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LIABILITIES OF DESIGNER TOWARDS VARIATION COST IN COMMERCIAL BUILDINGS IN KUCHING, SARAWAK

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Abstract:
Variation order is inevitable in construction industry.There are various reasons contributing to the issuance of instruction requiring for variations. Among the reasons for variations is changes of reuirement from the client. This research is looking into the reasons caused by designers. The contention is that the client may have to incur unnecessary extra cost to complete the building due to the mistakes in design by the said designers. This research aims to determine the liability of designer towards variation cost in commercial buildings in Kuching, Sarawak. The specific objectives of this research are to investigate the common causes of variation orders by designers and to determine the liability of designers towards variation order. A questionnaire was sent to 89 respondents in Kuching, which comprise of consultant, contractor and client. Results shows that the top three (3) causes of variation order in the consultant's and contractor's perspectives are drawing modification, change in specification errrors and omission in design. All of these reasons were supported by court cases, in which it has been decided by the court that in the event of negligence on the part of the designers that subsequently causes the client to suffer losses, the designers may be held liable. From the client's perspective, drawing modification, conflicts between contract document and errors and omission in design were the main reasons for variation. As for the consequences, the clients is due to lack of information gave to designers, they had to develop design base on their perception.It can be concluded that none of the construction can be 100% completed according to the design or scope of work that has been agreed in the contract.

Keywords: Designers;Variation Order;Consultants;Liability

1.0 INTRODUCTION

According to Abdel Rashid (2012) as cited by Albhaisi et al., 2016, construction project is the most commonly affected or influenced by variations. Moselhi et al. (2005), as cited by Albhaisi et al. (2016). mentioned that it could be an advantage to a project if there are effective patterns that would satisfy the needs of the owners during the project delivery process. On the other hand, it would be a drawback if there is absence of acknowledgement and insufficient understanding on the impact on project performance

Based on Mohammad et al. (2010) findings, changes in design by consultant is at the third rank with 30% behind substitution of material by client with 47% and change of plan by client with 65%. The 30% coming from the consultant is design changes that were caused by contradiction of opinion and suspended work such as utility services that involved redesign by the engineer. Meanwhile, 37% of errors and omission in design by consultant was said to be unimportant contributory to design changes. Furthermore, Burati et al. (1992), as cited by Mohammad et al. (2010), mentioned that design changes constitute to 52.5% of total changes which is caused by the improvement through design process effecting from design appraisals, design changes by owner and design changes by engineer or consultant such as addition of instrumentation that affects the operation of the facility. On top of that, Albhaisi et al. (2016) mentioned that conflicts between designers and contractors contribute to poor planning of design, design documents inaccuracies, high build cost of design options, delay in supplying drawings and unreasonable design fees.

Therefore, should there be any incompliance of designers towards their duty, they can be claimed for negligence for breach of standard of care, duty and causation damage. According to Schenk et al. (2010), design changes falls under economic loss. Economic loss refers to non physical damage or bodily injured to the property of the injured party. Thus this research looks forward to address the issue of liability of the designers for the variation that they caused. Common causes and effects of variation order by designers are investigated. The legal view for the liability of the designers is scrutinized. The results are presented in this article.

2.0 LITERATURE REVIEW

2.1 Variation Order

Persatuan Arkitek Malaysia 2006 (PAM 2006) Form stated that the term variation means alteration or modification of the design, quality or quantity of the works including the addition, omission or substitution work, alteration of materials, removal form site of any work executed and any changes to the provision in the contract with regards to any limitation of working hours, working space, access to or utilization of any specific part of the site and the executive and completion of the work in any specific order.

2.1.1 Concept of Variation Order

Arain and Pheng (2005), (as cited by Mohamad et al, 2010) classify variation to two categories, which are beneficial and detrimental variation. It was found that variation might be initiated from three parties, which are clients, contractor and consultants (Mhando, Mlinga, & Alinaitwe, 2017). Acharya et al. (2006) as cited by Alnuaimi et al. (2009) states that variation order ranked on the third from the list to cause dispute in construction in Korea. Variation could happen in any kind of procurement methods. The only difference is between the levels of consequences that they have to bear since each of the procurements has different concepts.

2.1.2 Provision of Variation in PAM 2006

This research focuses on commercial building. In commercial contracts, most commonly used SFOC is PAM FOC (Sundra Rajoo, 2006). The contracting practitioners have to obey the variation provision in the standard form of contract regarding any dispute in variation. According to Alsuliman et al. (2012),variation is an unwanted situation in a project but with stand by defence in the contract condition. The presence of variation provision in the standard form of contract indicates that change order has become a part of the project. This automatically implies that no project can be completed without vicissitudes.

2.1.3 Common Causes and Consequences of Variations

There are various causes of variations. In addition, variations may be caused by the client, contractor and consultant. This research focuses on the liability of the designers and thus, the literature search focuses on how designers may cause variations. The literature review shows that there are 19 common causes of variations by designers. It is shown in Table 1. As consequences of the variations are caused by designers, the literature also found several consequences as compiled in Table 2.

Table 1: Common causes of variation order

No	Factors	Almaimi et al (2009)	Alsuliman et al (2012)	Bala & Ibrahim (2007)	Javad et al (2009)	Keanne et al. (2010)	Mlhando et a.(2017)	Mohamad et al.(2010)	Nachatar & Omran(2010)	Ndihokubwayo(2009)	Oyewobi et al.(2016)	Memon et al.(2014)	Sunday(2010)	Bakr(2014)	Abdul Rahmand etal.(2013)	Kumarasqamy (1997)
	COMPLEXITY OF PROJECT															
1.	DESIGN COMPLEXITY		✓			✓		✓			✓			✓		
2.	LACK OF BUILDABILITY			✓												
3.	TECHNOLOGY CHANGE		✓			✓					✓		✓			
4.	POOR KNOWLEDGE ON AVAILABLE MAT & EQUIPMENT			✓		✓		✓			✓		✓	✓		
	EXTERNAL FACTOR															
5.	LACK OF REQUIRED DATA		✓			✓							✓			
6.	DEFICIENCY OF SITE CONDITION			✓			✓									
	INTERNAL FACTOR															
7.	LACK OF JUDGEMENT AND EXPERIENCE		✓	✓			✓						✓			
8.	LACK OF COORDINATION				✓	✓	✓			✓	✓		✓			
	DESIGN CHANGES															
9.	CHANGES IN DESIGN	✓			✓	✓	✓	✓		✓	✓	✓	✓		✓	
10.	ERRORS & OMISSION	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	
11.	INADEQUATE WORKING DRAWINGS		✓	✓		✓	✓					✓	✓			
12.	INADEQUATE DESIGN			✓		✓			✓							
13.	POOR DESIGN			✓							✓				✓	
14.	DESIGN DEFICIENCY						✓		✓		✓				✓	
15.	AMBIGUOUS DESIGN DETAIL					✓					✓		✓			
16.	CONFLICT BETWEEN CONTRACT DOCUMENT					✓	✓	✓		✓		✓	✓	✓		
17.	CHANGE IN SPECIFICATION					✓	✓				✓	✓				
18.	NON-COMPLIANCE WITH GOVERNMENT REGULATION						✓									
19.	DRAWINGS MODIFICATION															✓

Table 2: Consequences of variation order

No	Consequences
1	Being liable for any complexity of design that affect the flow of construction activities and loss of productivity.
2	Unfamiliarity of designers with construction method Lack of build ability element in the design, which eventually causes difficulty to the contractor.
3	Due to the use of unusual technology and design, there were difficulty between the contracting practitioners to understand the design. The design is so advance that it needed the designer's detailed explanations to make them understandable to the contractor and client.
4	Multiple choices of materials and equipment available in the market. Designer having difficulty in choosing the most appropriate material/equipment to be use. Therefore severely affect the project.
5	Due to lack of required data provided by client, the designers had to develop the design base on their own perceptions and later it were found not in accordance with the client requirements. Therefore, there were changes to contract terms, specification drawings etc
6	Designers had to alter their design. A variation order was issued under additional works to accommodate unexpected site condition.
7	Experts used their wrong beliefs in making decision, as they do not have the full knowledge on that specific subject thus affects the speed of the project.
8	Poor coordination between client and design team at design stage leads to variations.
9	Frequent design changes where construction starts before it is finalized in concurrent design and construction. Unrectified design error during design stage causing the project to suffer in terms of trouble in project's performance.
10	Misinterpretation of the documents between client, main contractor and designers occurred due to ambi and unclear specifications of plan that leads to discrepancies at design and construction interface.
11	Inadequate and improper design in an ongoing construction that lead to conflict between contract documents etc.
12	Designers had to issue variation order to correct errors. For example, there were design changes due to inconclusiveness of the design process before the construction phase started.
13	Misinterpretation of contract documents between client, main contractor and designers due to ambiguous design detail. Architect did not endorse the full scope of design required such as architect's drawings, structural and service-engineering drawings before the contract is sign. Problem such as inadequacies in estimation rises.
14	Conflicts between contract documents such as insufficient details in contract documents that lead to misinterpretation of the actual requirement of project for example contradiction between C&S and M&E drawings.
15	Change in specification due to lack of project objectives that root to variation on the cost and time of project.
16	Noncompliance of design with government regulation due to the unfamiliarity of contracting practitioner of the government regulation.
17	Drawing modification. Different opinion on the design between designers that lead to design modification in order to suit the existing ground condition.

3.0 METHODOLOGY

As shown in Figure 2, data collection was done through literature review, written documents, article,journal and questionnaires.Case law review had been carried out to understand the legal liability of the designers as decided in the court of law.

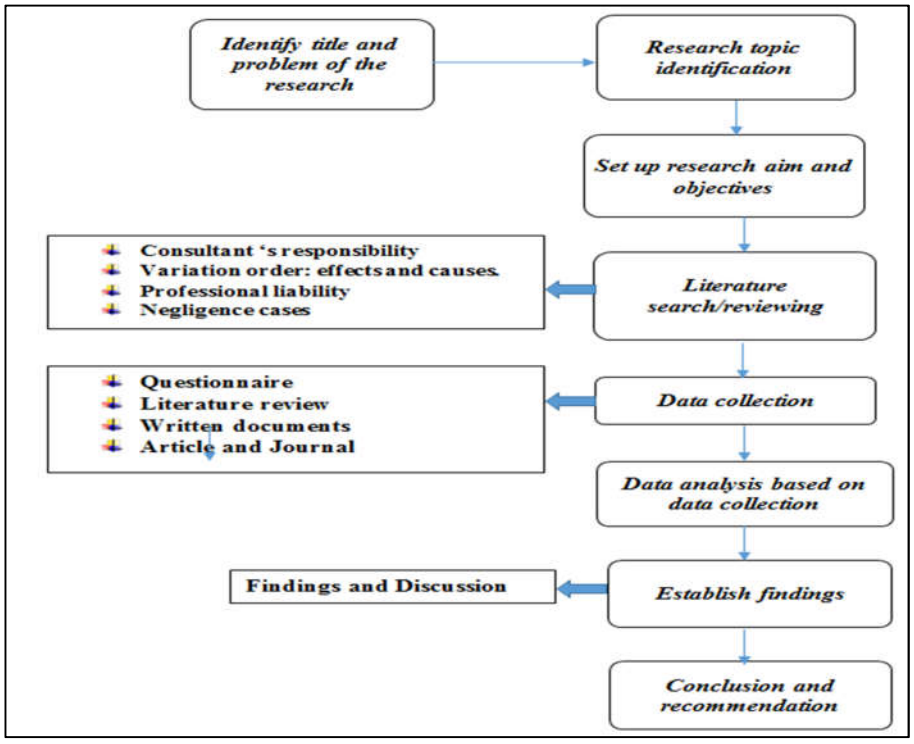

Figure 2 : Research Methodology Flowchart

A questionnaire was developed and sent to 153 respondents, which consist of 63 consultant firms, 81 G7 contractors in Kuching, Sarawak and snowball sampling was used to find the number of clients. The questionnaires were distributed by hand and by email from March to April 2018. The results were analysed using different statistical methods which are frequency analysis, average index analysis and relative index analysis as shown below :

$$\text{Average Index} = \frac{\sum 1x_1 + 2x_2 + 3x_3 + 4x_4 + 5x_5}{\sum x_1 + x_2 + x_3 + x_4 + x_5}$$

Figure 3 : Average Index Analysis
(Ling, 2004)

$$\text{Average Index} = \frac{\sum 1x_1 + 2x_2 + 3x_3 + 4x_4 + 5x_5}{5\sum x_1 + x_2 + x_3 + x_4 + x_5}$$

Figure 4 : Relative Index Analysis
(Ling, 2004)

4.0 ANALYSIS AND FINDINGS

4.1 Case Law Review

Table 3 illustrates the discovery on the case law reviews which shows the designers liability as decided in court :

Table 3 : List of cases

No.	Issues	Cases
1	Complexity of project	*Walter Lilly & Co Ltd v Mackay and another (No 2) [2012] EWHC 1773 (TCC); [2012] EWHC 1972 (TCC)* DMW was found liable in providing a deficient design which made it not buildable for WLC, too novel and advanced design which gave rise to problems to WLC.
2	Information	*London Underground Ltd v Kenchinton Ford plc and another (Harris & Sutherland Lrd, third party) 5 November 1998* KF was liable to pay LUL £66650 for damages for over dig, materials and additional work due to overdesigned and fault in interpreting the original drawing which led to error and over designed of diaphragm wall by the subcontractor.
3	Design changes	*MW High Tech Projects UK Ltd v Haase Environmental Consulting GmbH [2015]EWHC 152 (TCC)* HEC was liable to pay the extra cost for an improvised design. They did not have the consent to improvise the original design of the delivery plan thus HEC was in breach of contract.
4	Building defects	*Point West London Ltd v Mivan Ltd [2012] EWHC 1223(TCC) (10 MAY 2012)* This case emphasises that consultant is only liable to give advice and provide consultation service on the design of a structure. Any defect occurs will not fall under the consultant's liability.
5	Safety and building fitness	*Clayton v Woodman & Sons (Builders) Ltd (1962) 1 WLR 585* An architect had refused to vary contract works, which involved alterations to an existing building, and unfortunately, a part of the building fell on the workmen contractor. It was held that the architect was not liable for that unfortunate incident.
6	Build ability	*Brunswick Construction v Nowlan (1975)* The Supreme Court of Canada held that the duty to warn on design defect falls under the contractor even though the contractor is executing his work according to plans of the client's architect

4.2 Questionnaire Analysis

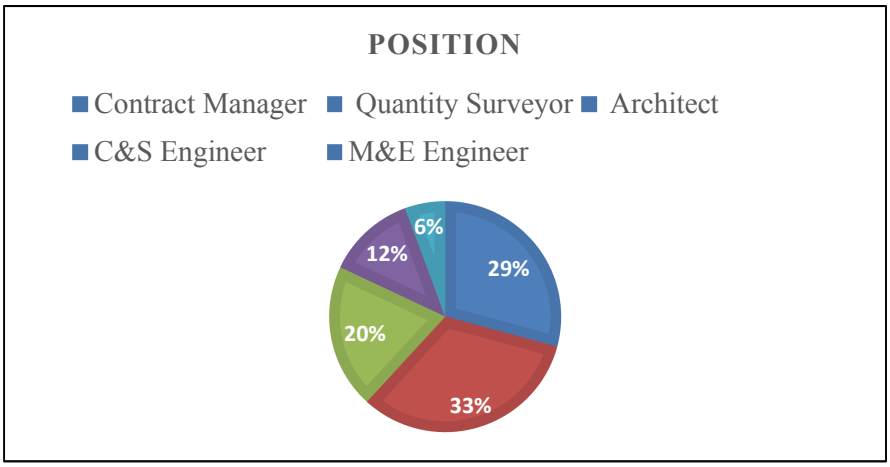

Figure 5 : Job Position

Majority of the respondents were Quantity Surveyors that covers 33% of total 89 repsondedts. Followed by Contract Managers 29% of total respondents, 20% Architects, 12% C&S Engineers and 6% M&E Engineers of total respondents.

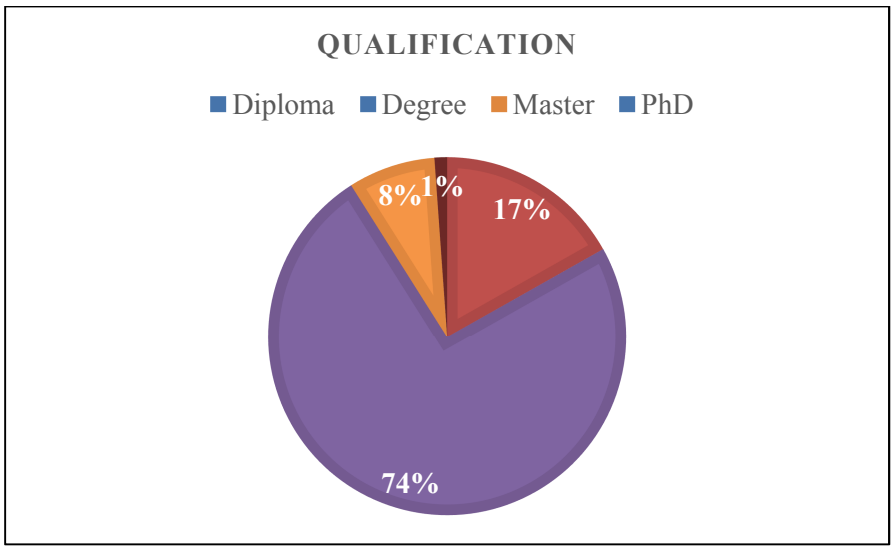

Figure 6 : Qualification

Most of the respondets are Degree holders that covers 74% from the total respondents. Followed by 17% Diploma holders, 8% Master holders and 1% PhD holders.

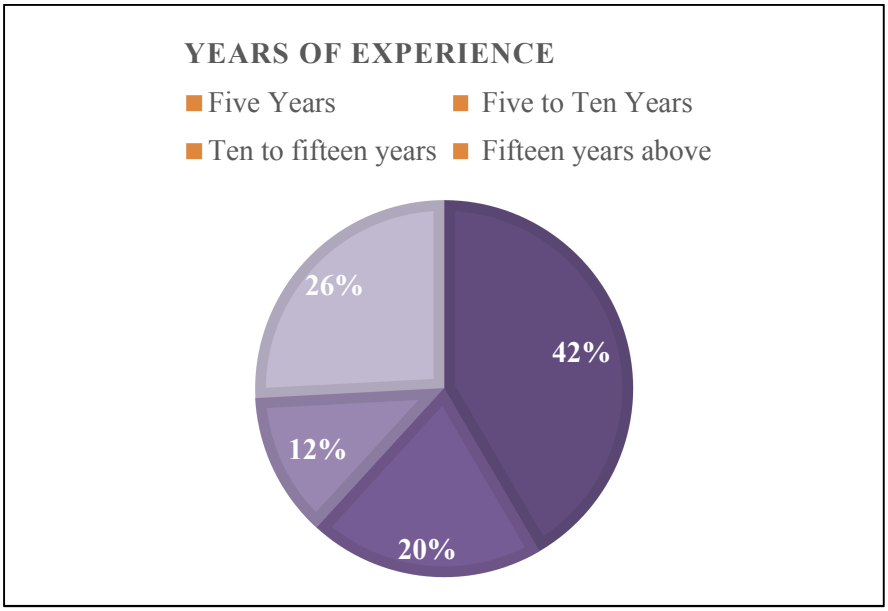

Figure 7 : Years of experience

Majority of the respondents' experience category is 5 years that is 42% from the total respondents. Followed by the experience category of 15 years and above with 26%, 20% had 5 to 10 years experience and 12% had10 to 15 years of experience.

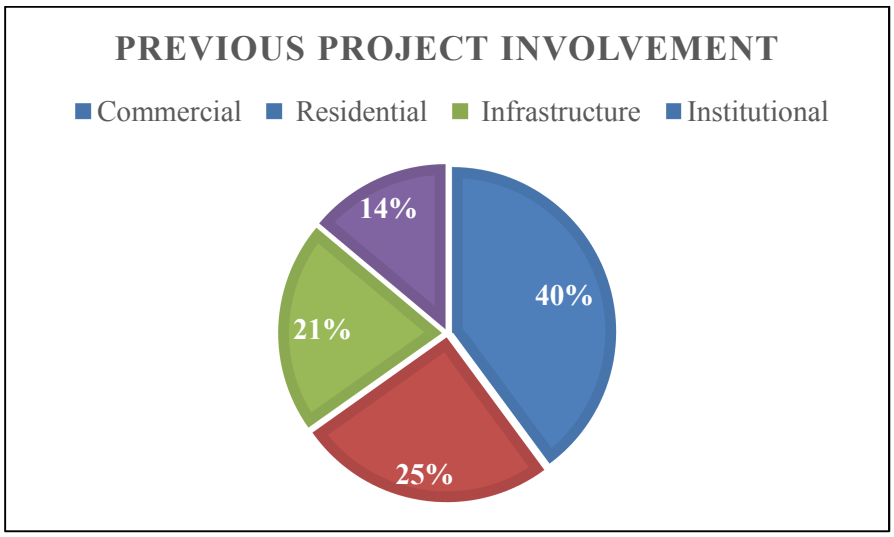

Figure 8 : Previous project involvement

In terms of previous project involvement, most of the respondents fall under commercial project with 40% of the total respondents. Followed by 25% on residential project, 21% infrastructure project and 14% institutional project from the total respondents.

4.3 Common Cause of Variation Order by Designers

With reference to Table 4, it can be seen that drawing modification is rated as the highest with the average index 3.8539 and has the highest relative index of 0.7708. Four causes were ranked as high (3.6629-3.4719 average index) while the other 12 causes were ranked as fair. It can be seen that change in specification, error and omission in design, conflict between contract document and poor site condition were ranked high. The rest of the causes, even though ranked as fair, they were considered as quite significant for none were ranked low.

Table 4: Descriptive statistics on the common causes of variation order by designers

No.	Types of variation	Average Index	Category	Relative Index	Rank
1	Drawing modification	3.8235	High	0.7647	1
2	Change in specification	3.4706	High	0.6941	2
3	Errors and omission in design	3.4118	Fair	0.6824	3
4	Lack off required data	3.3824	Fair	0.6765	4
5	Poor site condition	3.3529	Fair	0.6706	5
6	Conflicts between contract document	3.2353	Fair	0.6471	6
7	Ambiguous design detail	3.2059	Fair	0.6412	7
8	Poor coordination	3.1471	Fair	0.6294	8
9	Inadequate working drawings	3.1176	Fair	0.6235	9
10	Lack of judgment and experience	3.1176	Fair	0.6235	10
11	Change in technology	3.0882	Fair	0.6176	11
12	Design complexity	3.0588	Fair	0.6118	12
13	Non compliance with government regulation	2.9706	Fair	0.5941	13
14	Design deficiency	2.9706	Fair	0.5941	14
15	Poor knowledge of material and equipment	2.9412	Fair	0.5882	15
16	Inadequate and poor design	2.7941	Fair	0.5588	16
17	Lack of buildability	2.6765	Fair	0.5353	17
	Average	3.1626		0.6325	

4.4 Consequences of Variation Order towards Designers and Contracting Practitioners

Table 5 shows the analysis data for the evaluation of consequences towards designers and contracting practitioners on how often do the consequences happen to them. Generally all the consequences were rated as fair with average index ranged from 3.3034 to 2.6966. Among all the consequences, three consequences were rated as the most frequently occurred. Rated on the first rank, frequent design changes where construction starts before it is finalized in concurrent design and construction causing trouble in project's performance with an average index of 3.304 with a relative index 0.6607 were claimed as frequent by respondents. Followed by when designer had to alter the design in order to accommodate unexpected site conditions with the average index of 3.2360. At an average index of 3.2135, the discrepancies at design stage and construction interface due that are caused by misinterpretation due to incomplete and unclear specifications of plan falls on the third rank.

Table 5: Descriptive statistics on the consequences of variation order towards designers and contracting practitioners.

No	SITUATION	Average Index	Category	Relative Index	Rank
1	Frequent design changes where construction starts before it is finalized in concurrent design and construction.	3.3034	Fair	0.6607	1
2	Designers had to alter their design. A variation order was issued under additional works to accommodate unexpected site condition.	3.2360	Fair	0.6472	2
3	Misinterpretation due to incomplete and unclear specifications of plan that leads to discrepancies at the design and construction interface.	3.2135	Fair	0.6427	3
4	Insufficient details in contract documents that lead to misinterpretation of the actual requirement of project for example contradiction between C&S and M&E drawings.	3.1685	Fair	0.6337	4
5	Drawing modification. For instance, different opinion in design between desifners that lead to design modification in order to suit the existing ground condition.	3.0787	Fair	0.6157	5
6	Designers issue variation order to correct errors.For example, there were design changes due to inconclusiveness of the design process before the construction phase started.	3.0674	Fair	0.6135	6
7	Due to lack of required data provided by client, the designers had to develop a design base on their own perceptions and it was found not in accordance with the client requirements. Therefore, there were changes to contract terms, specification drawings etc	3.0562	Fair	0.6112	7
8	Poor coordination between client and design team at design stage that leads to variations.	3.0337	Fair	0.6067	8
9	Architect did not endorse the full scope of design required such as architect's drawings, structural and service-engineering drawings before the contract is sign. Problem such as inadequacies in estimation rises	2.9888	Fair	0.5978	9
10	Being liable for any complexity of design that affect the flow of construction activities and loss of productivity.	2.9663	Fair	0.5933	10
11	Change in specification due to lack of project objectives which roots to variation on the cost and time of project.	2.9101	Fair	0.5820	11
12	Inadequate and improper design in an ongoing construction that lead to conflict between contract documents etc.	2.8989	Fair	0.5798	12
13	Lack of build ability element in the design which eventually causes difficulty to the contractor.	2.8539	Fair	0.5708	13
14	Experts use their wrong beliefs in making decision, as they do not have the full knowledge on that specific subject and it affects the speed of the project.	2.7416	Fair	0.5483	14
15	The design is so advance that it needed the designer's detailed explanations to make them understandable to the contractor and client.	2.7303	Fair	0.5461	15
16	Noncompliance of design with government regulation due to the unfamiliarity of contracting practitioner of the government regulation.	2.7079	Fair	0.5416	16
17	Designer having difficulty in choosing the most appropriate material/equipment to be use therefore severely affect the project	2.6966	Fair	0.5393	17
	Average	2.98		0.5959	

5.0 CONCLUSION

Variation Order is inevitable in construction industry. Often, decisions on variations were made due to some circumstances which may require modifications to be made. However, if the cause of variation is because of the designers' negligence, then, the case laws showed that the designers may be liable for them. The view of construction practitioners in Kuching had shown that the occurrences of the variation order such as drawing modification, change in specification, design errors and emission and conflicts between contract documents are quite frequent. Thus, this research seeks to propose some mitigation actions to be taken by designers in making sure that their designs would be reasonably complete and thus, will not cause loss of money to their clients.

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