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Evaluation of Factors Responsible for Variation Order in Civil Engineering Projects: A Clients' Perspective (A Case Study in Kano State, Nigeria)

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Abstract - *Variation is any deviation from the original scope and schedule of work thus; variation order involves alteration, addition, omission and substitution in terms of quality, quantity and schedule of work. Variation order may have considerable negative impacts on items such as costs and schedule delays. This study is aimed to evaluate the factors of variation order in civil engineering project from the clients' perspective in Kano state, Nigeria. Questionnaires were used and distributed to the clients; out of 120 questionnaires that were sent, 90 questionnaires were retrieved and found suitable for the analysis. The findings concluded that; Change in scope of the project with a mean score of 3.5889 is the most significant factors of variation order in civil engineering projects and was ranked the first. While inadequate project objectives with a mean score of 2.9111 was ranked eighth which is the last. The study introduced valuable recommendations to clients in civil engineering project and provide measures to eliminate variations.*

Key Words: **Variation order, Construction projects, stratified random sampling, Analysis of factors, Ranking of factors, Client perspectives**

1. INTRODUCTION

Variation order involved alteration, addition, omission, and substitution in terms of quality, quantity and schedule of work (Enshassi 2010). Many time delays, cost overrun and quality defects of a construction can be attributed to variation at various stages of the project (Burati et al. 1992). Construction contract is a business agreement that is subjected to variability, contractual clauses relating to changes allows parties involved in the contract to freely initiate variation orders within the ambit of the scope of the work without alteration the original contract (Ndihokubwayo and Haupt 2008).

Variation is any deviation from the original scope and schedule of work thus; variation order involves alteration, addition, omission and substitution in terms of quality, quantity and schedule of work (Nasiru et al. 2015). They further pointed that demand of the owner, market forces and development in technology may impose changes in the design and other parameters for the project. According to Ashworth (2001), variation is a combination of any or all of the following: addition, omission or substitution of any work; the alteration of the kind or standard of materials or goods; the removal from site of work, material or goods that were formerly in accordance with the contract, but which have now been changed and change in the circumstances in which the work is carried out such as: access and use of site; limitation of working space; limitation of working hours and changes made to the sequencing of work.

1.1 Need for the research

Variation orders arises for a variation that were initiated by the owner (Journal of building performance volume 1 issue 1 2010). In some cases, the owner directly initiates variation or the variations are required because the owner fails to fulfill certain requirements for delivering the project.

Variation in the construction industry has become one of the common and serious issues (Aftab et al., 2014). Ala'a 2012 pointed that it has long been identified to have a negative impact on construction productivity, leading to a decline in labor efficiency and, in some cases, sizeable loss of man hours. Variation in construction projects are very common and likely to occur from different sources, by various causes, at any stage of a project, and may have considerable negative impacts on items such as costs and schedule delays (Hao et al., 2008).

Variation orders on construction projects have the potential to unnecessarily increase the cost of construction without adding value to the project in which case they may be regarded as waste, and the identification of their causes might lead to their reduction, possible elimination and subsequent improvement in overall project performance (Thomas 2002).

1.2 Significant of the study

Consequently, projects owners are forced to impose changes in the scope of work due to financial difficulty, thus, frequent variation in Nigeria has led poor project performance, time overrun and source of corruption and high incidence of building failure (Nasiru et al. 2015).

Studies have revealed the significant reduction in both cost increase and time delay as a result of a complete design before commencement of works on site resulting in the prevention of variation orders (Koushki et al., 2005). Arguably, the more the occurrence of variation, the greater the likelihood that unnecessary costs could accrue impacting on the overall project cost, whenever a variation order is issued, whether leading to additions, alterations, omissions or substitutions, unnecessary costs are likely to be incurred (Bello and Saka 2017).

2. RESEARCH METHODOLOGY

The study involves the use of questionnaire to collect data to evaluate the factors responsible of variation order in civil engineering projects. The questionnaire is in two sections, each section in the questionnaire was designed to measure a specific aspect of the set objectives. Section one was designed to collect demographic information about the respondents, such as official designation, gender, age, types of organization, academic qualification, years of working experience, membership of professional bodies and number of projects executed. This is to check for the quality of the data that were acquired from the field before embarking on statistical analysis. Section two asked the question on the possible factors of variation order in civil engineering project: a clients' perspective. The question was rated on a 5-points Likert scale ranging from extremely significant to insignificant depending on the type of rating.

2.1 Research design and methodology

Stratified random sampling method was adopted. Using sample size from Mugenda & Mugenda (1999), a sample size of 120 were distributed to the clients. A five-point Likert scale ranging from 1 (insignificant) to 5 (extremely significant) was adopted to capture the frequency of occurrence of factors causing variation order. The five-point Likert scale was evaluated using SPSS Software.

3. RESULT

Results from the questionnaire have been sorted and analyzed in Statistical Package for Social Sciences (SPSS) Software and presented in a simple table format.

90 questionnaires were retrieved and found suitable for analysis (representing 75% of response rate).

Table 3.1: Respondents rate

Number of questionnaires distributed	120
Number of questionnaires retrieved	90
Response rate	75%

3.1 Analysis of Factors of Variation Order

The score obtained by each factor is represented by the tables below:

Table 3.2: Factors responsible for variation order and their score

S/N	FACTORS OF VARIATION ORDER	SCORES				
		1	2	3	4	5
1	Change of plan by client	21	7	7	28	27
2	Substitution of materials	14	14	14	27	21
3	Owner's financial problem	7	21	20	35	7
4	Change of schedule	15	19	14	35	7
5	Inadequate project objectives	22	19	14	35	7
6	Change in specifications	32	8	8	16	26
7	Impediment in prompt decision making process	7	32	16	34	11
8	Obstinate nature of the client	15	8	22	26	16
9	Lack of coordination	13	5	24	39	9
10	Change in scope of the project	14	7	7	36	26

Table 3.3: Factors responsible for variation order and their mean score.

S/N	FACTORS OF VARIATION ORDER	MEAN
1	Change of plan by client	3.3000
2	Substitution of materials	3.3333
3	Owner's financial problem	3.1559
4	Change of schedule	3.0000
5	Inadequate project objectives	2.9111
6	Change in specifications	2.9444
7	Impediment in prompt decision making process	3.0000

8	Obstinate nature of the client	3.2889
9	Lack of coordination	3.2889
10	Change in scope of the project	3.5889

3.2 Ranking

Table 3.4: Ranking of factors responsible for variation order in civil engineering projects: A clients' perspective

S/N	FACTORS OF VARIATION ORDER	MEAN	RANK
1	Change in scope of the project	3.5889	1
2	Substitution of materials	3.3333	2
3	Change of plan by client	3.3000	3
4	Obstinate nature of the client	3.2889	4
5	Lack of coordination	3.2889	4
6	Owner's financial problem	3.1559	5
7	Impediment in prompt decision making process	3.0000	6
8	Change of schedule	3.0000	6
9	Change in specification	2.9444	7
10	Inadequate project objectives	2.9111	8

4. DISCUSSION OF RESULTS

Mean score for each factor was determined and ranked accordingly. The factors are: Change in scope of the project with a mean score of 3.5889 is the most significant factors of variation order in civil engineering projects and was ranked the first. Substitution of materials was ranked the second most significant factors of variation order with a mean score of 3.3333, the remaining factors with their mean score are; Change of plan by client with a mean score of 3.3000 was ranked third, obstinate nature of the client and lack of coordination with a mean score of 3.2889 were ranked fourth, owner's financial problem with a mean score of 3.1559 was ranked fifth, impediment in prompt decision making process and change of schedule with a mean score of 3.0000 were ranked sixth, change in specification with a mean score of 2.9444 was ranked seventh and Inadequate project objectives with a mean score of 2.9111 was ranked eighth.

4.1 Test of research hypotheses

Decision rule for assessing if there is an agreement in ranking of factors among the clients (for α=0.05):

If P>0.05 the null hypotheses is accepted (There is no agreement in ranking of factors between the clients)

If P≤0.05 the alternate hypotheses is accepted (There is agreement in ranking of factors between the clients)

Hypotheses 1

H0: There is no agreement in ranking of factors between Civil Engineer and Architect

HA: There is agreement in ranking of factors between Civil Engineer and Architect

From the computation of hypothesis 1, the agreement value was found to be 0.003.

Decision: Since 0.003 <0.05 HA (alternate hypotheses) is accepted

Hypotheses 2

H0: There is no agreement in ranking of factors between Civil Engineer and Builder

HA: There is agreement in ranking of factors between Civil Engineer and Builder

From the computation of hypothesis 2, the agreement value was found to be 0.122.

Decision: Since 0.122 >0.05 Ho (null hypotheses) is accepted

Hypotheses 3

H0: There is no agreement in ranking of factors between Architect and Builder

HA: There is agreement in ranking of factors between Architect and Builder

From the computation of hypothesis 3, the agreement value was found to be 0.137.

Decision: Since 0.137>0.05 Ho (null hypotheses) is accepted

Hypotheses 4

H0: There is no agreement in ranking of factors between Quantity Surveyor and Architect

HA: There is agreement in ranking of factors between Quantity Surveyor and Architect

From the computation of hypothesis 4, the agreement value was found to be 0.000.

Decision: Since 0.000<0.05 HA (alternate hypotheses) is accepted

Hypotheses 5

H0: There is no agreement in ranking of factors between Quantity Surveyor and Civil Engineer.

HA: There is agreement in ranking of factors between Quantity Surveyor and Civil Engineer.

From the computation of hypothesis 5, the agreement value was found to be 0.07.

Decision: Since 0.07 >0.05 Ho (null hypotheses) is accepted

Hypotheses 6

H0: There is no agreement in ranking of factors between Quantity Surveyor and Builder.

HA: There is agreement in ranking of factors between Quantity Surveyor and Builder.

From the computation of hypothesis 6, the agreement value was found to be 0.108.

Decision: Since 0.108>0.05 Ho (null hypothesis) is accepted

5. CONCLUSIONS

The following conclusion were drawn:

1. The factors that are responsible for variation order in civil engineering projects: a clients' perspectives are:

i. Change in scope of the project
ii. Substitution of materials
iii. Change of plan by client
iv. Obstinate nature of the client
v. Lack of coordination
vi. Owner's financial problem
vii. Impediment in prompt decision making process
viii. Change of schedule
ix. Change in specification
x. Inadequate project objectives

2. Mean score for each factor was determined and ranked accordingly. The factors are: Change in scope of the project with a mean score of 3.5889 is the most significant factors of variation order in civil engineering projects and was ranked the first. Substitution of materials was ranked the second most significant factors of variation order with a mean score of 3.3333, the remaining factors with their mean score are; Change of plan by client with a mean score of 3.3000 was ranked third, obstinate nature of the client and lack of coordination with a mean score of 3.2889 were ranked fourth, owner's financial problem with a mean score of 3.1559 was ranked fifth, impediment in prompt decision making process and change of schedule with a mean score of 3.0000 were ranked sixth, change in specification with a mean score of 2.9444 was ranked seventh and Inadequate project objectives with a mean score of 2.9111 was ranked eighth.

3. From the study it can also be concluded that there is agreement in ranking of factors between the clients (Civil Engineer and Architect; Quantity Surveyor and Architect; and Quantity Surveyor and Civil Engineer

6. RECOMMENDATIONS

Based on outcome of this research, the following recommendation were drawn;

1) Clients should provide a clear brief of the scope of works; Clear and thorough project brief would assist in eliminating or minimizing variations arising because of the unclear scope of work for the contractor.

2) Co-ordination is required at the design stage and all parties should be proactive all times. Direct communication and continuous coordination will provide professionals an opportunity to review the contract documents completely that would help in eliminating the variations arising because of conflicts in contract documents and also eliminate design discrepancies and errors as well as omissions in design.

3) Substitution or replacing of materials hinder the progress and quality of the completed project therefore, right and required materials should be used in execution of the works.

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