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A PRELIMINARY FRAMEWORK FOR PREVENTING DISPUTES IN DIFFERENT STAGES OF BUILDING CONSTRUCTION PROJECTS

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Abstract

The upward trend of dispute claims and occurrences throughout different stages has detrimentally affected the outcomes of construction projects. Building upon two major themes from a systematic literature review (SLR) study, Principal Component Analysis (PCA) was performed to further group the extensive causes and strategies into several meaningful groups using the Statistical Social Package Science (SPSS) software. Questionnaires were used and issued to three main stakeholders (clients, consultants, and contractors) in the Klang Valley area. This paper presents the PCA findings, which have led to the development of a framework to prevent disputes in different stages of building construction projects. The PCA findings have narrowed down the major contributors of disputes to "Contract-related causes" and "Time-related causes". PCA analysis has also shown that the three key themes of "Quality-related strategies," "Business relationship-related strategies," and "Productivity-related strategies" were the most effective ways to reduce disagreements. It is important to highlight that the findings related to the causes of disputes during the planning stage consistently align with those of a prior study. This underscores the importance of ethical conduct, particularly during the planning phase and, more specifically, within the tendering process.

Keywords: building construction projects, disputes, minimising, strategy

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INTRODUCTION

Soni et al. (2017) claimed that conflicts and disputes can happen at any stage of a project lifecycle, which can affect its pre-planned schedule, and adversely affect the construction cost, project delivery, and the overall project performance. Following this perspective, several studies (Ayudhya, 2011; Assaf et al., 2019; Cakmak & Cakmak, 2014; El-Sayegh et al., 2020) have classified the causes of disputes based on their common relationships, or by construction stages, or based on the individuals that started the disputes. The results of this study on a framework design that could reduce disputes at various stages of building construction projects are presented in this paper. This study has explored construction disputes by thoroughly assessing the causes and the potential strategies to minimise disputes in construction projects. This study has specifically focused on building projects in Malaysia based on a systematic literature review (SLR) conducted by Muhammuddin et al. (2022) and has identified two major themes. Table 1 lists these themes, namely, causes of disputes and strategies to minimise the dispute, which serve as a theoretical base for the development of the framework to minimise the occurrences of construction dispute in building projects, throughout the project phases. This framework is designed in accordance with the project phases outlined by Project Management Institute (PMI, 2017).

Table 1: Summary of SLR findings on causes of dispute and strategies to minimize them (Muhammuddin et. al, 2022)

Project Phases	Causes of dispute	Strategies to minimise dispute
Initiation	Poor estimation practices during feasibility study, unrealistic project planning, poor and ineffective communication between parties in the project	Established a clear definition of project scope, preserve a good relationship between the project team members
Planning	Poor estimation practices, unrealistic project planning, delay in obtaining permit or approval from the municipality and the other governmental authorities, inadequate design information, design errors, poor quality design, inconsistencies between the drawings and specifications, short time available during design stage, inadequate and incomplete specification, poor and ineffective communication between parties in the project, ambiguities in the contract documents, types of procurement method adopted, misinterpretation of contract documents, different interpretations of the contract provisions, lack of understanding and	Execute proper risk allocation, allocate adequate time to prepare for contract documentations, efficient communication, early detection of problems, provide timely resolution for problems, developed trust between parties, developed teamwork between parties, developed long term relationship between parties, select an experienced contractor to undertake the project, contractors should not take the projects beyond their technical capabilities, clients should be punctual in giving instructions, consultants to prepare clear and comprehensive documentation, selecting a professional

Project Phases	Causes of dispute	Strategies to minimise dispute
	agreement on the type of contract, incorrect pricing of the works, unfair risk allocation, selection of contractors based on the low bid only without considering the technical capabilities.	construction team, quality control checking before issuance of documents, record keeping, ensure full understanding of the contract requirements prior signing of agreement, client to prepare effective project planning, preserve a good relationship between the project team members, adoption of digital technology to facilitate coordination and early detection of problems
Execution, Monitoring and Controlling	Variation orders, change of material specification, unforeseen ground conditions, failure of the client to honour payments as and when due, time overrun, cost overrun, poorly drafted or incomplete and unsubstantiated claims, failure to make interim awards on extension of time and compensation, failure of the major stakeholders in understanding and complying with the contractual obligations, failure to properly administered the contract, mishandle the construction process, poor quality of work, late giving of site possession, delay in work progress, technical inadequacy, unrealistic contract duration, labour inefficiencies, inadequate contractor's experience, ineffective planning and scheduling of project by contractor, unavailability of cash flow faced by contractor, request for project acceleration, poor productivity, disagreement over scope variation, delay in issuing site drawings and materials, materials damaged during storage, late instruction by the employer, poor and ineffective communication between the parties in the project, breach of contract, unrealistic expectation of the client, change in rate due to quantity variations, change in material source and it cost	Efficient communication, early detection of problems, provide timely resolution for problems, developed trust between parties, developed teamwork between parties, preserve a good relationship between the project team members, clients should avoid making unnecessary variations, clients should be punctual in giving instructions, proper record keeping, proper payment schedule, payment as at when due, adoption of digital technology to facilitate coordination and early detection of problems
Closeout	Defects	-

RESEARCH METHODOLOGY

Built upon the findings of the SLR study by Muhammuddin et al. (2022), this study has analysed the returned questionnaires using the Principal Component

Analysis (PCA) to categorise the extensive causes and strategies into several meaningful groups. Similar to the study by Mohd-Nordin (2023), the targeted respondents were clients, consultants, and contractors (Grade 7) within the Klang Valley area. The lists of potential respondents were extracted from respective associations and professional bodies, such as the Real Estate and Housing Developers' Association Malaysia, the Construction Industry Development Board (CIDB), the Board of Architects Malaysia, and the Board of Quantity Surveyors Malaysia, which resulted in a total population of 1,896.

Based on the sample size determination table by Cohen et al. (2007), 322 questionnaire surveys were distributed, and 96 responses were received, which accounted for 29.8% response rate. Prior to distributing the questionnaires, a pilot study was conducted to ensure its clarity and effectiveness. The questionnaire consisted of Likert-scale questions and open-ended questions.

FINDINGS AND DISCUSSION

Principal Component Analysis (PCA)

The PCA is a statistical procedure that is used to reduce a large number of variables into several components by forming clusters that reflect the core of the original data (Adegbembo et al., 2020; Hadi et al., 2016; Karji et al., 2020). The PCA was used in this study to further identify and cluster the obtained variables into specific groups to describe the pattern of correlations within a similar set of variables. Subsequently, more meaningful findings and comprehensive insights were found for the framework's development. Examples of PCA application can be found in several construction industry-related research works, such as by Dogbegah et al. (2011), Karji et al. (2020), Saar et al. (2017), Sakyiama (2016), and Treacy et al. (2015). The PCA was conducted using IBM Statistical Package for Social Sciences (SPSS) software, version 28.

According to Pallant (2013), two appropriateness tests must be performed to evaluate the sample size and the relationship strength between the variables before conducting the PCA. The former can be determined using the Kaiser-Meyer-Olkin (KMO) test, while the latter can be tested using Bartlett's test of sphericity (Hadi et al., 2016). The KMO sampling adequacy of 0.50 and above was acceptable for this research (Kissi et al., 2016; Obeng-Ahenkora & Danso, 2018; Omaraka, 2020). Meanwhile, the Bartlett's test of sphericity must indicate a significant value of less than 0.05 (Field, 2005; Pallant, 2013). These tests were repeatedly performed on the data for each project phase. Communalities must also be established. Dogbegah et al. (2011) explained that communalities are the total amount of variances that the initial variables share with the other variables in the set of data. There are various views on the ideal value of communalities. However, this study has adopted the proposed 0.50 value

by Field (2005), Dogbegah et al. (2011), and Omaraka (2020) as the minimum communalities score.

Next, the collected data were analysed using the PCA with varimax rotation to ensure that each component was uncorrelated. Then, the principal components were determined using the eigenvalue test. As proposed by Karji et al. (2020), components with an eigenvalue of greater than 1.0 were selected to determine the principal components. Since some of the variables were quite large, for ease of reporting, the research findings presented in the relevant tables in the following sections have been set to display only those components with an eigenvalue of greater than 1.0. The rotated component matrix provided a better understanding of the principal components, as it clarified the theme represented by each principal component through the indication of the associated variables. These tests were conducted repeatedly for every set of data in each phase of construction. The findings and discussions in the next sections have been organised in the following order: causes of dispute and strategies to reduce dispute.

Causes of Dispute

The KMO and Bartlett's results for all phases regarding the causes of dispute indicated that this data set was appropriate for PCA, as this set passed the minimum sampling adequacy of 0.50 and a p-value of less than 0.001, respectively. The communalities values for all phases also reached the pre-determined cut-off of 0.50. In this section, only one cause of dispute would be listed under the closeout phase. Therefore, this cause was excluded from the PCA because no correlation can be calculated with only one variable. The following Table 2 presents the eigenvalue and component matrix for the respective project phases listed in Table 1.

Initiation Phase

Table 2 shows that only one component has an eigenvalue of greater than 1.0. Thus, rotation was not conducted.

Table 2: Total variance explained for causes of dispute during the initiation phase

Component (C)	Initial Eigenvalues (IE)			Extraction Sums of Squared Loadings (ESSL)		
	Total (T)	% of Variance (% Var)	Cumulative % (Cum %)	Total (T)	% of Variance (% Var)	Cumulative % (Cum %)
1	1.989	66.303	66.303	1.989	66.303	66.303
2	.619	20.635	86.937			
3	.392	13.063	100.000			

To further understand the variables related to this component, the results of the component matrix in Table 3 have been analysed. This table shows that all causes listed under the initiation phase are significantly related to Component 1. Based on the analysis of the three variables associated with it, Component 1 was themed as **"Developing business case–related causes"**, since these variables were closely related to the development of the business case, which would be undertaken during the initiation phase.

Table 3: Component matrix for causes of dispute during the initiation phase

Causes of dispute during the initiation phase	Component
	1
Poor estimation practices during feasibility study	.862
Unrealistic project planning	.825
Poor and ineffective communication between parties in the project	.752
Extraction Method: Principal Component Analysis.[a]	
a. 1 components extracted.	

Planning Phase

Table 4 summarises the five principal components of the causes of dispute that have been extracted for the planning phase, as they have greater values than the eigenvalue set in this research.

Table 4: Total variance explained for causes of disputes during the planning phase

C	IE			ESSL			Rotation Sums of Squared Loadings (RSSL)		
	T	% of Var	Cum %	T	% of Var	Cum %	T	% of Var	Cum %
1	6.899	38.325	38.325	6.899	38.325	38.325	4.298	23.877	23.877
2	1.951	10.839	49.165	1.951	10.839	49.165	3.219	17.882	41.759
3	1.645	9.138	58.303	1.645	9.138	58.303	1.834	10.186	51.946
4	1.068	5.931	64.233	1.068	5.931	64.233	1.765	9.807	61.752
5	1.028	5.712	69.945	1.028	5.712	69.945	1.475	8.193	69.945

Table 5 presents the results of the rotated component matrix that can describe the correlations between each variable and its components. Several observations were made to determine which variables produce the highest factor loadings. The higher the factor loadings of the variable, the stronger its correlation with the components, which can reveal the clusters to which the variables belong to. Evidently, Component 1 has the highest variance (38.33%), which inferred that all variables under this component were the critical causes of dispute during the planning phase. All six variables were related to design issues;

thus, Component 1 was given the theme of **"Design and specification-related causes"**. Meanwhile, the variables in Component 2 were closely related to contractual matters; thus, they were clustered under the theme of **"Contract-related causes"**, and Component 3 was assigned the **"Procurement-related causes"** theme, as it was strongly linked to procurement processes. Component 4 was relatively simple to understand, as both variables were associated with contract pricing. Hence, this component was themed as **"Contract pricing-related causes"**. Lastly, Component 5 was assigned with the theme of **"Time-related causes"**, as the variables were interrelated with time-related issues.

Table 5: Rotated component matrix for causes of dispute during the planning phase

Causes of dispute during the planning phase	Components				
	1	**2**	**3**	**4**	**5**
Poor estimation practices	.492	.162	.653	-.026	.163
Unrealistic project planning	.442	-.021	.672	.011	.272
Delay in obtaining permit or approval from the municipality and the other governmental authorities	-.032	-.002	.074	.125	.886
Inadequate design information	.710	.264	.001	.200	.188
Design errors	.847	-.013	.132	.152	.048
Poor quality design	.851	.124	.116	-.051	.119
Inconsistencies between the drawings and specifications	.743	.233	.136	.330	-.147
Short time available during design stage	.410	.128	.107	.048	.435
Inadequate and incomplete specification	.719	.359	.095	.158	.013
Poor and ineffective communication between parties in the project	.484	.355	.257	.018	-.052
Ambiguities in the contract documents	.504	.613	.239	.145	-.114
Types of procurement method adopted	.049	.453	.184	.333	.497
Misinterpretation of contract documents	.204	.856	.069	-.010	.088
Different interpretations of the contract provisions	.101	.891	.083	.111	.069
Lack of understanding and agreement on the type of contract	.247	.742	-.011	.304	.100
Incorrect pricing of the works	.207	.033	.237	.828	.121
Unfair risk allocation	.164	.317	.013	.718	.160
Selection of contractors based on the low bids only without considering their technical capabilities	-.059	.152	.809	.331	-.011
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. a. Rotation converged in 7 iterations.					

Execution, Monitoring, and Controlling Phase

Table 6 shows that for the execution, monitoring, and controlling phase, the computation has yielded seven principal components with eigenvalues of greater than 1.0.

Table 6: Total variance explained for causes of disputes during the execution, monitoring and controlling phase

C	IE			ESSL			RSSL		
	T	% of Var	Cum %	T	% of Var	Cum %	T	% of Var	Cum %
1	10.588	34.155	34.155	10.588	34.155	34.155	4.852	15.651	15.651
2	2.821	9.100	43.255	2.821	9.100	43.255	3.331	10.745	26.396
3	2.083	6.719	49.974	2.083	6.719	49.974	3.029	9.770	36.166
4	1.599	5.158	55.132	1.599	5.158	55.132	2.721	8.778	44.945
5	1.488	4.798	59.930	1.488	4.798	59.930	2.701	8.714	53.659
6	1.379	4.448	64.379	1.379	4.448	64.379	2.293	7.396	61.054
7	1.142	3.682	68.061	1.142	3.682	68.061	2.172	7.007	68.061

According to the rotated component matrix in Table 7, the causes of dispute during this phase can be grouped into seven clusters. There were eight variables with high correlations with Component 1. These variables were directly related to contractual issues, resulting in Component 1 being themed as **"Contract-related causes"**. Next, all variables under Component 2 can be linked under the theme of **"Contractor's competencies and capabilities-related causes"**, while the third principal component was clustered as **"Client-related causes"** because of their variables' direct relation to clients' affairs. With variables highly related to cost adjustment issues, Component 4 was labelled as **"Disagreement on cost adjustment-related causes"**, whereas Component 5 was themed as **"Change request and claims-related causes"**. After analysing the characteristics of the variables in Component 6, it was labelled as "**Time-related causes"**, as the variables were strongly connected to time-related problems. Finally, due to their characteristics and strong interaction with project risks and issues of uncertainty, the three variables in Component 7 were assigned under the theme of **"Project risk and uncertainties-related causes".**

Table 7: Rotated component matrix for causes of disputes during the execution, monitoring, and controlling phase

Causes of dispute during execution, monitoring, and controlling phase	Components						
	1	2	3	4	5	6	7
Variation orders	.084	.265	.153	.196	.728	-.070	.094
Changes in material specification	-.049	.084	-.025	.410	.663	.233	.177
Unforeseen ground conditions	.107	.032	-.129	.244	.043	.339	.681
Failure of the client to honour payments as and when due	.163	.102	.831	.063	-.015	-.038	.155
Time overruns	.163	.250	.306	-.038	.239	-.048	.745
Cost overruns	.202	.170	.434	.109	.255	-.100	.653
Poorly drafted or incomplete and unsubstantiated claims	.354	.011	.163	.365	.466	.085	-.045
Failure to make interim awards on the extension of time and compensation	.253	-.003	.801	-.009	.087	.165	.029

Causes of dispute during execution, monitoring, and controlling phase	**Components**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Failure of the major stakeholders in understanding and complying with their contractual obligations	.792	-.051	.143	.108	.127	.205	.124
Failure to properly administer the contract	.774	.350	.176	-.046	.107	.103	.009
Mishandling the construction process	.679	.371	.047	.087	.045	.320	.149
Poor quality of work	.485	.177	-.107	.024	.636	.217	.176
Lateness in giving of site possession	.143	.059	.192	.044	.196	.776	.101
Delay in work progress	.072	.368	.118	-.026	.531	.353	.242
Technical inadequacy	.428	.519	-.009	-.014	.274	.374	.234
Unrealistic contract duration	.300	.252	.297	.263	.180	.163	.276
Labour inefficiencies	-.091	.471	-.182	.413	.044	.283	.341
Contractor's inadequate experience	.259	.650	.146	-.034	.159	.092	.072
Ineffective planning and scheduling of the project by the contractor	.280	.698	.055	.135	.095	-.048	-.013
Unavailability of cash flow faced by the contractor	.006	.636	.139	.382	.068	-.110	.156
Request for project acceleration	-.031	.328	.464	.380	.120	.484	-.082
Poor productivity	.163	.601	-.034	.093	.333	.239	.179
Disagreement over scope variation	.660	.041	.294	.229	.124	-.154	.242
Delay in issuing site drawings and materials	.548	-.059	.266	.267	.315	.361	.146
Materials damaged during storage	.113	.482	.061	.434	-.064	.456	.033
Late instruction by the employer	.251	.052	.580	.214	.195	.412	-.003
Poor and ineffective communication between the parties in the project	.720	.179	.127	.113	.207	.028	.020
Breach of contract	.773	.226	.175	.021	-.155	-.117	.025
Unrealistic expectation of the client	.393	.091	.521	.365	-.140	.130	.324
Changes in rate due to quantity variations	.225	.174	.085	.779	.192	-.005	.123
Changes in material source and cost	.112	.129	.168	.782	.275	.133	.073
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. a. Rotation converged in 22 iterations.							

Strategies to Minimise Dispute

Initiation Phase

Table 8 shows that only one component has an eigenvalue of greater than 1.0 under the initiation phase.

Table 8: Total variance explained for strategies to minimise dispute during the initiation phase

C	**IE**			**ESSL**		
	T	**% of Var**	**Cum %**	**T**	**% of Var**	**Cum %**
1	1.552	77.624	77.624	1.552	77.624	77.624
2	.448	22.376	100.000			

Table 9 shows that both variables have a strong correlation with Component 1. Thus, Component 1 was assigned the theme of **"Developing business case-related strategies"** because business case development was among the activities performed during the initiation phase (PMI, 2017). The strategies listed during this phase were also highly relevant to be practised during the abovementioned activity.

Table 9: Component matrix for strategies to minimise dispute during the initiation phase

Strategies to minimise dispute during the initiation phase	Component
	1
Established a clear definition of project scope	.881
Preserve a good relationship between the project team members	.881
a. 1 components extracted.	

Planning Phase

Table 10 summarises the total variance that can be explained for this data set with five principal components because they have an eigenvalue of greater than 1.0.

Table 10: Total variance explained for strategies to minimise dispute during the planning phase

C	IE			ESSL			RSSL		
	T	% of Var	Cum %	T	% of Var	Cum %	T	% of Var	Cum %
1	7.474	39.334	39.334	7.474	39.334	39.334	3.030	15.946	15.946
2	2.053	10.807	50.141	2.053	10.807	50.141	2.910	15.318	31.264
3	1.340	7.053	57.194	1.340	7.053	57.194	2.601	13.689	44.953
4	1.150	6.050	63.244	1.150	6.050	63.244	2.591	13.635	58.588
5	1.028	5.408	68.652	1.028	5.408	68.652	1.912	10.064	68.652

Table 11 shows that the strategies under the planning phase can be clustered into five main components. With the highest value of 39.33%, variables under Component 1 were highly correlated with tackling quality issues; hence, Component 1 was themed as **"Quality-related strategies"**. Component 2 was labelled as **"Business relationship-related strategies"** and Component 3 was labelled as **"Technical competencies-related strategies"**, since the associated variables can be linked to improving technical competencies. Next, Component 4 accounted for 6.05% of the total variance explained, and the variables can be intrinsically related to the theme of **"Design and procurement-related strategies"**. Lastly, based on their clear connection to improving productivity, Component 5 was unambiguously assigned the theme of **"Productivity-related strategies".**

Table 11: Rotated component matrix for strategies to minimise dispute during the planning phase

Strategies to minimise dispute during planning phase	Components				
	1	2	3	4	5
Execute proper risk allocation	.183	.205	-.001	.796	.095
Allocate adequate time to prepare for contract documentations	-.026	.217	.029	.679	.182
Establish an efficient communication system	.495	.212	.123	.431	.102
Early detection of problems	.594	.168	-.001	.522	.043
Provide timely resolution for problems	.414	.296	.197	.537	.025
Develop trust between parties	.161	.807	.100	.333	.089
Develop teamwork between parties	.350	.735	.094	.289	.161
Develop long-term relationship between parties	.257	.751	.162	.164	.101
Select an experienced contractor to undertake the project	-.036	.047	.885	.051	.119
Contractors should not take projects beyond their technical capabilities	.146	.089	.902	.023	.000
Clients should be punctual in giving instructions	.217	.127	.390	.383	.496
Consultants need to prepare clear and comprehensive documentation	.421	.058	.206	.465	.421
Select a professional construction team	.384	.209	.731	.115	.025
Quality control checks before issuance of documents	.669	.202	.310	-.016	.207
Proper record keeping	.824	.152	.053	.153	.032
Ensure full understanding of the contract requirements prior to signing the agreement	.667	.324	.111	.106	.303
Clients need to prepare an effective project planning	.129	.093	.202	.312	.664
Preserve a good relationship between the project team members	.135	.759	.080	.124	.490
Adopt digital technology to facilitate coordination and early detection of problems	.108	.280	-.130	-.022	.747
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. a. Rotation converged in 7 iterations.					

Execution, Monitoring and Controlling Phase

Table 12 shows the three components that have emerged with eigenvalues of greater than 1.0.

Table 12: Total variance explained for strategies to minimise dispute during the execution, monitoring, and controlling phase

C	IE			ESSL			RSSL		
	T	% of Var	Cum %	T	% of Var	Cum %	T	% of Var	Cum %
1	5.452	49.566	49.566	5.452	49.566	49.566	2.862	26.016	26.016
2	1.270	11.548	61.114	1.270	11.548	61.114	2.696	24.513	50.529
3	1.023	9.303	70.417	1.023	9.303	70.417	2.188	19.888	70.417

The rotated component matrix, as shown in Table 13, illustrates the correlation between the variables and the components. Component 1 was themed as **"Business relationship-related strategies"**, while Component 2 was labelled as **"Productivity-related strategies"** because of their direct link to improving productivity issues. Finally, Component 3 was labelled as **"Payment-related strategies"**, since both variables were closely related towards resolving payment disputes.

Table 13: Rotated component matrix for strategies to minimise dispute during the execution, monitoring, and controlling phase

Strategies to minimise dispute during the execution, monitoring, and controlling phase	**Components**		
	1	**2**	**3**
Efficient communication	.623	.151	.465
Early detection of problems	.383	.692	.120
Provide timely resolution for problems	.615	.471	.199
Develop trust between parties	.858	.232	.064
Preserve a good relationship between the project team members	.857	.229	.142
Clients should avoid making unnecessary variations	.155	.739	.218
Clients should be punctual in giving instructions	.251	.763	.311
Proper record keeping	.537	.362	.301
Proper payment schedule	.190	.210	.914
Payment as and when due	.175	.193	.907
Adoption of digital technology to facilitate coordination and early detection of problems	.188	.726	.042
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. a. Rotation converged in 4 iterations.			

Framework Development

The framework, built upon the substantiated and data-driven findings derived from the analysis of PCA results, offers a meticulously structured outline that encompasses both the identified causes and the strategic approaches relevant to each specific project phase (Refer to Figure 1). It is important to highlight that the results regarding the causes of disputes during the planning stage consistently align with the findings from a previous study. This earlier study suggests that the implementation of a rigorous tendering procedure is essential to foster ethical conduct among contractors (Ismail et al., 2017). Emphasising the significance of ethical conduct, especially during the planning stage and particularly within the tendering process, is crucial. Neglecting ethics in this context can lead to a decreased competitiveness in tendering, potentially leading to the selection of inappropriate contractors, and ultimately, adversely impacting the overall performance of the project.

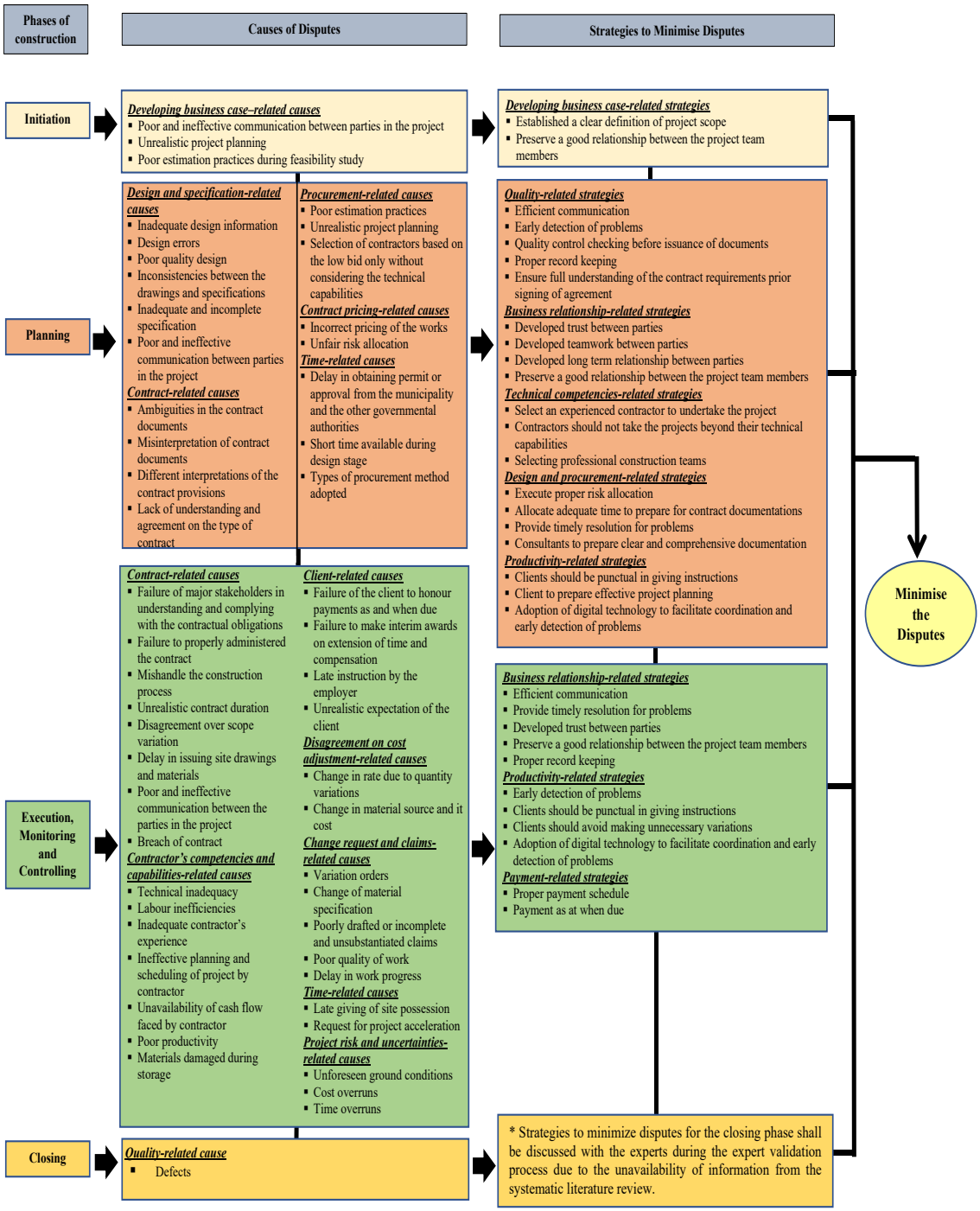

Figure 1: Preliminary framework to minimise the construction dispute in building projects

CONCLUSION

Overall, it is interesting to note that the PCA grouping has shown that the **"Contract-related causes"** and **"Time-related causes"** were nominated twice as the themes for causes of dispute, which indicated that these two groups can be deemed as the main contributory factors to dispute occurrences. These findings contributed to the knowledge area of project risk management, as disputes are considered as risks in a project that can influence its success rate. Despite facing several limitations, the findings of this study are expected to provide a general guideline for preventing dispute occurrences for construction practitioners. Furthermore, framework validation via expert validation could be done to further enhance the research findings, specifically to address the gaps in dealing with disputes during the closing phase which was not discovered during the SLR process.

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REFERENCES

Adegbembo, T. F., Awodele, O., & Oke, A. (2020). A principal component analysis of knowledge management success factors in construction firms in Nigeria. *Journal of Construction Project Management and Innovation, 10*(1), 42-54.

Assaf, S., Hassanain, M.A., Abdallah, A., Sayed, A. M. Z., & Alsharani, A. (2019). Significant causes of claims and disputes in construction projects in Saudi Arabia. *Built Environment Project and Asset Management, 9*(5), 597-615.

Ayudhya, B. I. N. (2011). Common dispute related to public work projects in Thailand. *Songklanakarin Journal of Science and Technology*, *33*(5), 565-573.

Cakmak, E., & Cakmak, P. I. (2014). An analysis of causes of disputes in the construction industry using analytical network process. *Procedia-Social and Behavorial Sciences,* 109, 183-187.

Cohen, L., Manion, L., & Morrison, K. (2007). Research Methods in Education (6th ed.). Routledge Publishers, New York.

Dogbegah, R., Owusu-Manu, D, & Omoteso, K. (2011). A principal component analysis of project management competencies for the Ghanaian construction industry, *Australasian Journal of Construction Economics and Building,* 11(1), 26-40.

Elhag, T, Eapen, S., & Ballal, T. (2019). Moderating claims and disputes through collaborative procurement. *Construction Innovation, 20*(1), 79-96.

El-Sayegh, S., Ahmad, I., Aljanabi, M., Herzallah, R., Metry, S. & El-Ashwal, O. (2020). Construction disputes in the UAE: Causes and resolution methods. *Buildings,* 10(171), 1-14.

Field, A. (2005) Discovering Statistics Using SPSS, 2nd ed., Sage, London.

Hadi, N. U., Abdulah, N., & Sentosa, I. (2016). An easy approach to exploratory factor analysis: Marketing perspective. *Journal of Educational and Social Research,* 6(1), 215-223.

Ismail, F., Mohd Danuri, M.S., Mohamed, O., Abd-Karim, S.B. and Mohd Nawi, M.N. (2017). Ethics-Related Issues in the Tender Evaluation of Malaysia Public Projects. *Journal of Design and Built Environment*, Special Issue 2017.

Karji, A., Namian, M., & Tafazzoli, M. (2020). Identifying the key barriers to promote sustainable construction in the United States: A principal component analysis. *Sustainability,* 12, 1-20.

Kissi, E., Boateng, E. B., Adjei-Kumi, T., & Badu, E. (2017). Principal component analysis of challenges facing the implementation of value engineering in public projects in developing countries. *International Journal of Construction Management,* 17(2), 142-150.

Mahamid, I. (2016). Micro and macro level of dispute causes in residential building projects: Studies of Saudi Arabia. *Journal of King Saud University,* 28, 12-20.

Mohd-Nordin, R., Mohd-Ahnuar, E., Nasid-Masrom, M. A, Ameer-Ali, N. (2023). Examining Corruption Issues In Malaysia Construction Industry: Partaker Perspectives. *Planning Malaysia: Journal of the Malaysian Institute of Planners*, Vol. 21(2), 52-68.

Muhammuddin, N. N., Mohd-Danuri, M. S. and Hanid, M. (2022). Dispute Occurrences During Construction Stages of Building Project: A Systematic Literature Review, Journal of Project Management and Practice, Vol. 2(1), 1-19.

Mukilan, K., BalaNivetha, M., Velumani, P., & Christopher, G., S. (2019). A qualitative study and analysis of causes and disputes in claims in construction industry. *International Journal of Civil Engineering and Technology,* 10(1), 951-957.

Obeng-Ahenkora, N. K., & Danso, H. (2018). Principal component analysis of factors influencing pricing decisions of building materials in Ghana. *International Journal of Construction Management,* 1-9.

Omaraka, A. E. (2020). A principal component analysis of supply chain management skills for the Nigerian construction industry. *International Journal of Construction Management,* 1-10. Doi: 10.1080/15623599.2020.1797984

Pallant, J. (2013). SPSS Survival Manual. A step-by-step guide to data analysis using SPSS, 4th edition. Allen & Unwin. Retrieved from: www.allenandunwin.com/spss

PMI. Project Management Institute. (2017), *A guide to the project management body of knowledge PMBOK guide.* 6th ed. Newton Square, Pennsylvania: Project Management Institute, Inc.

Saar, C. C., Chuing, L. S., Hai, T. K., Yusof, A. M. (2017). Modelling dispute management in construction industry, *Malaysian Journal of Civil Engineering 29 Special Issue*, 1, 1-14.

Sakyiama, E. (2016). *Managing discords, disputes and conflicts in the Ghanaian construction industry: An empirical examination of traditional procurement of assembly projects*. [Master dissertation, University of Education, Winneba].

Soni, S., Pandey, M., & Agrawal, S. (2017). Conflicts and disputes in construction projects: An overview. *International Journal of Engineering Research and Application,* 7(6), 40-42. Treacy, D., Spillane, J. P., & Tansey, P. (2015).

Construction disputes in small to medium enterprises in Ireland during recession. *International Journal of Law in the Built Environment, 8*(1), 21-41.

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