



INVESTIGATION ON THE CAUSES AND EFFECTS OF VARIATION ORDERS IN THE CONSTRUCTION PROJECTS IN JORDAN

Mohammed A.KA. Al-Btoush

Isra University Office 11622 Amman, Jordan. Amman PO Box 33 and 22

Keywords:

AEC, FIDIC , VO.ARTICLE INFO

Article history:

Received 01. October 2021

Accepted 15. October 2021

Available online 15 November 2021

©2022 THIS IS AN OPEN ACCESS ARTICLE
UNDER THE CC BY LICENSE

<http://creativecommons.org/licenses/by/4.0/>



Citation:

<http://doi.org/10.32441/jaset.04.01.07>

A B S T R A C T

The construction industry nowadays faces several challenges that prevent it to be completed within the planned budget. the most effected challenge on the project cost is the variation orders, which became common on most construction projects. The variations in construction projects mean any change in quantity or quality of the project work. Based on various studies in the Jordanian construction industry it is found various sources of variation orders. Therefore, it is important to provide suitable recommendations to minimize variation orders during the project lifecycle. The aim of this study is to study the variation orders causes on the governmental construction project in Jordan. To meet that aim, a comprehensive literature review was conducted to locate and study the variation orders causes and its effect on construction projects worldwide. To achieve the study objectively the researcher adopted a structured questionnaire to gather the required data about the causes of VO. The collected data were analyzed statistically using the Relative Importance Index (RII). Based on the results of the study the critical causes of VO in construction projects in Jordan are grouped into main four groups such as causes related to owners, causes related to contractors, and causes related to consultants, causes related to unforeseen circumstances. The findings of the current study revealed that the critical causes of VO in the Jordanian construction industry are: unskilled laborers, inaccurate quantity take-off, shortage of human and equipment Resource, change of scope or plans by owners, absence of construction manuals and procedures , unavailability of the required labor skills , logistic delays , shortage of equipment and tools , technology changes , internal politics .Also, the results show that consultants are responsible for about 50% of the causes, 20% due to owners and unforeseen variations, and contractors are responsible for about 10% of the causes.

* Corresponding Author: E-mail: Mohammed A.KA. Al-Btoush  <https://orcid.org/0000-0001-7006-7321>
Isra University, Amman Jordan.

Introduction

Variation and change refer to the same thing in this study, a variation order (VO) is a composed request to the contractor marked by the client and issued after the agreement's execution, allowing an adjustment in the work or any modification on the agreement, any change in the contract purpose as deduced from the contract describing or defining the work to be carried out is called a variation. (Al-Momani, 1996)

To avoid doubt, the concept of variation may consist of any changes stated above which may be instructed to modify the work in which will be put, but may ignore any instructions which a variation may somehow be and have ascended and imposed or planned to obviate any default or break of agreement by contractor, an engineer has the authority to initiate variations by FIDIC (1999) either by instruction (sub-clause 3.3) through contractor requesting to present a proposal. (Akinsola, Potts, Ndekugri, & Harris, 1997).

According to FIDIC (1999), Variations in design, quantity, quality, working conditions, or a work sequence are examples of variations. A thorough understanding of the main variations drivers is required for a viable investigation of variations and variation orders (Arain & Pheng, 2005b). Hence, 38 reasons of variation orders were recognized, reasons for variations were assembled under four classes: owner-caused variations, consultant-caused variations, contractor-induced variations and unexpected differences due to other initiators.

Effects of Variation Orders

After reviewing the causes of variation order, it was necessary to discuss the

effects of variation order on the projects, many researchers discussed the effects of variation order and how it influences the project badly, this section presented the 15 effects identified from the literature review and it will be discussed below briefly.

Project Progress

Changes throughout the project could influence the progress or quality (Oloo, Munala, & Githae, 2014). Time has an equivalent cash esteem regardless of the possibility that the expert group endeavours its best to keep the project fulfilment plan undamaged, nevertheless, just real variations amid the project may influence the project completion, the contractor would often endeavour to control the variations by employing the free floats in the construction schedules, thus, the variations influence the progress, however, with no intrusion in the project time to complete.

Increase in Project Cost

The most important impact of variations, amid the construction stage, is expansion in project cost (Hwang & Low, 2012). Any significant augmentations or adjustment in the design may in the end result in an increment of the project cost (Musa, Birma, & Ibrahim, 2021). In each construction project, an emergency sum is normally specified to provide the conceivable variations in the project while at the same time keeping the general project cost constant.

Hiring New Profession

Variety in complex innovative projects may influence the project badly (Sunday, 2010). Specific labour is the supporting resources for complex projects, (Arain & Pheng, 2005b),

contingent upon the nature, now and then, the varieties may need employing new experts or change in the whole project group.

Increase in Overhead Expenses

Varieties require a specific system, paper work and audits before they can even be applied (Arain & Pheng, 2005a). The procedure and usage of varieties in construction projects would expand the overhead costs for all the concerned parties, usually; these overhead charges are accommodated from the possibility of fund dedicated for construction projects.

Quality Degradation

Varieties, if nonstop, may influence the fineness of work gravely (Sunday, 2010), as indicated by (Hwang & Low, 2012), the nature of work was much of the time poor in view of continuous varieties and contractors slanted to reward for the misfortunes by compromising.

Productivity Degradation

Obstruction, postponements or redirection work are factors related to change orders and will negatively affect work profitability (Hwang & Low, 2012). These factors can be converted into worker fee or project value. (W. Ibbs, 2005) stated that the profitability of specialists was foreseen to be incredibly influenced in situations when they are required to spend additional time for stretched out periods to recuperate the schedule delays, (Arain & Pheng, 2005b), presumed that varieties regularly prompted intrusions and these interferences were in charge of work efficiency retrogression, the hugest sorts of retrogression were because of the absence of materials and data and in addition the work out of request, (Sunday, 2010), absence of

material was accounted for as the most noteworthy interference, hence, to oversee variety, one is expected to deal with these interruptions. In any case, the impacts could not be kept away from much of the time.

Delay in Procurement

Varieties which are urged when project is in progress, may require re-examination acquisition demands (Arain & Pheng, 2005b), obtaining postponements can be basic because of varieties that needed new materials and specific tools, Arain and Pheng (2005c) found that acquisition delays were regular effects on varieties identified with new resources for projects.

Delay in Procurement

Varieties which are urged when project is in progress, may require re-examination acquisition demands (Arain & Pheng, 2005b), obtaining postponements can be basic because of varieties that needed new materials and specific tools, Arain and Pheng (2005c) found that acquisition delays were regular effects on varieties identified with new resources for projects.

Rework and Demolition

Rework and demolition are common incidences because of varieties in construction projects (Arain & Pheng, 2005c), varieties which are forced when construction is ongoing or even finished, often lead to reworks and delays in project schedule (Sunday, 2010), rework and demolition are possible impacts of variation in construction. These impacts may happen because of varieties amid the construction stage.

Logistics Delays

Logistics delays may happen because of varieties needing new materials and equipment (Sunday, 2010). Ibbs (2005)

supposed that this kind of delay was important impacts of varieties in construction; the delay was examined in construction where varieties in construction stage required materials, new tools and equipment's.

Tarnish Firm's Reputation

Variations are defined as the main principle wellspring of construction claims and debate (Sunday, 2010). The claims and disputes may influence the association's standing badly, prompting to bankruptcy in severe cases, variations likewise increment the likelihood of expert struggles, predictably, variations introduce issues to everyone engaged in the construction process.

Poor Safety Conditions

Varieties may impact on the safety conditions in construction projects (Arain and Pheng, 2005c). This is on account of varieties in construction approaches, materials and tools that may require extra safety measures amid the construction stage (C. W. Ibbs, Wong, & Kwak, 2001).

Poor Professional Relations

Construction varieties may influence proficient and prompting arguments, clear techniques that are offered in the agreement and reasonable assignment of dangers can help in settling conflicts through transaction instead of claims (Hanna, Russell, Nordheim, & Bruggink, 1999), variation constructions are the main source of construction debate.

Additional Payments for Contractor

Extra payments for the contractor can be a probable impact of varieties in construction projects, this is on the grounds that varieties are a typical source of extra works, due to added payments, and contractor anticipates

varieties in the construction project (O'Keane, 2017).

Disputes among Professionals

Disputes debates among experts are conceivable impacts of regular variations in construction projects (Ibbs et al., 2001). The arguments about variation requests or claims are inescapable and the variations conditions are regular source of the project debate (Stocks & Singh, 1999), clear methods offered in the agreement and reasonable designation of experience can help in settling debate through collaboration as opposed to claims (Arain & Pheng, 2005a), frequent correspondence and solid coordination can support in removing the debate between experts (Ibbs et al., 2001).

Schedule Delay Completion

Schedule delay completion is a typical consequence of varieties in projects (Ibbs et al., 2001). The value of schedule is delayed because varieties as described by (Zeitoun & Oberlender, 1993), he mentioned that delay may reach to be 9% of the total time for 71 unchangeable cost projects. (Yogeswaran, Kumaraswamy, & Miller, 1998) recognized claims for expansion the time as a result of understandable delays in the Hong Kong's engineering projects, their findings proposed that over 50% of inspected projects were postponed due to varieties effects of variation orders (Ibbs et al., 2001).

Research Methodology

This research was accompanied through a survey study design using a quantitative method strategy. (Hira & Mugenda, 1999), survey ponders solicit vast numbers from individual's inquiries regarding their practices',

states of mind, and sentiments. Some reviews only depict what individuals say they think and do, (Murphy, Gibson, Smith, & Clifton, 2005) sustains that the primary benefit of survey method is that it provide evidence on large individuals of people through a slight effort and at low cost.

Data from (JCCA) showed that there are 2,935 registered civil contractors under the first to fifth category, whereby 1,246 of them are registered as construction buildings contractors, according to (MPHW) the number of the residential construction projects in 2017 was 82 projects, each single project was supervised by MPHW depending on its available engineers, the rests were supervised by private sector consulting engineering companies, the clients were the Jordan government ministries.

Questionnaires were used as the primary data collection instrument in this study. Kumar defined a questionnaire as a form that is prepared and distributed in order to elicit responses.

RESULTS AND DISCUSSION

The study was conducted through survey method, data was collected through a total of 150 questionnaires, the survey achieved a 70% rate of return, the first objective of this study was to explore the most significant causes of variation order in Jordanian governmental construction projects, to achieve this objective, the study sought to establish who the origin agents of variation orders are and what aspects of variations exist in in Jordanian governmental residential projects.

The respondents were asked to evaluate every potential cause according to his/her experience evaluation, using following scale, 1: strongly disagree; 2: disagree; 3: neutral; 4: agree; 5: strongly agree, as illustrated in Table 1 it was possible to rank the causes of variation orders by way of the Relative Importance Index (RII), the ten most important causes of variation orders in Jordanian governmental residential projects were tabulated in table 1.

Table 1 the Most Important Causes of Variation Orders in Jordan

Question	RII	Rank
<i>Unskilled laborers, missing material specifications</i>	0.63	1
<i>Inaccurate quantity take-off</i>	0.62	2
<i>Shortage of human and equipment Resource</i>	0.60	3
<i>Change of scope or plans by owners</i>	0.596	4
<i>Absence of construction manuals and procedures</i>	0.593	5
<i>Unavailability of the required labor skills</i>	0.591	6
<i>Logistic delays</i>	0.59	7
<i>Shortage of equipment and tools</i>	0.585	8
<i>Technology changes</i>	0.582	9
Internal politics	0.57	10

The Required Labour Skill is Not Available

The construction manager starts the first stage in organized technique to minimize the possibility of delays and other issues. Shortage of manager who are specialized in construction may lead to unqualified workmanship and construction project delay (Aibinu & Odeyinka, 2006).

Inaccurate Quantity Take-off

According to correspondents, Inaccurate quantity take-off is one of the most important cause of variation, it was found to be the second, absence of experience in project location and form as well as local regulations may led to inaccurate cost estimation, this may go back to insufficient arrangement to the governmental employments, who used to be the owner (Sweis, 2013).

Human and Equipment Resource

Inglorious demolition and rework in construction projects could be a result of lack of workmanship (Aibinu & Odeyinka, 2006; Keane et al., 2010; O'Brien, 1998). (Oyewobi, Jimoh, Ganiyu, & Shittu, 2016). In retrospect, a critical look at the top ten most important factors causing variation in Jordanian governmental residential projects reveal that the majority of these factors are consultant related as illustrated in Table 2, this finding further reinforces the argument that the consultant is indeed the most predominant origin agent of variation in Jordanian governmental residential projects as it obvious in Figure 1.

Non-availability of Construction Manuals and Procedures

Non-availability of construction manuals and procedures ranked as the fifth most important cause of variation order in Jordanian governmental residential projects. The obvious design tends to be

understood more easily (Kolawole et al., 2016).

The Required Labour Skill is Not Available

The construction manager starts the first stage in organized technique to minimize the possibility of delays and other issues. Shortage of manager who are specialized in construction may lead to unqualified workmanship and construction project delay (Aibinu & Odeyinka, 2006).

Logistic Delays

As example of logistic delays is due to unexpected circumstances, it can generally be solved through construction industry experts (Keane, Sertyesilisik, & Ross, 2010), these conditions need to be solved impulsively, because it may cause an effective change in projects, finally, it will interrupt the work unpleasantly, reworks and delays may accrue in the project.

The Required Equipment and Tools are not available

Sometimes the absence of equipment may cause changes in design or in scheduling to adjust the additional time, lack of necessary equipment is a big problem and it may delay the completion of the project. (Ghodsypour & O'Brien, 1998).

Technology Change

Technology change was ranked as the ninth most important cause of variation order in Jordanian governmental residential projects. Changing technology is a possible reason to change in a project. (Arain & Pheng, 2006b).

Internal Politics

Changing roles by government through construction stage will result in many modification and justification in design, local government may have particular rules that must be included in the contract. (Arain & Pheng, 2005c).

Table 2 The Ten Most Important Causes of Variation and Their Origin Initiators.

<i>Variation Orders Causes</i>	Rank	Agent
<i>Unskilled laborers, missing material specifications</i>	1	<i>Contractor</i>
<i>Inaccurate quantity take-off</i>	2	<i>Consultant</i>
<i>Shortage of human and equipment Resource</i>	3	<i>Other</i>
<i>Change of scope or plans by owners</i>	4	<i>Other</i>
<i>Absence of construction manuals and procedures</i>	5	<i>Consultant</i>
<i>Unavailability of the required labor skills</i>	6	<i>Consultant</i>
<i>Logistic delays</i>	7	<i>Contractor</i>
<i>Shortage of equipment and tools</i>	8	<i>Consultant</i>
<i>Technology changes</i>	9	<i>Client</i>
<i>Internal politics</i>	10	<i>Client</i>

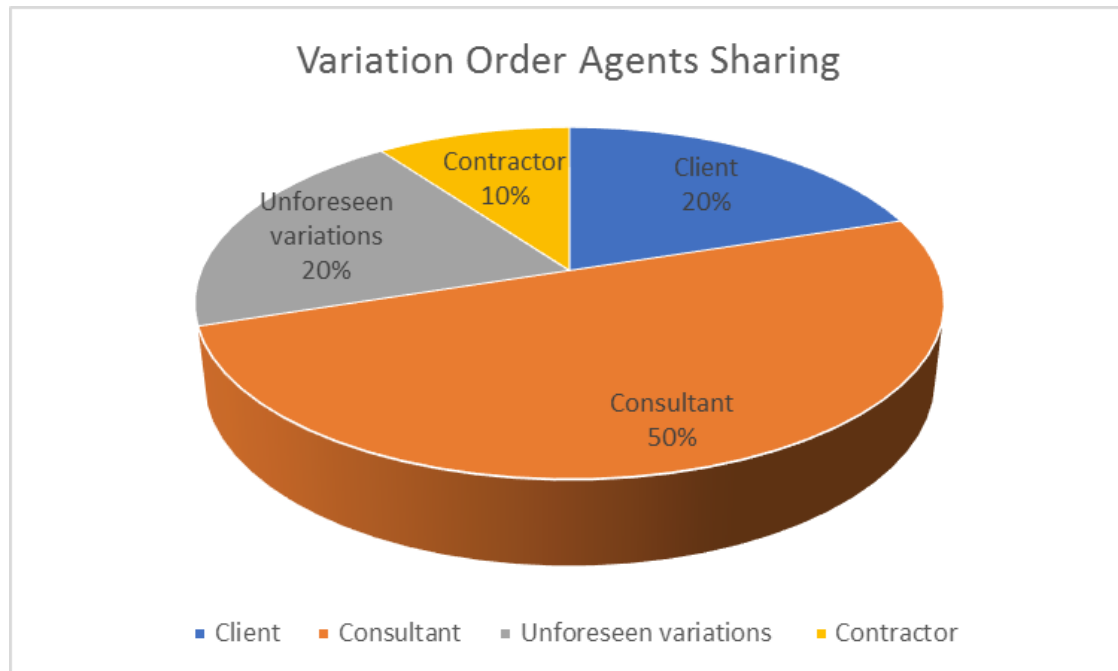


Figure 1 Variation Order Initiators Sharing.

REFERENCES

- Aibinu, A. A., & Odeyinka, H. A. (2006). Construction delays and their causative factors in Nigeria. *Journal of construction engineering and management*, 132(7), 667-677.
- Akinsola, A., Potts, K., Ndekugri, I., & Harris, F. (1997). Identification and evaluation of factors influencing variations on building projects. *International Journal of Project Management*, 15(4), 263-267.
- Al-Momani, A. H. (1996). Construction cost prediction for public school buildings in Jordan. *Construction Management & Economics*, 14(4), 311-317.
- Arain, F. M., & Pheng, L. S. (2005a). How design consultants perceive potential causes of variation orders for institutional buildings in Singapore. *Architectural engineering and design management*, 1(3), 181-196.
- Arain, F. M., & Pheng, L. S. (2005b). The potential effects of variation orders on institutional building projects. *Facilities*.
- Arain, F. M., & Pheng, L. S. (2007). Modeling for management of variations in building projects. *Engineering, Construction and Architectural Management*.
- Ashton-James, C. E., & Ashkanasy, N. M. (2008). *Affective events theory: A strategic perspective Emotions, ethics and decision-making*: Emerald Group Publishing Limited.
- Ghodsypour, S. H., & O'Brien, C. (1998). A decision support system for supplier selection using an integrated analytic hierarchy process and linear programming. *International journal of production economics*, 56, 199-212.
- Hanna, A. S., Russell, J. S., Nordheim, E. V., & Bruggink, M. J. (1999). Impact of change orders on labor efficiency for electrical construction. *Journal of construction engineering and management*, 125(4), 224-232.
- Hira, T. K., & Mugenda, O. M. (1999). The relationships between self-worth and financial beliefs, behavior, and satisfaction. *Journal of family and consumer sciences*, 91(4), 76.
- Hwang, B.-G., & Low, L. K. (2012). Construction project change management in Singapore: Status, importance and impact. *International Journal of Project Management*, 30(7), 817-826.
- Ibbs, C. W., Wong, C. K., & Kwak, Y. H. (2001). Project change management system. *Journal of management in engineering*, 17(3), 159-165.
- Ibbs, W. (2005). Impact of change's timing on labor productivity. *Journal of construction engineering and management*, 131(11), 1219-1223.
- Keane, P., Sertyesilisik, B., & Ross, A. D. (2010). Variations and change orders on construction projects. *Journal of legal affairs and dispute resolution in engineering and construction*, 2(2), 89-96.
- Kumar, R., Luthra, A., & Datta, G. (2006). Linkages between brand personality and brand loyalty: a qualitative study in an emerging market in the Indian context. *South Asian Journal of Management*, 13(2), 11.
- Murphy, V., Gibson, P., Smith, R., & Clifton, V. (2005). Asthma during pregnancy: mechanisms and treatment implications. *European Respiratory Journal*, 25(4), 731-750.

- Musa, M. M., Birma, A. I., & Ibrahim, I. I. (2021). Impacts of change management practices on construction project performance in Bauchi State, Nigeria. *Journal of Construction Project Management and Innovation*, 11(2), 36-48.
- O'Keane, V. (2017). Submission to the Joint Committee on the 8th Amendment of the Constitution. *depression*, 1(4).
- Oloo, D., Munala, G., & Githae, W. (2014). Factors contributing to variation orders: A survey of civil engineering construction projects in Kenya. *International Journal of Social Sciences and Entrepreneurship*, 1(12), 696-709.
- Oyewobi, L. O., Jimoh, R., Ganiyu, B. O., & Shittu, A. A. (2016). Analysis of causes and impact of variation order on educational building projects. *Journal of Facilities Management*.
- Stocks, S. N., & Singh, A. (1999). Studies on the impact of functional analysis concept design on reduction in change orders. *Construction Management & Economics*, 17(3), 251-267.
- Sunday, O. A. (2010). Impact of variation orders on public construction projects. Paper presented at the 26th Annual ARCOM Conference, Leeds, UK.
- Sweis, G. J. (2013). Factors affecting time overruns in public construction projects: The case of Jordan. *International journal of business and management*, 8(23), 120.
- Yogeswaran, K., Kumaraswamy, M. M., & Miller, D. R. (1998). Claims for extensions of time in civil engineering projects. *Construction Management & Economics*, 16(3), 283-293.
- Zeitoun, A. A., & Oberlender, G. D. (1993). Early warning signs of project changes (Vol. 91): *Construction Industry Institute*.