MODELING DISPUTE MANAGEMENT IN CONSTRUCTION INDUSTRY

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Abstract: Dispute is not uncommon in the complex and fragmented construction industry. Construction disputes, even though extensively investigated, still plagued the Malaysian construction industry. This paper aims to develop a dispute performance index to predict the dispute occurrence in Malaysia. A questionnaire survey was conducted among 374 respondents to generate the weightage of the indices. Dispute sources were classified into stages of pre-construction, construction, and post construction. Principal Component Analysis (PCA) was conducted on the data collected from the survey. PCA analysis results were then utilized to perform Structural Equation Modeling (SEM) analysis. SEM evaluated the causal relationship between dispute sources and dispute resolution methods to develop a dispute resolution performance index. The index is essential to benchmark the dispute resolution performance and hence provides a guideline to the construction players in handling and or avoiding disputes.

Keywords: *Dispute Management, Structural equation modeling (SEM), Malaysian construction industry*

1.0 Introduction

Construction industry plays an important role in the country development. It is known as the mainstays of country's economic growth. In Malaysia, construction industry is fragmented, involved numerous activities and different parties. Each activity is integrated to achieve the construction goals. Therefore, construction industry is always denoted as high conflict derivation.

Conflicts in construction are common and there are obvious trend in increasing. Remain unresolved conflict will definitely lead to dispute (Fenn *et al*., 1997). Disputes are

contributed by numerous sources as the construction industry is dealing with several disciplines with different interest. Disputes may affect the project progress resulted in delay that might lead to the entitlement of Liquidated Ascertained Damages (LAD). Therefore, the root causes of the dispute must be identified to mitigate its occurrence. At the same time, practitioners should adopt appropriate dispute resolution method to handle unpredicted occurrence dispute.

Mitkus and Mitkus (2014) analysed the causes of conflicts between client and contractors in the construction industry from the aspect of communication. Construction contract agreement, regulating the relations between the client and the contractor, is viewed as a product of communication. They found and confirmed that communication failure between the client and the contractor is the main cause of conflicts in the construction industry. Unfair behavior of the parties to a construction contract agreement and psychological defense mechanisms were also identified as possible causes of conflicts. Any conflicts, regardless of the root causes, will require the presence of dispute resolution to manage the situation.

Dispute resolution encompasses litigation and alternative dispute resolutions (ADR). ADR is initially referred to techniques for disputes resolution without litigation. With the advancement of modern techniques like caseload management and prevalence of ADR within the litigation milieu, ADR is more appropriately described as a technique that is apt in the context of dispute resolution generally instead of an alternative to litigation. Following that, litigation is therefore considered as just one of the many methods of dispute resolution (Fiadjoe, 2013; Safinia, 2014).

It is important to note that the term ADR does not have an agreed definition. For instance, a common argument on arbitration is that some may not regard it as a form of ADR because of its regulated adjudicative system. Some also argue that negotiation is not technically a kind of ADR since it requires the involvement of lawyers and their clients but no third party(Blake, Browne, and Sime, 2014). Terminology and methodologies are still developing. For the purpose of this paper, dispute resolution covers the full range of alternatives to litigation and ligation itself that are available to lawyer and client to resolve a construction dispute.

The suitability of a dispute resolution depends very much on the nature of the dispute thus an analysis of factors contributing to dispute is needed. By implementing most effective dispute resolution method, it can minimize damages from the dispute and help to ensure smooth running of the project. This paper reviews the disputes in construction and attempts to develop a dispute performance index that is modelled based on construction practitioners' opinion.

2.0 Literature Review

2.1 Disputes in Construction Industry

Dispute is actually known as a conflict or claim (Safinia, 2014). When there is an existence of incompatibilities among the parties, which means the relation between propositions that cannot be true at the same time. Disagreement in construction contract is likely to end up with dispute. Klinger, Moran and Arnold (2009) listed several situations during the course of a project that disputes often arise between construction players. The list of prime situations included plans and specifications or scope of work, shop drawings and submittals, change orders or out-of-scope work, differing site conditions, project access, subcontractor substitution, and construction defects.

This paper reviewed factors of dispute and categorised them according to pre-construction stage, during construction stage, and post construction stage. Figure 1 presents the factors contributing to dispute in construction.

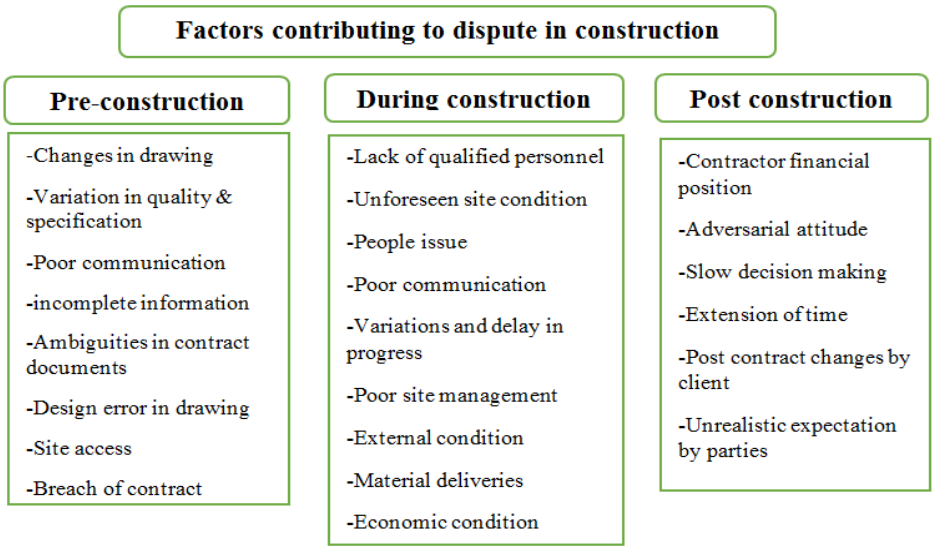

Figure 1: Factors Contributing to Dispute in Construction (Agarwal, Ramamoorti, and Jayaraman, 2011; Alwi and Hampson, 2003; Farooqui and Azhar, 2014.; Iyer, Chaphalkar, and Joshi, 2008; Love, Davis, Ellis, and Cheung, 2010; Memon, Rahman, and Hasan, 2014; Sambasivan and Soon, 2007)

2.2 Dispute Management

There are different methods to manage dispute. In relation to this, the disputing parties will involve in numerous procedures for resolution of dispute, ranged from traditional court processes to alternative dispute resolution. Negotiation is a process that has been preferred by disputing parties in the first step of resolving disputes (Safinia, 2014). In the process, the party involved will sit down together and trying to reach an agreement that is satisfy to them. Besides that, direct negotiations also allow disputants to retain their independence, privacy and addressing each disputing party's desires, needs and concerns.

Mediation is known as a facilitative process (Onn, 2003) that resolving dispute without going to court. In this process, the mediator will act as an impartial third party to assist the disputing parties in resolving dispute by helping them to reach an agreed settlement of their dispute. A so called "win-win" situation will be enhanced in mediation to benefit both parties. Arbitration is the involvement of neutral third party as an arbitrator who seeks the evidence and listens to the arguments from disputing parties. Then, he will assess all the evidence that gathered during the meetings and started to make some findings on the facts of dispute. Law will be applied and decision is made to settle the disputes. The decision given by the arbitrator is a final and binding award that is legally enforceable.

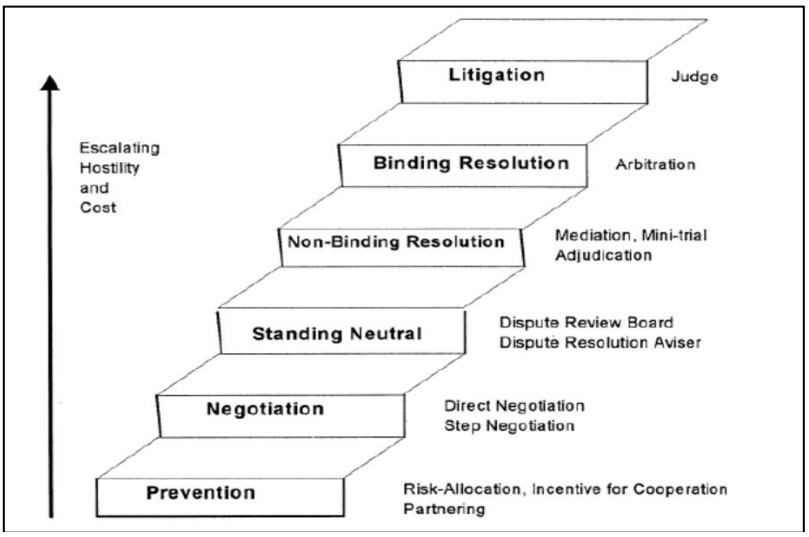

Figure 2: Dispute Resolution Methods (Agarwal *et al*., 2011; Enshassi and Rass, 2008; Hall, 2002; Onn, 2003; Safinia, 2014)

Additionally, mini trial is to provide the parties involved a clear understanding of the merits of their case. It allows the predicted results of an actual trial which enable the parties come to a decision to resolve dispute is also one of the main goals of mini-trial.

According to Hall(2002), mini-trial is effective for dispute that involves mix factual and legal issues, being thought to promise earlier business decision settlement. Mini-trial is often used in big projects when the senior decision made cannot be aware of the real situation, in addition to the subordinates who may not aware the needs of the parties (Enshassi and Rass, 2008).

The disputants will present their cases to a neutral third party who is known as the independent expert. The independent expert will evaluate the evidence collected base on rules, law, and contract that is applied in dispute to provide an opinion on the possible outcome of the case if disputes is review through arbitration (Agarwal *et al*., 2011). The opinion given by the independent expert is binding on the disputing parties in the interim unless there is further decision by court of law. Litigation (traditional process) has been known as the most traditional process in resolving disputes. It is the process of appointing a dispute cases through court whereby the plaintiff who brings the charge and defendant who against the charge will be involved in court. Litigation is a process that usually focuses on legal rights of disputing parties. It is a process that often provides the fact that is true. Therefore, the decision given by the judge is binding that makes the decision very ultimate and final towards resolution of dispute.

3.0 Methodology

Having reviewed the dispute resolution techniques, this survey was carried out to examine the performance of dispute resolution methods in the construction industry and hence to justify its competitiveness. Prior to collecting data, questionnaire is designed to consist of questions to elicit the respondents' perceived importance of the dispute resolution techniques that are adopted for this study. The respondents were also asked on the occurrence of disputes in the three main construction stages. The targeted respondents in this survey were taken from the contractors registered with CIDB. Two groups of contractors under class G6 and G7 were chosen. The questionnaire were sent to 1000 Malaysian construction companies and the targeted respondents were those that were involved in building projects and also coming from the managerial level. Respondents were required to rate the question on a five-point Likert scale, where 5 represented 'strongly agree', 1 represented 'strongly disagree' and 3 represented 'somewhat agree'.

The reliability of the questionnaire was accessed through Cronbach's Alpha coefficient. A factor analysis was conducted using Principal Component Analysis (PCA) to eliminate items that did not have significant contribution to the construct studied. Later, Structural Equation Modeling (SEM) was utilized to examine the causal relationship of dispute stages and dispute resolution in Malaysia. SEM was adopted for its capability in modeling relationships among multiple independent and dependent constructs simultaneously (Awang, 2012).

4.0 Analysis and Discussion

4.1 Response Rate

A total of 421 sets of questionnaire out of 1000 were received, 374 were valid without missing values, making the total response rate of 37.4%, which is fall in acceptable response range. Dulaimi *et al*. (2003) stated that the normal response rate in construction industry for survey is within 20-30%. The respondent demographics revealed that majority of the respondents (96.3%) were Bachelor's degree holder. The age of the respondents were ranged from 24-63 years old with the majority in the range of 40-49 years (62.2%). Most of them (71.4%) held managerial positions like senior manager, senior contract manager, general manager, construction manager, and project manager. Majority of the respondents were involved in the construction industry for at least 15 years and above. This revealed a high credibility of respondents in this study.

4.2 Respondent Demographics

Table 1 lists the respondent demographics of the sample.

Table 1: Respondent demographics

Demographic variable	*Category*	*Frequency*	*Percentage*	*Cumulative Percentage*
Education	Bachelor	360	96.3	96.3
	Master	14	3.7	100.0
	PhD	-	-	100.0
Age	20-29 years	28	7.5	7.5
	30-39 years	106	28.3	35.8
	40-49 years	233	62.2	98.0
	50-59 years	7	2.0	100.0
	>60 years	-	-	100.0
Designation	Project/Site Architect	36	9.6	9.6
	Project/Site QS	9	2.4	12.0
	Project/Site Engineer	55	14.7	26.7
	QA/QC	7	1.9	28.6
	Manager	267	71.4	100.0
	Director	-	-	100.0
Experience	5-9 years	23	6.2	6.2
	10-14 years	9	2.4	8.6
	15-19 years	88	23.5	32.1
	20-24 years	254	67.9	100.0
	>25 years	-	-	100.0

4.3 Internal Consistency Reliability

Cronbach's Alpha gives an accurate estimate of internal consistency and indicates the correlations among the items in the set(Brown, 2001). The Cronbach's Alpha computed for the survey was at 0.72, which is considered acceptable (Nunnally and Bernstein, 1994).

4.4 Factor Analysis

Factor analysis is a statistical technique that gives a summary of the relationships between original variables in smaller sets of derived variables known as factors or components (Hardy and Bryman, 2004). This paper adopted a Principal Component Analysis (PCA) to capture the similar aspects of the construction disputes and examine the relationship among the disputes surveyed. A total of 5 dispute factors were extracted in the PCA at Pre Construction stage, 7 factor sin Construction stage and 2 factors in Post Construction stage. The cut off threshold of factor loading is set at 0.7 to ensure that the extracted dispute factors are highly reliable and represent the most influencing dispute factors in construction industry. 'Design error in drawing' was found to be the major cause of dispute in pre-construction stage. 'Poor coordination' was the major dispute factor in construction stage and 'slow decision making' was the major post construction dispute.

Table 2: Principal Component Analysis

Rotated Component Matrix	
	Component
Pre-Construction	
F1 Changes in drawing	0.725
F2 Variations in quality and specification	0.701
F3 Poor communication	0.725
F4 Ambiguities in contract documents	0.710
F5 Design error in drawing	0.750
Construction	
F6 Lack of qualified personnel	0.738
F7 Unforeseen site condition	0.701
F8 People issue	0.795
F9 Poor coordination	0.809
F10 External condition	0.759
F11 Material delivery	0.705
F12 Economic condition	0.786
Post Construction	
F13 Slow decision making	0.729
F14 Extension of time claim	0.710

After conducted PCA, there are 14 factors extracted from 23 disputes factor (as shown in Figure 1). These factors are then used to compute Structural Equation Model in the following section.

4.5 Structural Equation Modelling

The extraction of the dispute factors in PCA is served as the Confirmatory Factor (CF) for the Structural Equation Model (SEM). The SEM dispute model is shown in Figure 3.

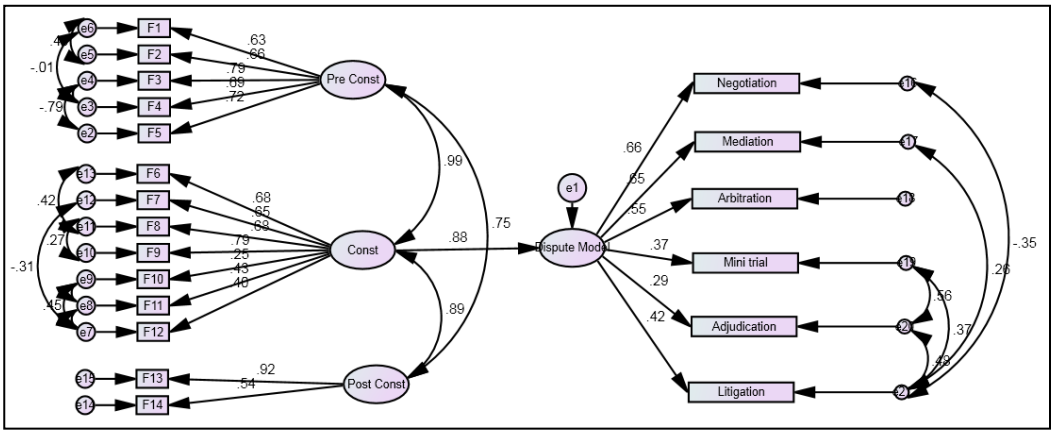

Figure 3: Dispute Model

The SEM model shown in Figure 3 is selected from 24 hypothesis models based on mean discrepancy rule of thumb. 24 hypothesis models are resulted from the availability of correlations in the constructs. It is found that Figure 3 dispute model recorded the lowest mean discrepancy, therefore, it is selected to be further analyzed.

The validity of the SEM model is justified by Goodness of Fit. There are 3 categories of Goodness of Fit, namely absolute fit, incremental fit and parsimonious fit. The minimum requirement to satisfy the Goodness of Fit is that either one of the indices in each category should be greater the threshold value in order for the model to be considered fit. The most common index to be used to justify the fitness of Absolute Fit is RMSEA or CMIN, Incremental Fit is either CFI or TFI and Parsimonious Fit is CMN/df (Schermelleh-Engel, Moosbrugger, and Müller, 2003). The result of Goodness of Fit for dispute model is shown in Table 3.

Table 3: Goodness of Fit for Dispute Model

Category	*Index*	*Threshold*	*Dispute Model*
Absolute Fit	Chi sq (CMIN)	> 0.05	235.699
	Root Mean Square of Error Approximation (RMSEA)	< 0.100	0.089
	Goodness of Fit Index (GFI)	> 0.800 0 (no fit), 1 (perfect fit)	0.762
Incremental Fit	Adjusted Goodness of Fit Index (AGFI)	> 0.800 0 (no fit), 1 (perfect fit)	0.671
	Comparative Fit Index (CFI)	> 0.800 0 (no fit), 1 (perfect fit)	0.880
	Tucker Lewis Index (TLI)	> 0.800 0 (no fit), 1 (perfect fit)	0.850
	Normal Fit Index (NFI)	> 0.800 0 (no fit), 1 (perfect fit)	0.734
Parsimonious Fit	Chisq/degree of freedom (CMIN/DF)	< 5.0 Or 1-2	1.551

Table 3 demonstrated that the dispute model satisfied the Goodness of Fit as the indices were all above the designated threshold value. The next step was to evaluate the causal relationship of the dispute factors and dispute resolution methods. The importance weights of the different construct of dispute model and stages were found in Table 4 and the relationships were explained in Table 5.

According to Table 5, Construction Stage is the major dispute contributor in construction industry. Meanwhile negotiation and mediation are the most favorable dispute resolution methods in the industry. The SEM model is able to transform into a mathematical model through linear equation approach (Chai *et al*., 2015). The severity of the dispute occurrence in a particular construction project can be evaluated through the following;

Let: $Dispute = \alpha Pre\ Construction + \beta Construction + \gamma Post\ Construction$

$$Dispute = 0.65PreC + 0.78Con + 0.59PostC \quad \text{Eq (1)}$$

The sum of the indices should total up to 1 and adjustment of .01 has been made on each coefficient.

Therefore,

$$Dispute = 0.32PreC + 0.39Con + 0.29PostC \quad \text{Eq (2)}$$

Where:

PreC is construct score of disputes at Pre-Construction stage:
PreC = 0.06F1 + 0.06F2 + 0.07F3 + 0.06F4 + 0.07F5

Con is construct score of disputes at Construction stage:
Con = 0.07F6+ 0.06F7 + 0.07F8 + 0.08F9 + 0.03F10 + 0.04F11 + 0.04F12

PostC is construct score of disputes at Post Construction stage:
PostC = 0.18F13 + 0.11F14

Table 4: Summary of construct standardized weight of measurement items

Construct	*Underlying disputes and techniques*	*Standardized Weight*
Pre-Construction		
	F1 Changes in drawing	.634
	F2 Variations in quality and specification	.659
	F3 Poor communication	.786
	F4 Ambiguities in contract documents	.688
	F5 Design error in drawing	.723
Construction		
	F6 Lack of qualified personnel	.684
	F7 Unforeseen site condition	.645
	F8 People issue	.682
	F9 Poor coordination	.786
	F10 External condition	.254
	F11 Material delivery	.427
	F12 Economic condition	.396
Post Construction		
	F13 Slow decision making	.923
	F14 Extension of time claim	.540
Dispute Model		
	D1 Negotiation	.66
	D2 Mediation	.65
	D3 Arbitration	.55
	D4 Mini trial	.37
	D5 Adjudication	.29
	D6 Litigation	.42

Table 5: Dispute Model and Its Relationship

Relationships	*Standardized Weight*
Pre-Construction → Dispute Model	.99*.75*.88 = .65
Construction → Dispute Model	.99*.89*.88 = .78
Post Construction → Dispute Model	.89*.75*.88 = .59

According to Table 5, negotiation and mediation were found to be the most sought after dispute resolution techniques, whereas mini trial and adjudication were the less popular options.

4.6 Model Application and Discussion

The dispute formulae developed from this study are able to predict the likelihood of dispute occurrence in the construction industry. This can be done by examining the dispute factors in each construction stage, evaluated through a standardized performance scale. The final index represents the probability of dispute occurrence in the particular project. It serves as a self-assessment tool by contractors to forecast the severity of disputes in any project. To calculate PreC, a construction firm has to rate their dispute occurrence (F1-F5) on a 5-point scale, where 5 represents 'Always', 1 represents 'Never' and 3 represents 'Sometimes'. A sample calculation is tabulated in Table 6.

From the sample calculation, it is found that the project scored 3.74 in dispute formulae which indicated that dispute is predicted to often occur in the project. The prediction score is based on the characteristic of the project, project management team performance and external factors. Therefore, the dispute formulae are considered valid in terms of theoretical derivation and functionality.

Using the equation PreC, Con, and PostC, the dispute severity can be predicted for each stage. These scores can also serve as input to equation Dispute to determine the dispute level of that particular project. The equations PreC, Con, and PostC also provide valuable insights to understand the different disputes that contribute to each respective stage. The coefficients of these constructs are useful for contractors to manage their disputes and keep it minimal so as to avoid any adverse effects on their projects at any construction stage.

Table 6: Sample calculation of using dispute formulae

Construct	*Underlying disputes and techniques*	*Weight*	*Rating Scale*	*Score*	*Sum*
Pre-Construction					
	F1 Changes in drawing	0.06	4	0.24	
	F2 Variations in quality and specification	0.06	4	0.24	
	F3 Poor communication	0.07	3	0.21	
	F4 Ambiguities in contract documents	0.06	2	0.12	
	F5 Design error in drawing	0.07	4	0.28	
					1.09
Construction					
	F6 Lack of qualified personnel	0.07	3	0.21	
	F7 Unforeseen site condition	0.06	3	0.18	
	F8 People issue	0.07	4	0.28	
	F9 Poor coordination	0.08	4	0.32	
	F10 External condition	0.03	2	0.06	
	F11 Material delivery	0.04	5	0.20	
	F12 Economic condition	0.04	3	0.12	
					1.38
Post Construction					
	F13 Slow decision making	0.18	4	0.72	
	F14 Extension of time claim	0.11	5	0.55	
					1.27
	Total Score				*3.74*

Rating Scale: • 1 – Never • 2 – Rarely • 3 – Sometimes • 4 – Often • 5 – Always

5.0 Conclusions

The study concludes that dispute in construction may emanates from various sources. These sources are classified according to pre-construction, construction and hand over phases. Based on the developed performance index, dispute tends to be severe at the construction stage. The high probability occurrence at construction stage explained by the fact that it is the drawing realization which involves more parties compared to pre and post construction. The need to comply contractual and statutory requirements also contributed to the risk of dispute.

6.0 Acknowledgements

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