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Determinants of Successful Collaborative Project Management: Insights From Malaysian Construction Industry

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Abstract. Project management (PM) has garnered significant attention from both academia and business stakeholders to understand the factors that contribute to the success of project delivery. Despite years of accumulated experience and a significant increase in the number of certified project managers, the success rate of construction projects remains relatively low. This study aims to explore possible determinants for collaborative project management success and validate the framework in the context of the Malaysian construction industry. Specifically, the study tested project management maturity, decision-making management, knowledge management, organizational culture, coordination, and PM certification as antecedents for collaborative project management success. The study adopted a quantitative research approach and used a close-ended questionnaire as the data collection instrument. The questionnaires were distributed to local project practitioners, and the 232 responses were analyzed using Partial Least Squares of the Structural Equation Modeling (PLS-SEM). The empirical evidence indicates significant relationships between the identified determinants and project management success. The study's findings can be applied to manage construction projects or any other collaborative project and also contribute to the project management body of knowledge and elaboration of Coordination Theory application in home construction projects. However, emerging challenges to PM in the post-COVID era suggest that further studies on PM success factors are necessary.

Keywords: Business decision making; Collaborative project management; Coordination; Knowledge management; Project management maturity

1. Introduction

Project Management (PM) is vital for success and competitive advantage (PMI, 2020), with its historical roots lie in efficient resource management (Meirelles *et al.,* 2019). PM has evolved significantly in the last decade (Söderlund, 2004), becoming a critical field with practical and theoretical research (Vergopia, 2008). Despite this, construction project success rates remain low globally and in Malaysia (Ahmad, Mohd, and Ab, 2021). PM involves the practical application of knowledge, tools, and techniques to deliver projects (PMI, 2017), distinct from managing operations (PMI, 2019). Success assessment often focuses on cost, time, and quality, neglecting overall objectives (Carvalho and Junior, 2015; Davis, 2017; Vergopia, 2008). Emerging trends include agile, sustainability, and collaborative management (PMI, 2020a). Collaboration with stakeholders is crucial for

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effective PM (Miller and Oliver, 2015). Collaboration thrives when beneficial outcomes are anticipated (Blomquist *et al.,* 2010). Collaborative projects involve distinct team members forming virtual teams (Silva, 2011), constituting collaborative PM. Jabar *et al.* (2019) highlighted the need to understand key competencies for PM success.

Jupir *et al.* (2022) suggest that PM maturity, knowledge management, and decision-making have an impact on PM success, and these factors are moderated by culture and certification, with coordination acting as a mediator. PM maturity refers to an organization's effectiveness in project management (Sopko, 2015), which, in turn, influence collaborative PM outcomes (Ibbs *et al.,* 2007). However, evidence linking PM maturity to project value is limited (Thomas and Mullaly, 2007). Knowledge management (KM) facilitates shared context (Clarke and Cooper, 2000) and enhances coordination for project success. Decision-making is vital in complex projects (Goff, 2012), but construction sites present unique challenges. Examining how coordinating parties facilitate decision-making in construction projects is essential. PM skills are critical (Henkel *et al.*, 2019), while the impact of project manager certification is unclear (Natchayangkun, 2014). Organizational culture influences project planning and coordination (Suda, 2007). Investigating how cultural components affect decision-making and coordination provides insights. Lastly, coordination among project team members and tasks, considering complexity, uncertainty, and organizational structure, impacts project success (Mannan, Haleem, and Jameel, 2013). Examining coordination's role, particularly in the construction industry, is valuable (Berawi, 2021).

Thus, this paper presents the validation of the proposed framework for the successful management of collaborative projects within the context of the Malaysian construction industry. To achieve this objective, the study addresses the primary research question: What are the determinants for successful collaborative project management (CPM)?.

2. Methods

Consistent with previous studies, this study used quantitative methods for data collection and analysis (Jamieson, Govaart, and Pownall, 2023; Ponto, 2015). Data was collected using self-administered questionnaires in printed and Google online form to cover a larger target population (Check and Schutt, 2012). Invitation to complete the form was distributed to project practitioners in Malaysia. Out of 350 invitations sent, 232 completed forms were received. The response rate (66.2%) is considered acceptable to provide fair, confident estimates (Fosnacht *et al.,* 2017; Chong and Zin, 2010). Cronbach's alpha scores for internal consistency are above 0.8 for all variables; hence, this research is considered to have an adequate sampling to test the hypothesis. Data were analyzed using SmartPLS 3.0 software. PLS-SEM is considered an appropriate method to assess the results since the algorithm permits the unrestricted computation of cause-effect relationship models for the reflective measurement models employed in this study (Diamantopoulos and Siguaw, 2006). In the process of examining the relationships between variables, the study assessed the measurement model for reliability and construct validity, and also evaluated the structural model for hypothesis relationships, following the recommendations of Hair *et al.* (2018).

2.1. Research Framework

The research framework (see Figure 1), first proposed in the first phase of this study (Jupir *et al.,* 2022), consisted of three independent variables, namely Project Management Maturity (PMM), Decision Making System (DMS), and Knowledge Management (KMM); one dependent variable namely CPM Success (SCS); two moderating factors namely Culture

(CUL) and Certification (CER); and Coordination (CDN) as the mediating factor. The following are the finalized hypotheses tested in this study;

- H1: PMM has a positive, significant influence on SCS
- H2: DMS has a positive, significant influence on CDN
- H3: KMM has a positive, significant influence on CDN
- H4: CUL has a positive, significant influence on CDN
- H4a: CUL moderates the relationship between the DMS and CDN
- H5: CER has a positive, significant influence on SCS
- H5a: CER moderates the relationship between PMM and SCS
- H6: CDN has a positive, significant influence on SCS
- H6a: CDN mediates the relationship between the DMS and SCS
- H6b: CDN mediates the relationship between KMM and SCS

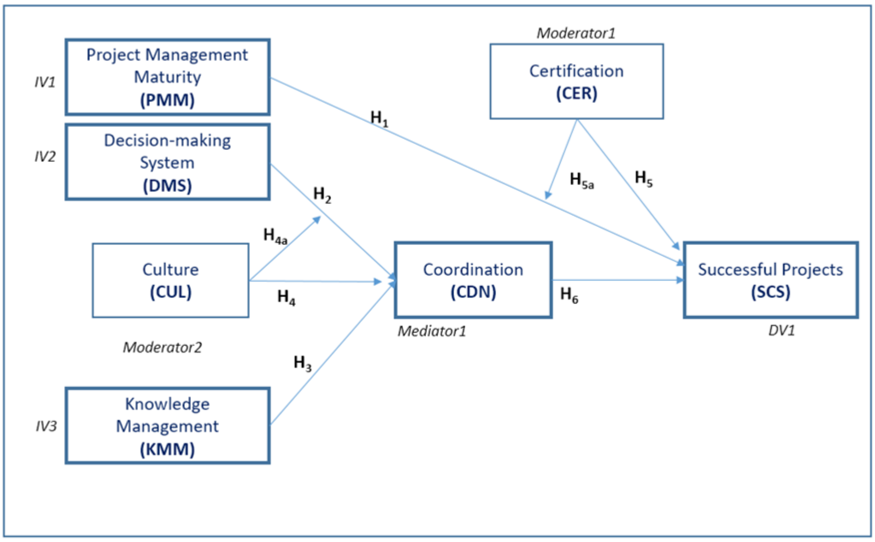

Figure 1 Research Framework (Jupir *et al.,* 2022)

3. Results and Discussion

3.1. Measurement Model

The proposed model for the framework was tested for internal consistency, convergent validity, and discriminant validity (Hair *et al.,* 2018). Listed in Table 1, average factor loadings for all items are above 0.7, indicating the model's constructs explained more than fifty percent of the indicator's variance; hence, the factor loading satisfied the cut-off values, and the items in the questionnaires are reliable for the measurement model assessment. The constructs' internal consistencies were estimated using Cronbach's Alpha, Rho Alpha, and Composite Reliability (Samani, 2016; Hair, Ringle, and Sarstedt, 2012). Table 1 displays Cronbach's Alpha values for all the constructs, ranging from 0.786 to 0.935. These values indicate high internal consistency reliability for the constructs' scale and suggest that the content of the items is not heterogeneous (Taber, 2018; Kline, 2011). Composite Reliability results between 0.885 and 0.953; hence, the internal consistency of this research is statistically confirmed. Rho Alpha minimum value of 0.876 is between Cronbach's Alpha (0.786) and CR (0.885); the maximum value of Rho Alpha of 0.939 is between Cronbach's

Alpha of 0.935 and CR of 0.953. The cut-off value of the coefficient of Rho Alpha must be greater than 0.7 (Dijkstra and Henseler, 2015).

Convergent validity measures the relationships between constructs using Average Variance Extracted (AVE) and Composite Reliability (CR). The AVE for the constructs falls within the range of 0.518 to 0.854, which exceeds the minimum recommended value of 0.50, according to Hair *et al.* (2018). The results showed values of factor loadings, CR, and AVE are greater than the recommended cut-off values; hence, the measurement model is confirmed for having a convergent validity. All constructs have achieved the minimum estimation required, which are 0.70 for Cronbach Alpha, 0.60 for CR, and 0.50 for AVE. The results indicated DMS, CER, CUL, CDN, KMM, PMM, and SCS are valid measurements of their respective constructs. Discriminant validity provided evidence that those constructs that theoretically should not be related to each other are not found to be related to each other (Henseler *et al.,* 2015). In Table 2, all constructs in the path model are not considered distinct from each other; each of the constructs is trying to validate project success from a different perspective. All constructs in this research have an HTMT value below 0.90; hence, acceptable discriminant validity for the model of the constructs (constructs is trying to validate project success from a different perspective (Henseler *et al.,* 2015).

Table 1 Reflective Measurement Model

Construct	Item	Loadings	Cronbach's Alpha	rhoA	Composite Reliability	Average Variance Extracted (AVE)
DMS	1	0.766	0.826	0.828	0.885	0.658
	2	0.812				
	3	0.845				
	4	0.819				
CER	1	0.884	0.786	0.789	0.876	0.703
	2	0.855				
	3	0.772				
CUL	1	0.824	0.864	0.868	0.908	0.710
	2	0.846				
	3	0.834				
	4	0.867				
CDN	1	0.609	0.883	0.895	0.906	0.518
	2	0.668				
	3	0.769				
	4	0.798				
	5	0.792				
	6	0.781				
	7	0.699				
	8	0.718				
	9	0.615				
KMM	1	0.927	0.829	0.830	0.921	0.854
	2	0.921				
PMM	1	0.818	0.837	0.838	0.902	0.755
	2	0.895				
	3	0.892				
SCS	1	0.929	0.935	0.939	0.953	0.837
	2	0.932				
	3	0.891				
	4	0.906				

3.2. Structural Model

This study used the coefficient of determination (R2), estimation of path coefficient (β), effect size (f2), and prediction relevance measure (Q2) for the assessment of the structural model of CPM as per suggestion by Hair *et al.* (2017), and Henseler *et al.* (2009). Results indicate that CDN and SCS have moderate fit with R2 of 0.683 and 0.585, respectively, plus Adjusted R2 of 0.677 for CDN and 05.78 for SCS (Hair *et al.,* 2017; Chin, 1998). An R2 of 0.683 indicated over 68 percent of the variation in the outcome has been explained just by predicting the outcome using the CDN variables of the model. The estimation of the path coefficient tests the significance of the hypotheses. Table 2 shows the direct effect of the independent variables on the SCS in the path model. The findings in Table 2 confirmed that the PMM-related factor significantly influenced project quality (β = 0.486, T = 7.506, p = 0.000). Hence, H1 was considered supported. Observing the positive influence of the DMS-related factors on CDN (H2), the findings endorsed that the DMS factor positively influenced CDN (β = 0.254, T = 3.903, p = 0.000), and confirmed H2. The influence of the KMM-related factor on CDN was positive and significant (β = 0.236, T = 3.363, p = 0.000), showing that H3 was supported. The effect of the CUL-related factors on CDN was significant (β = 0.427, T = 6.586, p = 0.000), therefore supporting H4. Similarly, the findings provided practical support for H6, where the influence of the CDN-related factors on SCS positively affected SCS with β of 0.206, T at 2.919, and p-value slightly over zero at 0.002 only.

In Table 2, each hypothesis in the model had a value of over 0.02, with PMM having a moderate value of 0.300 on the scale. Following Cohen (1988) guideline for the interpretation of the effect size, the results of f2 suggested the effect sizes of PMM, CER, and CDN as exogenous latent variables have medium effects on endogenous variable SCS. The moderate impact of the effect size of the population suggested that another independent variable(s) would have no apparent effect on the dependent variable's shared variance. Q^2 proposed a model must be able to provide a prediction of the dependent variable's measuring items for the model to be valid (Hair *et al.,* 2017). The results (CDN: Q2 = 0.318; SCS: Q2 = 0.451) showed that the cross-validation redundancy measure Q^2 is above zero, suggesting the model has a good predictive relevancy (Henseler *et al.,* 2009; Fornell and Cha, 1994). Standardized Root Means Square Residual (SRMR) measured the estimated model fit by transforming the sample covariance matrix and the predicted covariance matrix into correlation matrices to avoid model misspecification (Henseler *et al.,* 2015). The model yielded an SRMR of 0.071, where a value of 0.08 or lower suggests a good model fit (Hussain *et al.,* 2018).

3.3. Structural Model

Table 2 shows the moderating impact of CER on the relationship between PMM and SCS; the relationship between PMM and SCS is significantly positive (β = -0.128, T = 2.394, p = 0.0080); hence, H5a was supported. The direct path standardized beta for the relationship between PMM and SCS is 0.486, which changed to -0.128 after introducing CER as the moderator. The decrease in the relationship between PMM and SCS accounted for by the moderator was 0.614, representing over 127% of the direct effect. The influence of CUL on the relationship between the DMS function factor and CDN factor is positively significant (β = 0.149, T = 5.260, p = 0.000), showing that H4a is supported. The direct path standardized beta for the relationship between DMS factors and CDN is 0.254 and changed to 0.149 after the introduction of CUL as the moderator. The decrease in the relationship between the DMS factor and CDN accounted for by the moderator is 0.105, or 41.33% of the direct effect.

3.4. Mediating Effects

The influence of CDN on the relationship between DMS and a Successful Project is positively significant (β = 0.122, T = 3.615, p = 0.000), showing that H6a is supported (Table 8). Looking at the next hypothesis, the influence of the CDN on the relationship between KMM-related factors and Successful Projects was found to be positive and significant (β = 0.102, T = 3.054, p = 0.002), showing that H6b is supported. As the p-value is above 0.050 (p = 0.098), the model shows a mediation correlation by the mediating variables; hence, DMS and KMM exert their influence through CDN in ensuring PM success. This study aims to investigate the structural relationship between collaborative PM components and project success by examining the hypothesized model, with all ten hypotheses being supported.

Table 2 Hypotheses Testing

	MODEL	Beta	Lower boundary 5%	Upper boundary 95%	Standard error	T value	P Value	f^2	Decision
H_1	PMM -> SCS	0.486	0.377	0.587	0.065	7.506	0.000	0.300	Supported
H_2	DMS -> CDN	0.254	0.144	0.355	0.065	3.903	0.000	0.077	Supported
H_3	KMM -> CDN	0.236	0.124	0.351	0.070	3.363	0.000	0.061	Supported
H_4	CUL -> CDN	0.427	0.320	0.533	0.065	6.586	0.000	0.203	Supported
H_5	CER -> SCS	0.163	0.055	0.266	0.065	2.493	0.006	0.029	Supported
H_6	CDN -> SCS	0.206	0.098	0.330	0.071	2.919	0.002	0.040	Supported
Moderation									
$H4_a$	CUL X DMS -> CDN	0.149	0.103	0.195	0.028	5.260	0.000	0.104	Supported
H_{5a}	CER X PMM -> SCS	-0.128	-0.216	-0.041	0.054	2.394	0.008	0.044	Supported

Table 3 Mediation Effects of Coordination (CDN)

	Indirect Beta	Lower boundary 5%	Upper boundary 95%	Standard error	T value	P Value	Decision
H6a DMS -> CDN -> SCS	0.122	0.063	0.195	0.034	3.615	0.000	Supported
H6b KMM -> CDN -> SCS	0.102	0.048	0.177	0.033	3.054	0.002	Supported

3.5. Discussion

Organizations with higher PMM levels tend to deliver more successful projects (Mittermaier and Steyn, 2012; Cooke-Davies and Arzymanow, 2003), supported by previous research (Gorecki, 2014; Mir and Pinnington, 2014; Prado *et al.,* 2014; Ofori, 2013). Having the right tools, best practices, and competent personnel enhances project management (Jaleel and Khan, 2013). This study also found a direct relationship between PM success and project manager certification, with certification amplifying PMM's impact. Project managers' competencies influence organizational PMM (Ngonda and Jowah, 2020), with a growing trend of organizations considering certification for PM skills development (PMI, 2020). Project complexity, uncertainty, and structure determine team coordination levels (Strode, 2012). Construction industry collaboration leads to task interdependencies (Blomquist *et al.,* 2010), emphasizing the importance of communication for decision-making and information-sharing (Cohen *et al.,* 2007). In collaborative projects, success is a cohesive result, with common goals and effective communication reducing work delays. A Community of Practices and specialized social groups highlight collaboration.

Organizational culture and shared context guide employee behavior (Clarke and Cooper, 2000). Effective project teams rely on trust, cooperation, and continuous teamwork, contrasting with traditional construction projects marked by competitive relationships and ineffective communication. In the construction industry, knowledge management systems are crucial due to staff turnover, external expertise reliance, and inexperienced project managers. Improving PM capabilities should go hand in hand with enhancing knowledge management processes, including adopting digital solutions (Tereshko and Rudskaya, 2021). Capturing personal knowledge for corporate use is essential. Social media platforms like YouTube and Instagram are emerging alternatives for tacit knowledge sharing, warranting further study. Coordination affects information-sharing willingness, yet understanding cognitive structures in practical knowledge-sharing among team members from different companies requires more research.

4. Conclusions

Project Management (PM) is vital for enhancing project delivery and organizational competitiveness. In construction, where collaboration among diverse parties is crucial, this research explored factors contributing to project success. It integrates Coordination Theory, Social Learning Theory, and Social Cognitive Theory to explain PM success in collaborative construction projects, emphasizing coordination's role in decision-making and knowledge management. The study's primary contribution lies in its practical implications. Project practitioners can apply its principles for effective project planning, execution, and monitoring. By focusing on the six factors in the collaborative PM model, project managers can enhance project success. Additionally, the study underscores the significance of PM certifications in selecting project managers. Data from Malaysian construction companies informed this study, but broader industry diversity would enhance understanding and statistical power. Furthermore, the study lacks specific project details like type, cost, timeline, and resources, which could offer further insights into PM success determinants. Including such project details may allow for additional analysis and a better appreciation of how such aspects influence PM success. Generally, as CPM become increasingly common, more studies are needed to better understand it for better project outcomes.

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