigation in the Malaysian construction industry. *Journal of construction engineering and management*, 321(2), pp. 125-133.
- Akinsola, A.O. (1997). Identification and evaluation of factors influencing variations on building projects. *International Journal of Project Management*, 15(4),263-267.
- Al-Hazmi, M., Assaf, S.A., &Al-Khalil A. (2006).Causes of delays in large building construction projects. *Journal of Construction Engineering and Management*, 11(2), pp. 45-50.
- Arain, F. M., Assaf, S. & Low, S. P. (2004). Causes of discrepancies between design and construction. *Architectural science review*,47(3), pp. 237-249.
- Bhadmus, R. T., Ilekoin, O. A.& Ahmed, S. N. (2016).The causes of variation order of construction industry in Nigeria. *Proceedings of the academic conference of African scholar publications & research international on African sustainable development*. 2(2).

- Clough R. H. & Sears, G. A. (1994). *Construction contracting* (6th ed.). Milton Qld: John Willey & Sons.
- Cariappa, A.(2000). The effects of contracts changes performance of construction projects. Unpublished MSC thesis, University of New Brunswick.
- Finsen, E. (2012). *The building contract – A commentary on the JBCC Agreement* (1st ed.). Cape Town, Juta and Co. Ltd.
- Geok, O. S. (2002). Cause and improvement for quality problems in design and build projects. Unpublished MSC thesis, National University of Singapore.
- Harbans-Singh K.S. (2003). *Engineering and construction contracts management: Pre-contract award practice*. Singapore, Lexis Nexis.
- Ibbs, C. W., Wong, C. K. & Kwak, Y. H. (2001). Quantitative Impacts of project change: Special issues. *Journal of construction, engineering & management*, 123(3), pp. 308-311.
- Isa, R. B., Jimoh, R. A. & Achuenu, E. (2013), An overview of the contribution of construction sector to sustainable development in Nigeria, *Net Journal of Business Management* 1 (1). Pp 235-244
- Joint Contract Tribunal (1980), *Standard form of contract: With quantities*, RIBA, UK.
- Kumaraswamy, M.M., Miller, D.R.A. & Yogeswaran, K. (2010). Claims for extensions of time in civil engineering projects. *Construction management and economics*, 16(3), pp. 283-94.
- Mohammed A.A. (2005). *Analysis and management of change orders for combined sewer overflow construction projects*. Dissertation, Wayne State University.
- Nwosu, C.C.C & Ozioko F.M. (2013). *Construction contracts: Law and arbitration*. Enugu-Nigeria, Rhyce Kerex Ltd.
- O'Brien, J. (2010). *Construction change orders: Impact, avoidance, documentation*. New York: McGraw – Hill Professional.
- Onwusonye S.I.J. (2005). *Project planning in the construction industry: Theory and practice*, Owerri-Nigeria, Inter Continental Educational Books & Publishers.
- Thomas, H. R. & Napolitan, C. L. (1995). Quantitative effects of construction changes on labour productivity. *Journal of construction engineering and management*, 121(3), 290-296.