

# e-Proceeding

# V-GO GREEN 2020<sup>29-30</sup> SEPT

VIRTUAL GO-GREEN: **CONFERENCE & PUBLICATION**

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**Publication Date : 22<sup>nd</sup> February 2021**

## Virtual Go-Green Conference and Publication 2020

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February 2021

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e ISBN 978-967-2920-06-9



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# FACTORS CAUSING VARIATION ORDERS OF MOSQUE CONSTRUCTION IN PERAK, MALAYSIA: A CASE STUDY

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## Abstract

Variation order is a formal document used for any form of amendment during construction on an agreed-upon, well-defined scope or schedule of works. Variations are mostly inevitable despite leading to dispute among stakeholders, affecting labour's productivity and consume time and cost. Variation order was treated variedly according to the conditions of the contract of the particular construction. This study focused on mosque projects as per Public Work Department condition of contract which is Public Work Department Form of Contract PWD203a 2010 with quantity and Public Work Department Form of Contract PWD203 2010 with drawings and specifications. Both of the articles of agreement partake different approaches on variation order calculation specifically on the cost incurred. This paper aims to identify the variation order factors of mosque construction in Perak and identify the contributors that caused variation orders of mosque constructions in Perak, Malaysia. This research employs document analysis and a total of 10 projects have been analysed.

**Keywords:** *amendment; construction; project; variations; variation order*

## 1.0 INTRODUCTION

The construction industry is loaded with complexity and complication. Most authors agreed that practically all projects, either big or small, will always avert from its original plan and design. Memon (2014) asserted that all types of construction are never absent from variation, highlighting how standard the process is (Memon et al., 2014). Muhammad also emphasized that the complex nature of construction will always eventually lead to variations (Muhammad et al., 2015). Klee (2018) stressed that there is no perfectly prepared, drafted, designed and engineered large project that could deflect from variations (Klee, 2018). Variations cost in the United States alone was estimated around 13-26 billion dollars per year (Memon et al., 2014). One of the significant contributors to sick projects in Nigeria, as claimed by Muhammad (2015) is the variation (Muhammad et al., 2015). Malaysia showed variations had taken tolls leading to sick and abandoned projects (Memon et al., 2014).

Variations are often perceived in a pessimistic light as presumably resulted in cost increment. Still, stakeholders should be able to solve the changes as the contract agreement, thus further confirming the inevitable nature of variations (Klee, 2018). Hence, to achieve the project's victory, it is essential that a well-drafted variation clauses were emphasized during inception (Klee, 2018). Variation order could either be beneficial or detrimental (Muhammad et al., 2015). According to Mohammad et al. (2010), a variation order is beneficial when the order causes cost reduction, standard quality improvement, schedule reduction or degree of difficulty reduction. In contrast, a variation is detrimental when it causes increment to the client's budget or decrease in project performance (Mohammad et al., 2010). Nevertheless, the effects of variations highlighted by Muhammad (2015) are delayed payment, delay in completion, additional overhead, cost overrun, rework, low productivity, additional payment to the contractor, delayed logistics, disruption of the progress of work, affects the integrity of the firm, time overrun, incidence of building failure, source of corruption, affect project performance and abandonment of project (Muhammad et al., 2015).

Although variation is often viewed negatively, the function of variation in a contract cannot be denied as it empowers architects or the client's proxy to instruct changes should there be any changes required to the project (Obagboye et al., 2019). The absence of variation clause in a contract would hinder any changes to the project outside of the original contract scope; thus variation clause seeks to bring flexibility to both parties (Obagboye et al., 2019).

This research seeks to:-

1. To identify the variation order factors for the constructions of mosques in Perak
2. To identify the contributors of variation orders for the constructions of mosques in Perak

## 2.0 LITERATURE REVIEW

The term variation is widely interpreted across literature, but all are carrying the same meaning more or less. Arain and Pheng (2005) defines variation as:-

"Any deviation from an agreed well-defined scope and schedule. Stated differently, this is a change in any modification to the contractual guidance provided to the contractor by the owner or owner's representative. This includes changes to plans, specifications or any other contract documents" (Arain & Pheng, 2005).

Whereas variation order as defined by Fisk (1997) and O'Brien (1998) is:-

"The formal document that is used to modify the original contractual agreement and becomes part of the project's documents" (Fisk, 1997; O'Brien, 1998).

Conclusively, a variation order is issued upon variation to the contracted work, which includes adding or omitting work or changing the quality or character of the material or the order of work. Numerous authors had identified different factors of variation orders. The factors were attributed to clients, consultants, contractors and others. A study by Wu et al. (2005) reported that there were 1038 variation orders authorized for a highway construction project in Taiwan, and it was revealed that one of the significant factors of variation order of the project is design changes resulted from civilian complaints and geological conditions (Wu et al., 2005). Another study by Arain & Pheng (2006) established 53 factors of variation orders in institutional buildings in Singapore whereby the significant factors were identified as errors and omission in design, change in specification by both owner and consultant, design differences, change and design that did not comply with regulations (Arain & Pheng, 2006). Other than that, a survey by Ismail et al. (2012) disclosed that the most significant cause of variation order is a change of scope by owner followed by errors and omissions, differing site conditions and contractor's financial difficulty (Ismail et al., 2012). However, a study by Memon (2014) had concluded that the most severe factor that affects time and cost performance is a schedule change (Memon et al., 2014). Mohammad (2019) establish top five (5) key factors of variation order which are changes in the scope of the work by the client, exchange of construction materials by the client, specification changes by the client, changes in building design by the consultant and discrepancies between the contract documents and drawings (Mohammad et al., 2017).

It was accepted that although most researchers had identified the causes of variation orders, the significant factor identified by each author differs from one another depending on the nature of the project, site, stakeholders and many other internal and external influences.

## 3.0 RESEARCH METHODOLOGY

This research adopted a qualitative method of case study and document review. The analysis was carried out by examining the final account of ten (10) mosques in Perak including variation order approval documents, monthly progress reports, design reports, project completion reports, exchange correspondence between clients, consultants, contractors, third-parties as well as various meetings recorded in the form of minutes of a meeting which indicated the causes and effects of variations on projects.

## 4.0 FINDINGS AND ANALYSIS

### 4.1 Factors of Variation Order of Mosque Construction in Perak

Through document reviewing of ten (10) mosques in Perak, fourteen (14) factors of variation order related to the project were tabulated in Table 1.

**Table 1. Frequency of variation order factors**

No.	Variation orders / Mosque	Layang Kiri	Klian Intan	Bandar Universiti	Al-Ikhwan Slim River	Ijok Perak	Menglembu	Lekir	Bukit Chupak	Halaman Meru	Padang Changkat
1	Changes of scope	√	√	√	√	√	√	√	√	√	√
2	Changes of schedule	√	√	√	√	√	√	√	√	√	√
3	Impediment to prompt decision-making process			√	√	√	√			√	√
4	Change in specifications	√	√	√	√	√	√		√	√	√
5	Inadequate design								√		
6	Change in design by consultant			√	√		√	√	√	√	√
7	Errors and omissions in design			√							
8	Poor procurement process			√							
9	Conflicts among contract documents		√						√		
10	Value engineering			√	√						
11	Lack of coordination	√							√		√
12	Design complexity			√				√			
13	Inadequate working drawing details			√					√		
14	Poor knowledge of available materials and equipment							√			

Although there are more than 15 variation order factors recorded in the literature review, some variation order factors were not significant to the mosque construction as per contract. Mosque construction falls under the jurisdiction of the government. Thus, the contract basis is the Public Work Department Form of Contract PWD203a 2010 with quantity and Public Work Department Form of Contract PWD203 2010 with drawings and specifications. Elaborated further is the variation order factors along with the relations to mosque construction.

According to Keane (2010), change of scope is the most significant contributor to variations (Keane et al., 2010). Change of scope refers to addition or omission of the original scope of works as per contract, which would either increase or decrease the contract amount. This situation often occurred in mosque construction due to requests from the end-user such as additional space for dining or cooking, additional fixtures such as a chandelier, furniture, CCTV and air-conditioning system.

Change of schedule as stated by Memon (2014) may cause significant reallocation resources whereby contractors would have to keep resources on hold or increase resources but either way both resulted in cost incurring (Memon et al., 2014). In some cases, the handling of several works on-site as opposed to plan would affect the contractor's cost.

Prompt decision making is an essential factor for a successful project. Delay in decision making during mosque construction often occurred during the stage of material approval as the selection process often took longer than expected. Keane (2010) addressed that failure to decide efficiently would cost time and money (Keane et al., 2010).

Change in the specification refers to the change of the quality of the product which happens during the construction phase and generally due to the Authority's requirement, site condition, or non-approved SIRIM product. In some circumstances mosque construction's specifications were upgraded when there is an extra budget that comes from the donation and this includes additional air-conditioning, other interior or exterior works or increasing the

thickness of carpet. Change in design currently in mosque construction due to requirements by the Local Authority such as numbers of car parks, sewerage system and due to site condition.

Inadequate design, as claimed by Memon (2014), is the most frequent cause of variations (Memon et al., 2014). Due to time constraint during the pre-contract stage as well as insufficient detail drawings provided to the quantity surveyor, some items in the bill of quantities were not fully described as per final drawing by the consultants. This situation creates a gap to the real and expected cost, which eventually resulted in variations.

Arain & Pheng (2005) had identified a change in design by the consultant as one of the significant roots to variation order (Arain & Pheng, 2005). Change in design occurred during the construction phase to accommodate the unforeseeable condition.

Design errors presumably caused additional cost meanwhile omission could reduce the cost of the project. Arain & Pheng (2006) which studied 53 factors that caused variation orders in institutional buildings in Singapore had reported that one of the significant causes of variation is errors and omissions in design (Arain & Pheng, 2006).

According to Ndiokubwayo (2008), one type of procurement method may result in more variation orders than another (Ndiokubwayo, 2008). Some mosque construction procurement adopts design and builds a contract which provides a very general description of the project. This left consultants with the responsibility to design and build the mosque not knowing the exact need of the client resulting in a series of changes throughout the project commencement. Therefore, an imperfect procurement process leads to many variations in the project.

One of the critical factors to variation order as insisted by Muhammad et al (2015) is conflicts among contract documents (Muhammad et al., 2015). It is ideal for an architect to specify the materials in drawing at design stage to ensure the price is synchronized throughout the construction.

Value engineering is a method to optimize cost by team brainstorming consisting of project stakeholders. In mosque construction, consultants would advise on changing items or materials to minimize cost without affecting the building performance. Mohammad & Hamzah (2019) insisted that ideal value engineering should be conducted during the design stage for optimum impact (Mohammad & Hamzah, 2019).

One of the significant causes of variation order to construction projects in Gaza Strip is lack of coordination among stakeholders (Mahamid, 2017). In mosque construction, project delay could be caused by lack of planning and communication among contractor and sub-contractor.

Mosque construction, specifically in Malaysia, is complex and cross-dimensional, resulting from the overlapping design's background of Arabic, Malay, Indonesian, and Chinese (Megat et al., 2016). Undertaking mosque construction requires high skill in craft to complete a delicate task such as arch, Islamic patterns, decorative timber facial board, mihrab wall, etc. Often mosque construction design approaches that utilize decorative glass reinforced concrete (GRC) panels are faced with increasing construction cost and variation order due to additional items as per manufacturer's requirement for installation. Some mosques that utilized Turkish-style dome or double-layer dome also faced variation order due to execution difficulty.

For a project to be successfully conveyed, the drawing should be clear and concise; otherwise, it will result in misinterpretation and eventually variations (Keane et al., 2010). Some of the mosque construction was given additional detail drawing which increased project cost. Therefore, a complete detailed drawing should be provided beforehand to the QS so that a precise bill of quantities can be provided.

Keane et al. (2010) elaborated that if a consultant does not possess adequate knowledge on available materials and equipment, the project would likely face variation in the later stage of construction due to changes in the mentioned segment. Therefore, it is important that the consultant to have relevant knowledge in materials and equipment to ensure the contract is priced appropriately.



#### 4.2 Parties Contributed to Variation Order of Mosque Construction in Perak

The frequency of variation order factors was tabulated below. Based on the table, it can be observed that most variation order factors came from clients and consultants. This is because the condition of contract for PWD Form 203A clearly stated that for a variation order taking place, it must be authorized by a Superintending Officer (SO) acting as client's agent. On the other hand, the contractor's contribution in variation order was derived from the change of schedule.

**Table 2. Frequency of variation order factors**

No	Factors of Variation Order	Client	Consultant			Contractor	Others
			Architect	Mechanical & Electrical	Quantity Surveyor		
1	Changes of scope	5					
2	Changes of schedule	5				5	
3	Impediment to prompt decision-making process						
4	Change in specifications	5					2
5	Inadequate design						
6	Change in design by consultant						
7	Errors and omissions in design	3	5		1		
8	Poor procurement process	1					
9	Conflicts among contract documents				2		
10	Value engineering	2		2			
11	Lack of coordination	2			4		4
12	Design complexity		2		3		5
13	Inadequate working drawing details	2					
14	Poor knowledge of available materials and equipment		1				2
Total of variation order		25	8	2	10	5	13

#### 5.0 CONCLUSION AND RECOMMENDATIONS

Most variation orders of mosque construction in Perak came from clients and consultants. It can be summarized that most literature only focus on the factors, causes and effects of variation order while dismissing the solution-oriented outcomes which are more important given the current urgency of and demanding nature of the construction industry. Therefore, it is highly recommended that in-depth research can be carried out in the future to formulate a

comprehensive framework that could help reduce variation order and increase project performance from all aspects.

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