BORNEO JOURNAL OF SCIENCES AND TECHNOLOGY (BJoST)
VOL. : 05, ISSUE: 01 , 109-120
DOI: http://doi.org/10.35370/bjost.2023.5.1-13
e-ISSN: 2672-7439 © 2018, UTS Publisher.

University of Technology Sarawak

ORIGINAL ARTICLE

Causes and Effects of Variations on Civil Engineering Construction Projects in Nigeria

Afonne Uchenna

Quantity Surveying Department, Federal University of Technology, Owerri, Nigeria

ABSTRACT - Variations have been highlighted as a crucial factor responsible for time overrun, cost overrun, poor quality, loss of value, project abandonment, claims and disputes in construction projects. Variation contributes to the criticism that the construction sector is faced with and has reduced the contribution of the sector to sustainable growth and infrastructure provisions. Despite this, variations have not been given adequate attention especially in civil engineering projects in Nigeria. This study aims to assess the causes and effects of variation in civil engineering construction projects in Imo State, Nigeria. A well-structured questionnaire was adopted to gather data from construction professionals engaged by clients, consultants and contractors organizations using snowball sampling techniques via electronic means. Appropriate descriptive statistical tools were used to analyze the gathered data. The study revealed that experts have a high level of experience in the management of variations and that the major causes of variations are poor and unabridged communication gap, lack of proper monitoring and evaluation, replacement of materials or procedures, technology change, and weather conditions. Also, the effects of variation on civil engineering projects are increasing of construction time, total project abandonment, increasing of construction cost, project failure and logistics delays. The study recommends effective communications among the clients, consultants, and contractors to bridge the communication gaps.

ARTICLE HISTORY
Received: 02 Dec 2022
Revised: 03 Jan 2023
Accepted: 20 Jan 2023

KEYWORDS
causes of variation
effect of variations
construction projects
cost overruns
time overruns
Nigeria

INTRODUCTION

The construction industry drives building and infrastructural development in every nation. Most of the building and infrastructure development observed in most nations of the world is brought about by the activities of the construction industry [1]. The industry is a powerful sector that provides jobs, boost nations' Gross Domestic Product (GDP), and contribute to wealth creation [2],[3]. According to [4], the industry influence and stimulate growth in non-construction sectors. Despite the crucial role the sector plays in the economic life of nations, it has been criticized for the continuous problems of poor project delivery that are evident in cost and time overruns, claims, disputes, quality issues, and among others [5]. One of the factors that have been blamed for these problems is changes occasioned by variations during the construction stage of construction projects.

Variation is an inherent issue of construction projects, as the agreement involved in construction businesses are subject to variability [6],[7]. This is because change will normally arise during the execution of a project in an industry that is complex and involves multiple stakeholders [8],[9]. The parties to a construction contract are empowered by some contractual causes to request changes within the scope of the project without making an excessive alteration to the original contract [10]. Variation orders involved alteration, addition, omission, and substitution in terms of quality, quantity, and schedule of work [11],[8]. Resources availability, environmental conditions, the performance of the parties to the

*Corresponding Author: Afonne Uchenna. Federal University of Technology Owerri (FUTO),
email: afonneuchenna2014@gmail.com

contracts, the involvement of other parties, and contractual related issues; are some of the sources of variation.

The global construction industry suffers from cost and time overruns issues on construction contracts [12],[13]. It is evident in the literature that variation orders can cause up to 6-71% rise in project cost, and 10-50% time overruns [14],[15]. Every party in the contract has a role to play in variation, for example, [15] reported that variation order on a construction project can be up to 85% of the entire instruction on the site. Of these, 49% originated from the client, 47% from the consultants, and 4% from the contractors. There have been efforts at controlling and containing the magnitude of allowable variation in construction contracts. For example, a ceiling of 10% is allowed according to FIDIC [16], and 25% of the total contract sum is allowed in FIDIC [17]. Despite these restriction measures, civil engineering construction projects in developed and developing economies are still overwhelmed by variation orders.

In the Nigerian construction industry, the incessant and excessive variation orders impact negatively on the delivery of both public and private construction projects. During the construction stage of infrastructure projects like railways, bridges, roads, flyovers, and airport construction, variation orders are the main change to the delivery of such projects [18]. According to [19], variation is a major problem of a construction project in Nigeria, as it impacts project delivery. The magnitude of variation varies from project to project, and its importance spans from the project inception to completion [20]. Unwarranted variations provide an avenue for the embezzlement of public funds [21]. In addition to cost and time overruns, variation also led to rework in construction, slows down wok progress, and contributed to the abandonment of critical infrastructure project across Nigeria [18].

A review of construction management literature shows that the causes and impact of variations have attracted some attention of researchers in the Nigerian context [22],[18],[19],[23],[24],[25],[26], Imo state in which the present study covers has not been given adequate attention. In addition, the variation of civil engineering construction projects is an area that has been underexplored in the Nigerian context. It is based on this knowledge that this study assesses the causes and effects of variations in civil engineering construction projects in Imo State, Nigeria. Construction clients have been reported to contribute the highest proportion of variations to construction projects completion [20]. The consultants and contractors also contribute to variations that have contributed to poor project performance. The outcome of this study will assist in the administration of civil engineering contracts particularly as it regards variations orders and change requests. Knowledge of the negative effects of variation orders would assist the design and construction teams to work collaboratively to ensure that variation-related changes are avoided or minimized, so that clients can get value for their monies. It is advocated that planning of activities should be prioritized by all key project stakeholders to minimize the occurrence of variations as well as their impacts [23]. This study also adds to the existing body of knowledge on variations in construction.

REVIEW OF LITERATURE

CAUSES OF VARIATIONS ON CONSTRUCTION PROJECTS

Agreement existed among the stakeholders of construction projects regarding the rating of causes of variations [6]. The causes were categorized into client-related factors, consultant related factors and contactors related factors. The study further shows that the consultant contributes more to variations than the client and contractors. In addition, the lack of materials and equipment spare parts due to closure, change in design by the consultant, lack of consultant's knowledge of available materials, errors and omission in design, conflicts between contract documents, client's financial problems, lack of coordination among project parties, using inadequate specifications for local markets by international consultants, internal politics, and change in specification by owners; are the most important causes of variation in Palestinian. In Singapore, the potential factors responsible for variation in construction projects are errors and omission in design, change in specification by the owner, design discrepancies, change in specifications by consultant, and non-compliance of design with governmental regulation [27]. For [28], in Pune, the most ranked causes of variations are owner changes, additional work and modification to prior work, lack of contractor involvement in design stage unrealistic design periods, lack

of communication between contractor and the consultants. A lot of failures and poor project performances reported on construction projects have been blamed on communication problems [29].

In Malaysia, reviewed the causes of variation and found that client-related variations are the most dominant causes of variations in construction [30]. The review reported 18 prominent causes of variation and they are; change of scope by client, owner's financial problems, inadequate project objectives, replacement of materials or procedures, impediment to prompt decision-making process, obstinate nature of the owner, change in specifications by the owner, change in design by the consultant, errors and omissions in design, conflicts among contract documents, technology changes, value engineering, lack of coordination, design complexity, inadequate working drawing details, consultants' lack of required data, poor knowledge of available materials and equipment, and ambiguous design details. Similarly, in Malaysia, the absence of apparatus, poor workmanship, design difficulty, alteration of schedule and impairment to quick decision-making procedure were found as the top most important causes of variations [31].

In the construction industry of Sudan, Mohammed et al. [9] found that the top 10 most important causes of variation orders are; lack of stability of prices and the exchange rate change, new government regulations, non-availability of construction manual and procedure for construction projects, errors and omissions in design, the owners failure to make decisions or review document at the right time and owner's needs during the design stage not well-defined or variably defined, owner's financial problems, contractors financial difficulties, lack of coordination between consultants and contractors and subcontractors and not using value engineering in the design stage to find the best alternatives and providing cost. In Iranian construction projects, the employer's financial problems, change of plans or scope by employer, errors and omissions in design, value engineering, differing site conditions, contractor's financial difficulties, acceleration of work, weather conditions, quality improvement, and conflict in the project site are the major causes of variations in road construction projects [32].

The dominant factors responsible for variation are change of plans or scope of work, client`s financial difficulties, inadequate working drawings, inadequate project objectives, and errors and omissions in design [23]. The clients and consultants are the major origins of variation orders, although the clients cause dominate [19]. Client induced variations are unclear projects often seen as briefs and change of plan or scope. The consultants' induced variations are on their own part was seen as change of requests in design, and errors or omissions in design. The design-related factors, client-related factors and consultant-related factors are the major causes of variations on infrastructure projects delivery [18]. Top design-related factors include discrepancies, inadequate working drawing, error, and omission in design. In Sri Lanka, the major causes of variations in road construction projects are the poor estimation, unforeseen site conditions, political pressure during the construction stage, poor investigation, and client-initiated variations [20]. In the Kenyan construction industry, the additional work constitutes 58% of the variation requests [33]. Furthermore, the top causes of variations in civil engineering projects are delay in land acquisition/compensation, differing site conditions, change of plans or scope by the client, change of schedule by the client, and lack of coordination between overseas and local designers.

In India, the most prominent causes of variation are poor planning value engineering, and project complexity, unavailability of equipment and tools and change of project scope by owner [13]. The variations could be for financial, design aesthetics, changes in drawings, weather, geological and geotechnical reasons [34]. However, causes of variations could be linked to the employer, consultants and/or contractors. The variation in construction impact project cost and time and is linked to the activities of factors such as owner, consultant, contractor, project management, local authorities, and force majeure [12].

EFFECTS OF VARIATIONS ORDERS ON CONSTRUCTION PROJECTS

Variation orders impact the successful delivery of construction projects. However, not all changes lead to variation and have meaningful impacts. Variation orders on critical items of construction projects have negative consequences on the performance of the project. At many stages of construction projects, variations orders have an impact on the budget and calendar of the project [35]. Changing orders result in claims and disputes, time overrun, cost overrun, logistic delays, poor quality, demolition and waste [36]. The main effects of variation orders in civil engineering projects are Cost Overruns, Contractual Disputes and Claims, Time Overruns, Increased Overhead Costs, and Progress Degradation [33].

The effects of variation on infrastructure project delivery are construction delays, increase in cost of project, slow progress of the project and rework [18]. The consequences of variation are schedule overrun, budget overrun, and disagreement among parties on road construction projects [32]. In the work of [37], the significant impacts of variation are budget and schedule overruns. Changes emanate from additional work requests from the project owner, and such change leads to scheduled overrun, cost overrun, claims and disputes both in Nigeria and Oman [26]. The variations lead to logistic delays, postponement or work, and budget overrun on construction projects [31].

Disputes and avoidable claims will be on the increase on construction projects with variation issues, [38]. Loss of productivity, construction delays, additional cost to contractors, non-value-added activities, slow progress of work, disputes between client and contractor, poor quality, were highlighted as the major effects of variations order [39],[32]. A study revealed that the most significant effects of variation order on construction projects were increase in project cost, retarded progress of work, cash flow crises, decrease in contractor's profit, abandonment of project, quality degradation, logistics delay, rework and demolition [24]. One of the harmful impacts of the change order was identified as increase in cost, and therefore must be minimized in a project [40]. Construction projects are not immune to changes, variations or fluctuations, therefore, the parties to construction contracts must strive hard to reduce changes to the lowest minimum to deliver value to the client [22].

The complexity of construction projects makes it difficult for construction operations to be accurately determined prior to commencement of work on site [7]. These leads to variations during construction which could be detrimental, and cause Cost overruns, Time overruns, disputes between the parties of the contract, adverse effect on the professional reputation of one or more parties, additional specialist equipment/personnel, additional health & safety equipment/measure, degradation of health & safety, and degradation of quality. In Ethiopia, [41] found that completion schedule delay, increase in project cost, additional payments for the contractor, effect on progress, and increase in overhead expenses were the main impacts of variation orders on public construction projects. [12] posit that variation orders in construction are frequently accompanied with series of impacts particularly on projects quality, time, and cost. El Sarag [42] developed a model based on variation data and found that 40% addition to project cost and time were caused by variations. It was advocated that absolute care should be taken to ensure that project resources are monitored and controlled to minimize the changes/variations, so that project goal would be achieved. The major effects of variation on projects are increase in project cost, increase in overhead expenses, decrease in quality of work, and decrease in labour productivity [13]. The use of work breakdown structure, reviewing the contract documents prior to construction and freezing the design after a certain stage of construction, were advocated to ensure control of variations.

MATERIALS AND METHODOLOGY

The purpose of this study is to determine the causes and effects of variations in civil engineering construction projects in Imo State, Nigeria. The study adopted a well-structured questionnaire administered to collect quantitative data from construction professionals within the study area. The questionnaire provides a less time consuming, less expensive means of data sampling larger audiences [43]. It is a common instrument used for social research and it can reach larger participants within a short period of time [44],[45]. The sampled professionals include Architects, Builders, Engineers and Quantity Surveyors who have an acceptable level of experience in the delivery of civil engineering construction projects. These experts are the key employees of clients, consulting and contracting organizations in the construction industry of any nation [43]. Clients, consultants and contractors have been sampled in previous related studies, for example [31],[33].

Snowball sampling was adopted in the administration of the questionnaire to the experts. The snowball sampling techniques can increase the sample size [46], and it depends on referrals [47]. Snowball sampling is suitable for collecting data from experienced participants, who met the study survey conditions but are difficult to reach. Some conditions for participation in a study include (i) participants must have at least 5 years of work experience, (ii) are experienced in the subject under consideration, (iii) and still actively engaged in the delivery of civil engineering projects [48]. These sample participation conditions were adopted in this study to ensure that the survey obtained quality, rich and unbiased data [48],[49]. With such sampling selection criteria, determining the sample population and size becomes impracticable as there is no separate database of experts with such criteria. Thus, this justifies the use of

snowball sampling [49]. The researcher administered the research instrument using electronic means. According to [43], the electronic means of the survey is an environmentally friendly means of a survey.

The questionnaire was designed into three sections. The first section gathered information on the background details of the respondents. The information from the first section served as a quality check for those collected from other sections. The second section gathered data on the causes of variation in civil engineering projects, and the last section gathered data on the effect of variation on civil engineering projects. The gathered data were based on a 5-Likert scale in which 1 is the lowest scale and 5 is the highest scale. After a sampling period that span from September to November of 2021, a total of 126 usable responses were received.

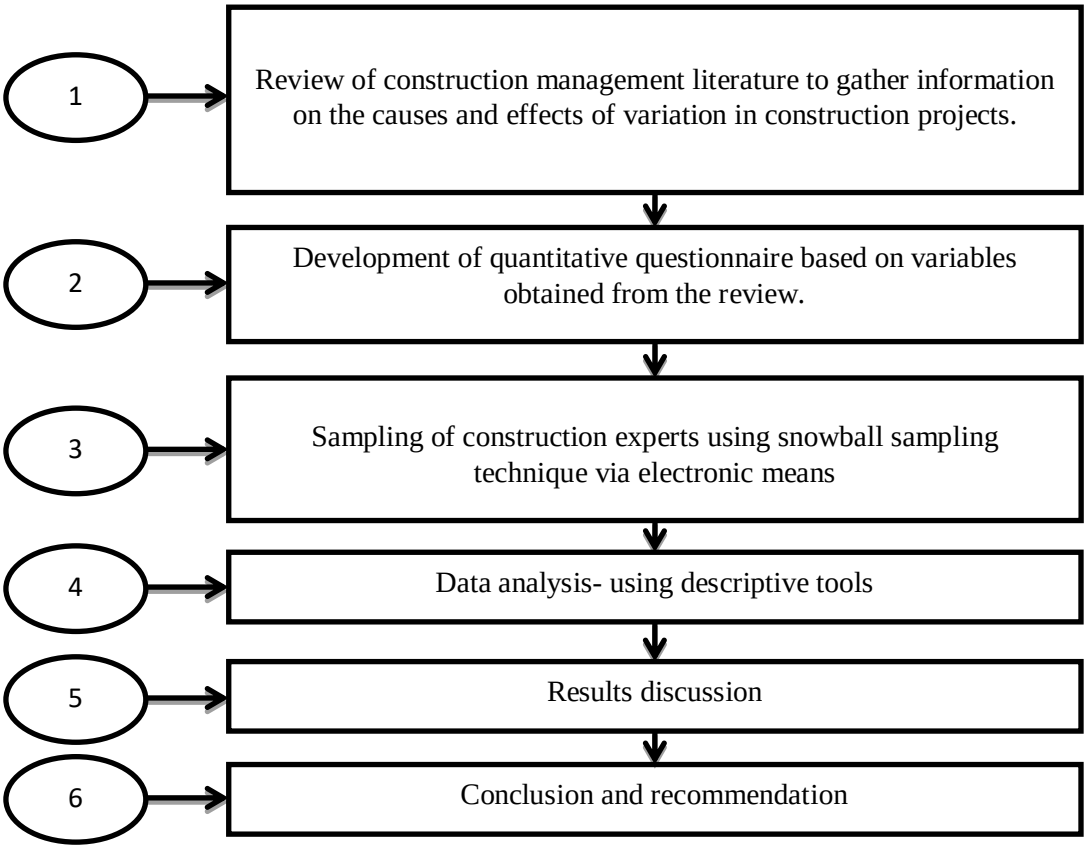

Figure 1: Study methodological flow chart

Frequency, percentage, and mean item score were used to analyze the collected data. Frequency and percentage were used to analyze data gathered on the basic information of the participants. Mean item score (MIS) was used to analyze data collected on the causes and effects of variation in civil engineering projects. The reliability of the research instrument was carried out using Cronbach's alpha test. A Cronbach's alpha coefficient of 0.812 and 0.879 was obtained from the analysis and this is well above the 0.70 proposed by [50],[51]. Based on this, it was concluded that the data has high reliability and internal consistency and is of good quality. Figure 1 shows the summary of the study methodological flow chart.

RESULTS AND DISCUSSION

BACKGROUND INFORMATION OF THE RESPONDENTS

It can be seen from Table 1 that more of the respondents came from the private sector with 72.22%, followed by the public organizations (27.78%). The professional distribution of the participants shows that

19.84% are architects, 15.87% builders, 36.51% engineers, and 27.78% Quantity Surveyors. In terms of their experiences, 34.92% have 6-10 years experience, those with 11-15 years (42.86%), 16-20 years (18.25%) and above 20 years (3.97%). In terms of the Highest educational qualification, HND holders are 7.914%, PGD (14.29%), BSc/BTech (45.24%), MSc/M.Tech (32.54%) and PhD (0.79%).

Table 1. Demographic characteristics of Respondents

Category	Classification	Freq.	%
Category of Organization	Public organization	35	27.78
	Private organization	91	72.22
	TOTAL	**126**	**100.00**
Respondents' profession	Architects	25	19.84
	Builders	20	15.87
	Engineers	46	36.51
	Quantity Surveyors	35	27.78
	TOTAL	**126**	**100.00**
Years of experience	6-10 years	44	34.92
	11-15years	54	42.86
	16-20 years	23	18.25
	Above 20	5	3.97
	TOTAL	**126**	**100.00**
Academic Qualification	HND	9	7.14
	PGD	18	14.29
	BSc/Btech	57	45.24
	M.Sc/M.Tech	41	32.54
	PhD	1	0.79
	TOTAL	**126**	**100.00%**

LEVEL OF EXPERIENCE IN MANAGING VARIATIONS

The respondents have a high level of experience in the management of variations in civil engineering projects. This is evidenced in Figure 2 in which 7.95% indicated having a medium experience, while 54.76% indicated having high experience and 37.30% indicated having very high experiences. It can be concluded that their experience ranges from high to very high.

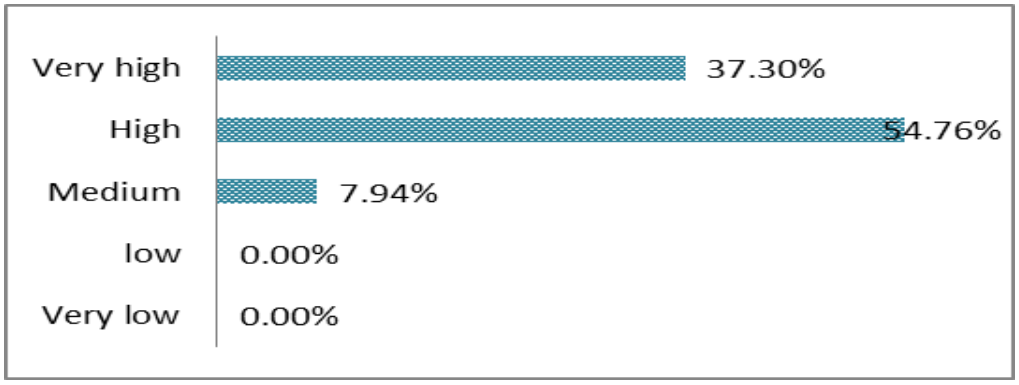

Figure 2. Level of experience in managing variations.

CAUSES OF VARIATION IN CIVIL ENGINEERING PROJECTS

Table 2 shows the result of the analysis on the data obtained for the causes of variation in civil engineering projects. Under the contractors'-related factors, the top causes of variations in civil engineering projects are; Poor and unabridged communication gap (mean=4.12), Lack of proper monitoring and evaluation (mean=4.06), and Poor quality contract documentation (mean=3.89). Under the Employer/client-related causes, the top causes of variations are; Replacement of materials or procedures (mean=3.94), Obstinate nature of the employer (mean=3.92), Change of plans or scope by the employer (mean=3.46), and Impediment in the prompt decision-making process (mean=3.17).

Under the Consultant related causes, the major causes of variations are; Technology change (mean=3.94), Errors and omissions in design (mean=3.92), and Lack of coordination (mean=3.90). Other causes of variation are; Weather conditions (mean=3.94), Change in government regulations (mean=3.86), Change in economic conditions (mean=3.83), and Safety considerations (mean=3.75).

Table 2. Causes of variation in civil engineering projects.

S/No.	Causes of variation	mean	Rank	Overall rank
A	**Contractor's related causes**			
1	Poor and unabridged communication gap	4.12	1st	1st
2	Lack of proper monitoring and evaluation	4.06	2nd	2nd
3	Poor quality contract documentation	3.89	3rd	9th
4	Unavailability of skills (shortage of skilled manpower)	3.73	4th	14th
5	Lack of contractor's involvement in the design	3.56	5th	16th
6	The desire for higher profit	3.47	6th	17th
7	Lack of strategic planning	3.43	7th	19th
B	**Employer/ client-related causes**			
8	Replacement of materials or procedures	3.94	1st	3rd
9	Obstinate nature of the employer	3.92	2nd	6th
10	Change of plans or scope by employer	3.46	3rd	18th
11	Impediment in the prompt decision-making process	3.17	4th	20th
C	**Consultant related causes**			
12	Technology change	3.94	1st	3rd
13	Errors and omissions in design	3.92	2n	6th
14	Lack of coordination	3.9	3rd	8th
15	Change in design by consultants	3.78	4th	12th
16	Inadequate working drawing details	3.67	5th	15th
17	Design complexity	3.17	6th	20th
D	**Other variation causes**			
18	Weather conditions	3.94	1st	3rd
19	Change in government regulations	3.86	2nd	10th
20	Change in economic conditions	3.83	3rd	11th
21	Safety considerations	3.75	4th	13th

Overall, the top five (5) causes of variations in civil engineering projects are Poor and unabridged communication gap (mean=4.12), Lack of proper monitoring and evaluation (mean=4.06), Replacement of materials or procedures (mean=3.94), Technology change (mean=3.94), Weather conditions (mean=3.94). While the least major causes of variations in civil engineering projects are; desire for higher profit (mean=3.47), Change of plans or scope by the employer (mean=3.46), Lack of strategic planning (mean=3.43), Impediment in the prompt decision-making process (mean=3.17), and Design complexity (mean=3.17).

An average mean weighting of 3.74 (74.77%), a maximum mean weight of 4.12 (82.38%) and a minimum weighting of 3.17 (63.49%) showed that they are all significant contributors to civil engineering projects in Nigeria. This is premised on the average mean weight which is above 50%. The finding in this section is however in support of studies such as [9],[20],[28],[30].

EFFECTS OF VARIATION ON CIVIL ENGINEERING PROJECTS

Table 3 shows the results of the analysis of the data gathered on the effects of variation on civil engineering projects. It can be seen that in order of their mean weighting the most critical effect is an increase in construction time (mean=4.31), this is followed by total project abandonment (mean=4.16), followed by an increase in construction cost (mean=4.15), Project failure (mean=4.08), logistics delays (mean=3.93), Contractor dissatisfaction (mean=3.92), Dispute among the parties (mean=3.87), Safety issues (mean=3.68), Determination by the contract (mean=3.61) and Arbitration/ litigation (mean=3.27). The result obtained in this section is in support of previous studies [24],[31],[32],[35],[40].

Table 3. Effects of a variation on civil engineering projects

S/No.	Variables	MIS	RANK
1	Increase in construction cost	4.15	3rd
2	Increase in construction time	4.31	1st
3	Project failure	4.08	4th
4	Contractor dissatisfaction	3.92	6th
5	Total project abandonment	4.16	2nd
6	Arbitration/ Litigation	3.27	10th
7	The dispute among the parties	3.87	7th
8	Logistics delays	3.93	5th
9	Safety issues	3.68	8th
10	Determination by the contract	3.61	9th

RELATIONSHIP BETWEEN THE CAUSES AND EFFECTS OF VARIATION IN CIVIL ENGINEERING CONSTRUCTION

Based on the major findings and results in Table 2 and 3, the relationship between the causes and effects of variation in civil engineering construction are summarized in the fishbone diagram (figure 2) below. The top overall ten causes and five effects of variations on construction projects are shown. It can be seen from Fig. 3 that unguided variation has the capability to kill a project as it affects negatively the key parameters with which project success is measured. Therefore, variation impact on the project performance measurement baselines could lead to premature failure, termination, and ultimate abandonment of civil engineering projects.

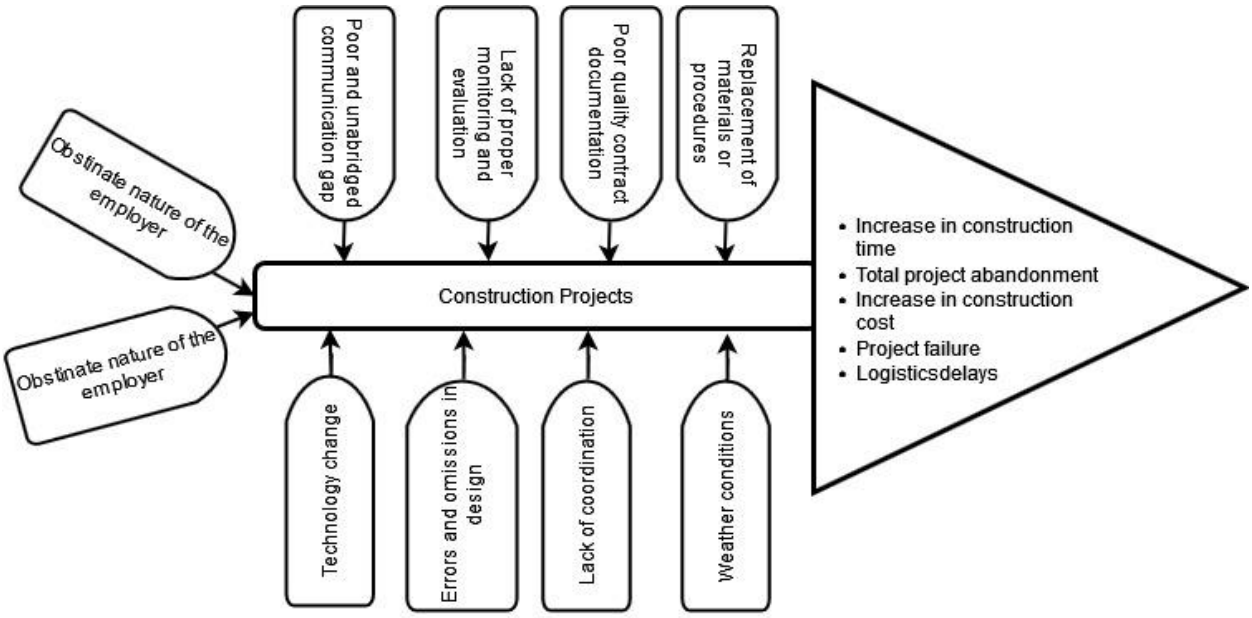

Figure 3: Fishbone diagram showing the causes and effects of variation in construction

CONCLUSION

This study adopted a well-structured questionnaire to determine the causes and effects of variation in civil engineering construction projects in Imo State, Nigeria. Experts working in clients, consulting and contracting organizations were sampled using snowball sampling technique via electronic means in the study area. Following descriptive statistical analysis, the results obtained revealed that the experts have a high level of experience in the management of variations in civil engineering projects and that the major causes of variations are poor and unabridged communication gap, Lack of proper monitoring and evaluation, replacement of materials or procedures, Technology changes, and Weather conditions. The most ranked effects of variation on civil engineering projects are an increase in construction time, total project abandonment, Increase in construction cost, Project failure and logistics delays.

It is recommended that communications should be increased among the project participants, especially between the clients, consultants and contractors. This is particularly important in the exchange of ideas, instructions, timely dissemination of directives and other vital information for the project. There should be proper monitoring of projects by the concerned construction professional and timely evaluation of reports to ease and quicken decisions that affect the project. Proper development of brief and drafting of specifications regarding materials and procedures should be completed before mobilizations to site and commencement of work. With evidence of the effect of variation orders, the design team and construction team must work collaboratively to ensure that changes are minimized, and clients get value for monies expended. This will prevent changes to materials during the construction stage. Technology has been found to improve projects' performance and workers' productivity. In this era of the fourth industrial revolution which is equally known as industry 4.0. Technology is critical in every stage of the project's life cycle.

This study will help construction-related organizations with the basic information required to effectively administer civil engineering contracts, particularly as it relates to variations orders and change requests. This study will also add to the few available studies on variations in the Nigerian and other developing countries of the world. This study is however limited by sampling method, sample size, geographical boundary, and method of data analysis. While the result could be useful to other clans, the generalizations of the result should be made with care. Based on this, a similar study could be carried out in other states or regions in Nigeria or other developing countries of Africa. There is yet to be agreement among scholars on the major originators of variations order, this is evident in the differing reports regarding the clients' factors, consultants' factors and contractors' factors. Who is to be blamed on

variations and other changes are still being debated; however, more studies have blamed the clients more than the consultants. A study that will explore the causes and effects of client-specific causes of variation is necessary.

ACKNOWLEDGEMENT

The author appreciates the efforts of the reviewer(s) for their constructive comments and recommendations which have helped to improve the quality of this paper. The efforts of the industrious editorial team of BJoST are also acknowledged.

REFERENCES

[1] Okereke, R.A., Pepple, D.I., & Eze, E.C. (2022). Major Finance Sources in Construction Project Delivery and Impact of Financing in the Construction Industry. borneo journal of sciences and technology (BJoST), 04(02), 112-124. DOI: http://doi.org/10.35370/bjost.2022.4.2-13

[2] Edison, J.C., & Singla, H.K. (2020). Development of a scale for factors causing delays in infrastructure projects in India. Construction Economics and Building, 20 (1), 36-55. https://doi.org/10.5130/ AJCEB.v20i1.6750

[3] Luangcharoenrat, C., Intrachooto, S., Peansupap, V., & Sutthinarakorn, W. (2019). Factors Influencing Construction Waste Generation in Building Construction: Thailand's Perspective. Sustainability, 11, 3638; doi:10.3390/su11133638

[4] Onyeagam, O.P., Eze, E.C., & Adegboyega, A. A. (2019). Assessment of Quantity Surveying Firms' Process and Product Innovation drive in Nigeria. SEISENSE Journal of Management, 2(3), 21-37

[5] Greenwood, D., & Wu, S. (2012).Establishing the association between collaborative working and construction project performance based on client and contractor perceptions. Construction Management and Economics,30,299308. http://dx.doi.org/10.1080/01446193.2012.666801

[6] Enshassi, A., Arain, F., & Al-Raee, S. (2010). Causes of variation orders in construction projects in the Gaza strip. Journal Of Civil Engineering And Management, 16(4), 540-551

[7] Baştuğ, Ö. (2022). Variation Orders in Construction Projects. Available at: http://wiki.doing-projects.org /index.php/Variation_Orders_in_Construction_Projects

[8] Okereke, R.A., Zakariyau, M., & Eze, E.C. (2021). Extension Of Time (Eot) Claims Substantiation And Associated Issues In Complex-Multi Stakeholders Building Construction Contracts. Journal of Engineering and Technology for Industrial Applications, 7(32), 23-31. DOI: https://doi.org/10.5935/jetia.v7i32.782

[9] Mohammed, E.A.E., Mohammed, S.Y., & Hassan, A.S. (2017). Factors Causing Variation Orders In Building Projects In Khartoum State- Sudan. International Journal of Engineering Sciences & ResearchTechnology 6(11), 117-129. DOI: 10.5281/zenodo.1042094

[10] Ndihokubwayo, R., & Haupt, T. (2008). Origin cause matrix: a practical approach for identification of waste associated with variation orders. Acta Structilia, 126-142.

[11] Designing buildings wiki (2022). Variations in construction contracts. Available at: https://www. designingbuildings.co.uk/wiki/Variations_in_construction_contracts

[12] Thani, H.A., Saleh, M.E., & Amer, N.H. (2018). Identification and analysis of main reasons of variation orders and their impacts during construction project Life Cycle. Proceedings of the 12th ICCAE-12Conference, 3-5 April, 2018. Available at: https://iccae.journals.ekb.eg/article_30056_82690f7f6dad29be70a19bcc87b0886c.pdf

[13] Thakar, S.J. (2020). A Study on Impacts of Variation Order in Construction Projects. International Research Journal of Engineering and Technology (IRJET), 07(05), 5365- 5373

[14] Randa, J.S.M., Razali, B.A., & Abang, A.A.A. (2009). Variation Orders in Construction Projects. Journal of Engineering and Applied Sciences, 4(3), 170-176.

[15] Ndihokubwayo, R. (2008). An Analysis of the Impact of Variation Orders on Project Performance. (Masters of Technology: Construction Management), Cape Peninsula University of Technology, South Africa. (33)

[16] FIDIC. (1999). Condition of Contract for Building and Engineering Works Designed by the Employer. Switzerland: FIDIC.

[17] FIDIC. (2006). Condition of Contracts for Building and Engineering works Designed by the Employer. Geneva, Switzerland: FIDIC, MDB.

[18] Kasimu, A.M., Mohammed, D., Kolawole, A.F., & Kbiru, U.M. (2019).the causes and effects of variations on infrastructure projects delivery in Abuja. Nigeria. Journal of Multidisciplinary Engineering Science and Technology (JMEST), 6(4), 9811-9818.

[19] Eigbe, S. (2016). Empirical Study of the Origins and Causes of Variation Orders in Building Projects. Journal of Engineering Research and Application, 6(10) 34-48.

[20] Halwatura, R. U., & Ranasinghe, N. P. N. P. (2013). Causes of Variation Orders in Road Construction Projects in Sri Lanka. Hindawi-ISRN Construction Engineering, Volume 2013, Article ID 381670, 7 pages. http://dx.doi.org/10.1155/2013/381670

[21] KACC. (2007). Kenya Anti-Corruption Commission: Examination Report into the Systems, Policies, Procedures, and Practices of the Road Sub-Sector. Nairobi: KACC.
[22] Ola-Ade, E.O., & Mafimidiwo, B. (2021). Minimising Variation and Fluctuation in Housing Delivery in the Developing Economy of Nigeria. FIG e-Working Week 2021, Smart Surveyors for Land and Water Management - Challenges in a New Reality Virtually in the Netherlands, 21–25 June 2021
[23] Adu, E.T., Ekung, S.B., & Lashinde, A.T. (2020).Key Causes of Variation Orders in Public Construction Projects in South-South Zone of Nigeria: An Explanatory Factor Analysis. Civil and Environmental Research, 12(1),47-59.
[24] Tunde, B.R., Ayodele, I.O., & Namadi, A.S. (2015). 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 Vol. 2 No. 2. 7th May, 2015- G.S.U. Multipurpose Hall, Gombe.
[25] Muhammad, N. Z., Keyvanfar, A., Majid, M. Z. A., Shafaghat, A., Magana, A. M., & Dankaka, N. S. (2015). Causes of variation order in building and civil engineering projects in Nigeria. Jurnal Teknologi (Sciences and Engineering), 77(16), 91–97.
[26] Ijaola, I.A., & Iyagba R.O.A. (2012). A Comparative Study of Causes of Change Orders in Public Construction Project in Nigeria and Oman, Journal of Emerging Trends in Economics and Management Sciences (JETEMS),3(5), 495-501
[27] Arain, F.M., & Low, S.P. (2006). Developers' views of potential causes of variation orders for institutional buildings in Singapore. Architectural Science Review, 49(1), 59-74.
[28] Jadhav, O.U., & Bhirud, A.N. (2015). An Analysis of Causes and Effects of Change Orders on Construction. International Journal of Engineering Research and General Science, 3(6), 795-799.
[29] Obonadhuze, B.I., Eze, C.E., Lawrence Uche Siunoje, U., & Sofolahan, O. (2021). Causes and Effects of Ineffective Communication on Construction Projects. Borneo Journal of Sciences & Technology, 3 (1), 77-92. DOI: http://doi.org/10.3570/bjost.2021.3.1-11
[30] Mohammad, N., & Hamzah, Z. (2019). A review of causes of variation order in the construction of terrace housing projects in Malaysia. MATEC Web of Conferences 277, 03013 (2019). https://doi.org/10.1051/ matecconf/201927703013
[31] Memon, A.H., Rahman,I.A., & AbulHasan,M.F. (2014). Published paper on Significant Causes and Effects of Variation Orders in Construction Projects, Research Journal of Applied Sciences, Engineering and Technology, 7(21), 4494-4502.
[32] Ismail, A., Pourrostam, T., Soleymanzadeh, A., & Ghouyounchizad,M. (2012). Factors Causing Variation Orders and their Effects in Roadway Construction Projects, Research Journal of Applied Sciences, Engineering and Technology, Shoushtar, Iran, 4(23), 4669-4972
[33] Dickson, O.D., Gerryshom, M., & Wanyona, G. (2015).Variations in Civil Engineering Construction Projects in Kenya: Causes and Effects. International Journal of Engineering Research & Technology (IJERT), 4(2),1124-1129
[34] UK Essays. (November 2018). Causes of Variation in Construction Projects. Retrieved from https:// www.ukessays.com/essays/construction/potential-causes-of-variation-construction-essay.php?vref=1
[35] Ndihokubwayo, R., & Haupt, T. (2009). Variation Orders On Construction Projects: Value Adding Or Waste?, International Journal of Construction Project Management, 1, 1-17.
[36] Gobana, A.B., & Thakur, A.S. (2017). Critical Review on Causes and Effects of Variation Order on Construction Project. International Research Journal of Engineering and Technology (IRJET), 04(12), 1602-1606.
[37] Oladapo, A.A. (2007). Durban, Assessment of the cost and time impact of variation orders on construction projects ,Journal of Engineering, Design and Technology, South Africa,5(1), 35-48.
[38] Babatunde, S.O., Babalola, O, Jagboro, G.O., & Opawole, A. (2012). An assessment of building elements proneness to variation in Nigerian. Journal of Construction Project Management and Innovation. 2(2), 424-447.
[39] Kolawole, A.R., Kamau, P.K., & Munala, G. (2015).Change order management in Nigeria. The current context. Journal of Management Research. 7(5), 127-136.
[40] Naji, H.I., Hatem, W.A., & Maula, B.H. (2018).Change Orders in Iraqi Construction Projects. The Open Civil Engineering Journal, 12,458-467. DOI: 10.2174/1874149501812010045
[41] Yadeta, A.E. (2016). The Impact of Variation Orders on Public Building Projects, *International Journal of Construction Engineering and Management*, 5(3), 86-91. doi: 10.5923/j.ijcem. 20160503.03
[42] El Sarag, J.M. (2017). Causes of variation orders in the Egyptian construction industry: Time and cost impacts [Master's Thesis, the American University in Cairo]. AUC Knowledge Fountain. https://fount.aucegypt.edu/etds/291
[3] Nwaki, W.N., & Eze, C.E. (2020). Construction as a panacea for poor construction projects performance. ITEGAM-Journal of Engineering and Technology for Industrial Applications (JETIA), 6(26), 61-72.
[44] Tan, W. (2008). Practical Research Methods Third Edition (Third Edition ed.). Singapore: Pearson Education.
[45] Blaxter, L., Hughes, C., & Tight, M. (2001). How to research (2nd ed.). Buckingham; Philadelphia: Open University Press.
[46] Atkinson, R., and Flint, J. (2001). Accessing hidden and hard-to-reach populations: snowball research strategies. Social Research Update, Vol. 33. Retrieved from https://www.researchgate.net/ on April 23 2019
[47] Heckathorn, D.D. (2011). Comments: snowballing versus respondent-driven sampling. Sociological Methodology, 41(1), 355-366.

[48] Eze, E.C., Ugulu, R.A., Onyeagam, O.P., & Adegboyega, A.A. (2021a). Determinants of sustainable building materials (SBM) selection on construction projects. International Journal of Construction Supply Chain Management Vol. 11, No. 2 (pp. 166-194). DOI:10.14424/ijcscm110221-166-194
[49] Eze, C.E, Ugulu, R.A., Egwunatum, S.I., &Awodele, I.A. (2021b).Green Building Materials Products and Service Market in the Construction Industry. Journal of Engineering, Project, and Production Management, 11(2), 89-101
[50] Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate Data Analysis. In Vectors. https://doi.org/10.1016/j.ijpharm.2011.02.019
[51] Pallant, J. (2005). SPSS Survival Manual: A Step By Step Guide to Data Analysis Using SPSS for Windows (Version 12)., (2nd ed.).. Allen and Unwin, Crows Nest NSW 2065.