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**Department of Built Environment Studies & Technology (JABT),
Faculty of Architecture, Planning & Surveying (FSPU)**

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The Impact of Variation Orders on the Cost of Mosque Construction Projects in Perak, Malaysia: A Case Study

**Mohd Nazri Abdullah, Syed Haris Syed Mustapa, Zaiwanizar Zainal Abidin,
Mohammad Nasharudine Shuib, Mohd Esham Mamat**

*Department of Quantity Surveying, Faculty of Architecture, Planning and Surveying, Universiti
Teknologi Mara, Perak Branch, Seri Iskandar Campus, Seri Iskandar, 32610 Perak, Malaysia*

Abstract

This research investigates the impact on costing from variation order of ten (10) mosques in Perak, Malaysia derived from different stakeholders. Variation order were treated variedly according to the conditions of contract of the particular construction. This study focused on mosque project in Perak 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 article of agreement partakes different approach on variation order calculation specifically on cost incurred. This paper aims to analyze variation order towards the costing of mosque construction in Perak, Malaysia and identify the cost distribution among the stakeholders of the mosque constructions in Perak, Malaysia. Employing analytical research that adopted qualitative method of case study and document review, a total of 10 mosques were analysed in Perak, Malaysia. From the study, it was revealed that the total variation order cost for the ten (10) mosque is RM417,479.79. Some variations are either beneficial or detrimental to the overall contract sum. The order of ranks of stakeholders contributing to variation order cost starting from the highest contributor to the lowest contributor are civil engineering, mechanical and electrical engineering, client, architect, contractor, quantity surveyor and lastly government authorities.

Keywords: *Construction; Cost; Project; Variations; Variation order;*

1.0 Introduction

The economic growth in Malaysia is largely forged by the construction sector. Khan (2014) affirmed that the construction sector played a pivotal role in Malaysia's economy which encompasses revenue generation, capital formation and employment creation that contribute towards the gross domestic product (GDP) and the socio-economic development of Malaysia (Khan et al., 2014). Hence, the need for continuous discussion around construction sector is contemporary considering the everlasting complexity of construction industry. A considerable number of authors agreed that practically all projects either big or small will always avert from its original plan and design. Albeit various studies done on variation orders, the occurrences in construction projects are beyond common (Smith, 2016)

Memon (2014) also asserted that all types of construction is never absent from variation (Memon et al., 2014). The complex nature of construction will always eventually lead to variations (Muhammad et al., 2015). Apparently, no perfectly prepared, drafted, designed and engineered large project could deflect from variations (Klee, 2018). In fact, variations cost in United States alone were estimated to be around 13-26 billion dollars per year (Memon et al., 2014). One of the significant contributor to sick projects in Nigeria as claimed by Muhammad (2015) is variation (Muhammad et al., 2015). Evidently, Malaysia showed variations had taken a toll which lead to sick and abandoned projects (Memon et al., 2014).

The occurrence of variation order could result in domino effect that sets off a chain reaction resulting in unnecessary costs accrue that impact on the overall project cost (Pokharel & Joshi, 2020).

Nevertheless, variations are often perceived in a negative light presumably resulting in cost increment (Klee, 2018). Hence, to achieve project's victory, it is essential that 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, quality standard improvement, schedule reduction or degree of difficulty reduction whereas 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 contractor, delayed logistics, disruption of progress of work, affects 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 therefore seeks to complete the following: -

1. To identify the cost of variation order for the constructions of mosques in Perak
2. To identify the cost distribution among the stakeholders of constructions of mosques in Perak

This research particularly choose mosque construction in Malaysia because it had undergone an extensive period of changes from traditional, colonial, post-independence to modern (Sojak et al., 2019). On top that, mosques design is strongly infused by the multi-layered socio-cultural, geo-political, and economic influences of different country and race which results in various design and façade (Shah et al., 2014). Thus, these differences lead to various type of variation order and variation costs. The state of Perak has the third highest number of mosque in Malaysia with Muslim population of approximately 50-59% (Rahim et al., 2015; Shafaei & Mohamed, 2015).

2.0 Literature Review

The term variation is widely interpreted across literatures but all 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).

Fisk (1997) and O'Brien (1998) identified variation as: -

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

Whereas Pokharel & Joshi (2020) defined variation order as: -

"Variation orders involve additions, omissions, alterations and substitutions in terms of quality, quantity and schedule of works" (Pokharel & Joshi, 2020)

Conclusively, a variation order is issued upon amendment, modification and changes to the contracted work which include adding or omitting work or changing the quality or character of material or the order of work.

2.1 Types of Variation Order

Variation order can either increase or decrease the construction costs. There are two types of variation order as suggested by numerous authors which is beneficial and detrimental variation order: -

Beneficial Variation Order

According Arain & Pheng (2005), beneficial variation order are changes or modification that are advantageous to the project particularly the clients which would help in reducing the costs, schedule, degree of difficulty or help in improving the quality of the project (Arain & Pheng, 2005). Mustapha (2018) added that beneficial variation order is initiated for value analysis purposes to achieve the balance between functionality, cost and quality of the project whilst considering client's satisfaction (Mustapha et al., 2018). It also aimed to improve the project as well as determining and removing unnecessary budgets that has no purpose in terms of function, aesthetic, life or quality (Mustapha et al.,

2018). All in all, beneficial variations seeks the optimization of client's needs and removing unnecessary costs. (Mustapha et al., 2018)

Detrimental Variation Order

Arain & Pheng asserted that detrimental variation order refers to the changes and modifications that decrease the owner's value by increasing the project costs or giving adverse impact on the construction project (Arain & Pheng, 2005). Hence, a detrimental variation order jeopardize with the client's value by instigating more costs or substitution of low quality materials which could lead to an increase in maintenance cost (Mustapha et al., 2018).

2.2 Factors of Variation Order

Numerous authors had identified different factors of variation orders. The factors were attributed to clients, consultants, contractors and others. Among factors of variation order were listed as follows:-

Change of Scope

Although the reasons of variation order can be implicated by many factors but most variation order were attributed to change of scope (Smith, 2016). Change of scope refers to the addition or omission of original scope of works as per contract which would either increase or decrease the contract amount.

Change of Schedule

Change of schedule as stated by Memon (2014) may cause major reallocation resources whereby contractor would have to keep resources on hold or increase resources but either way will result in incurring costs (Memon et al., 2014).

Prompt Decision Making

Prompt decision making is an important 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 Specification

Study showed that changes in specifications initiated typically by clients were the most predominant causes of variation order. Change in specification refers to the change of the quality of product which happen during construction phase and normally due to Authority's requirement, site condition, or non-approved SIRIM product.

Inadequate design

Inadequate design as claimed by Memon (2014) is the most frequent cause of variations (Memon et al., 2014). Due to time constraint during 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 create gap to the real and expected cost which eventually resulted in amendments.

Change in Design by Consultant

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

Design Errors

Design errors presumably caused additional cost meanwhile omission could reduce the cost of 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).

Poor Procurement Process

According to Ndiokubwayo (2008) one type of procurement method may result in more variation orders than another (Ndiokubwayo, 2008). Some mosque construction procurement adopt design and build contract which provide very general description of the project. This left consultants with the responsibility to design and build the mosque not knowing the detailed needs

of the client resulting in a series of changes throughout the project commencement. Therefore, poor procurement process lead to many amendments in a project.

Conflicts among Contract Documents

One of the key 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 the design stage to ensure the price is synchronized throughout the construction.

Value Engineering

Value engineering is a method to optimize cost by team brainstorming among project stakeholders. Mohammad & Hamzah (2019) insisted that an ideal value engineering should be conducted during design stage for optimum impact (Mohammad & Hamzah, 2019).

Lack of Coordination among Stakeholders

One of the significant cause 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.

Design Complexity

Mosque construction specifically in Malaysia is complex and cross-dimensional resulted from the overlapping designs background of Arabic, Malay, Indonesian, and Chinese (Megat et al., 2016). Undertaking mosque construction requires high skill in workmanship to complete fine task such as arch, Islamic patterns, decorative timber facial board, mihrab wall and other intricate details atypical to mosque architecture.

Inadequate Working Drawing Details

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).

Poor Knowledge of Available Materials and Equipment

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 (Keane et al., 2010).

3.0 Research Methodology

This research is analytical research that adopted qualitative method of case study and document reviewing. The research was carried out by directly 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 meeting which indicated the impact of variation order on cost as well as stakeholders involved.

4.0 Findings and Analysis

4.1 Cost of Variation Order of Mosque Construction in Perak, Malaysia

Table 1 shows the cost of variation order of ten (10) mosques in Perak, Malaysia. The variation orders documented from each mosque construction in Perak, Malaysia were either significant or insignificant to the contract sum. Mosque 1, 3 and 6 showed less than 2% additional cost due to variation order whereas Mosque 2, 5, 7, 8 and 9 recorded 2% to as high as 7.49% of variation order cost. It was also noted that mosque 4 and 10 had a decrease in variation order cost which is 0.76% and 0.84% respectively.

Table 1. Cost of Variation Order of Mosque Construction in Perak, Malaysia in Ringgit Malaysia (RM)

Mosque	1	2	3	4	5	6	7	8	9	10
Contract Sum (RM)	2,114,901	1,160,664	3,919,582	7,153,018	1,481,644	1,777,776	3,355,000	1,677,538	2,196,690	1,720,252
Variation Cost	23,049.40	30,292.00	59,146.93	(54,226.80)	74,104.55	33,442.54	76,381.85	125,676.82	63,983.00	(14,370.50)
Percentage (%) of Variation	1.09	2.61	1.51	(0.76)	5.00	1.88	2.28	7.49	2.91	(0.84)

4.2 Parties Contributed to Variation Order of Mosque Construction in Perak

The cost of variation order of mosque construction in Perak, Malaysia were tabulated in Table 2. Based on the table, it can be observed that the total variation order cost for the ten (10) mosque is RM417,479.79. Some variations are either beneficial or detrimental to the overall contract sum.

Evidently, there are significant variation cost deduction contrived by quantity surveyors and government authorities. The most significant variation cost omission was caused by government authority which amounted to a hefty RM 253,454.54. The substantial variation order omission is due to the abolishment of Government Services Tax (GST) 6% on 31st May 2018 which resulted in the variation order omission of several mosques in Perak, Malaysia. Government authority also contribute to variation order costs such as contribution fees for Tenaga Nasional Behad (TNB), Indah Water Konsortium (IWK) and Jabatan Pengairan & Saliran (JPS). This occurred due to conditions of contract for PWD Form 203A clearly stated that for a variation order to take place, it must be authorized by a Superintending Officer (SO) acting as the client’s agent. On the other hand, contractor’s contribution in variation order were derived from change of schedules.

Another party contributing to the variation order cost omission is quantity surveyor whereby they had omitted a trifling amount of RM 49,054.00 from the total contract sum of the ten mosques in Perak, Malaysia. By examining the minute of meetings, it was revealed that the omission is due to lack of quality in documentation including missing items in bills of quantity and inconsistency of descriptions in drawings as compared to quantity counted.

It can also be observed from Table 2 that the contractor had omitted a small amount of variation order for mosque 8 amounted to RM 2,854.42. As stated in the conditions of contract, the contractor has no authority to add or omit the scope of works without client’s consent, but in the case of mosque 8, a mistake by the contractor during construction such as failing to execute the said construction with materials approved by client had caused variation order omission.

Further observation indicated that most variation order cost come from the civil engineering consultant amounting to RM393,871.91 due to the changes of design structure and infrastructure as well as site condition associated with weakness of soil strata. It can also be observed that nearly all mosques except for Mosque 1 had undergone variation order ensued by civil engineering consultant. The second contributor of cost of variation order is mechanical & electrical engineering consultant which is RM195,470.53. The variation order was prompted after employing a lump sum bill of quantity provided whereby most items are not structured and improper. The third place comes from client which amounted to RM 91,582.26. Unequivocally, clients are authorized to add or omit any scope of works in any constructions. In the case of mosques constructions in Perak, Malaysia, the clients which are the mosques committees play a substantial role in contributing to the additional cost for mosques construction by changing the agreed specifications of the mosque construction including the dome, carpet, roof and so forth. Followed by architect with RM 51,918.26 variation order cost, this study revealed that the scope of variation order of architect often corresponded with the design changes for more aesthetically pleasing and well functioned buildings.

Table 2. Cost of Variation Order of Mosque Construction in Perak, Malaysia by Stakeholders in Ringgit Malaysia (RM)

Mosque	Client	Consultant				Contractor	Government Authority	Total
		Architect	Mechanical & Electrical	Civil	Quantity Surveyor			
1	-	5,300.00	-	-	-	-	17,749.40	
2	-	-	-	20,292.00	10,000.00	-	-	
3	-	17,710.00	31,920.00	11,471.70	-	-	-1,954.77	
4	-	32,460.00	126,840.00	(4,287.00)	-	-	(209,239.80)	
5	105,345.20	12,246.00	-	40,380.00	-	-	(83,866.65)	
6	26,092.00	9,973.26	2,955.00	43,266.00	(48,815.00)	-	(28.72)	
7	(143,209.15)	(35,817.00)	-	255,408.00	-	-	-	
8	149,094.00	-	(16,960.00)	(1,563.76)	(6,739.00)	(2,854.42)	4,700.00	
9	(14,640.00)	-	50,715.53	31,407.47	(3,500.00)	-	-	
10	(31,100.00)	10,046.00	-	(2,502.50)	-	-	9,186.00	
Total	91,582.05	51,918.26	195,470.53	393,871.91	(49,054.00)	(2,854.42)	(253,454.54)	

5.0 Conclusion and Recommendations

Altogether, the study revealed that the total variation order cost for the ten (10) mosque is RM417,479.79. The variations can also be distinguished into either beneficial and detrimental to the overall contract sum. Three stakeholders contribute to beneficial variation order that cuts down expenses although some occurred unintentionally such as the blunder made by the contractor and quantity surveyors. On the other hand, the exclusion of the Government Services Tax (GST) 6% on 31st May 2018 which resulted in the variation order omission of several mosques in Perak, Malaysia was a fortunate event that reduce the cost substantially.

There are also detrimental variation order costs incurred which were derived by consultants including civil engineering consultant, mechanical and electrical engineering consultant and architect and also clients. These detrimental variations were either caused by design changes, practice of lump sum bills of quantities and changes in specification particularly by clients. The order of ranks of stakeholders contributing to variation order cost starting from the highest contributor to the lowest contributor are civil engineering consultant, mechanical and electrical engineering consultant, client, architect, contractor, quantity surveyor and finally government authorities. The amount of variation order reflects how well the fund given by federal government being managed by the local government.

As a recommendation, an in-depth research should be carried out in the future to formulate a comprehensive framework or formula to reduce variation order, eliminate unnecessary costs, increase project performance as well as optimizing the clients value.

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Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak



Tuan,

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Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

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Timbalan Ketua Pustakawan

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Setuju.

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