

Examining the Causal Relationships of Risk Management Variables in Construction Firms: A Structural Equation Modelling Approach

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Abstract—This study aims to develop and validate a causal model to explain risk management practices among construction firms in the Davao Region. Specifically, it would test the influence of buyer–supplier collaboration, top management commitment, and organizational culture on risk management through a structural equation modeling (SEM) approach. The researchers used a quantitative, descriptive-correlational design and collected data from 401 key operational personnel in construction firms selected as respondents. The results indicated high ratings for buyer–supplier collaboration, very high ratings for top management commitment and organizational culture, and high ratings for risk management practices. Correlation analysis revealed that all exogenous variables were significantly related to risk management. Results from regression and SEM further confirmed that organizational culture was the most direct influence on risk management, followed by buyer-supplier collaboration and top management commitment. The final structural model fit the data well, indicating that the three organizational variables had significant, combined effects on risk management. The findings show that to improve risk management practices, it is important to foster a collaborative environment, secure strong leadership commitment, and build an organization that is risk-aware. The study presents a model empirically validated and offers practical insights for construction firms seeking to enhance project resilience and performance.

Index Terms—Buyer–Supplier Collaboration, Construction Industry, Organizational Culture, Risk Management, Structural Equation Modelling, Top Management Commitment, Philippines.

1. Introduction

Risk management is indeed the most important aspect of any construction project, as it directly affects safety, financial viability, and success. Effective risk management will enable the construction company to identify, assess, and mitigate potential risks, thereby ensuring that the project is completed on time, within budget, and to the required standard. Re-evaluating this risk would help the company minimize disruptions, ensure operational efficiency, and protect its corporate reputation from incidents involving design faults, cost overruns, safety issues, and regulatory issues. Furthermore, a proactive risk management approach would foster a safe, responsible work culture by reducing accidents and improving

workforce morale. Last but not least, robust risk management not only safeguards investment value but also enhances a company's competitive edge in a challenging, dynamic market.

Construction projects are complex, and the involvement of multiple stakeholders and subcontractors makes it very hard to identify and mitigate the risks. Many companies fail to include comprehensive risk assessment practices in project management, thereby leaving them open to unforeseen events (Hair et al., 2022). Many construction firms without properly developed and systematic risk management approaches will only be escalating costs, reducing profit margins, and compromising project outcomes (Song, Munyinda, and Sarfo, 2025). Therefore, more than ever before, there is a need for improved strategies and tools to overcome such challenges.

Effective risk management in a construction company enhances buyer-supplier collaboration. It identifies potential challenges in advance, thereby allowing partners to devise strategies together to mitigate risks (Huma, Ahmed, & Najmi, 2020). This collaborative effort will help improve project efficiency and results by building trust among the parties involved. Also, top management commitment is crucial in construction companies as it fosters a culture of risk awareness and allocates resources necessary for effective risk management (Haldorai, Kim, & Phetvaroon, 2025). Moreover, risk management and organizational culture in a construction company are strongly interlinked, are proactive in fostering a free and open communication-based culture of collaboration, and are important for the identification and mitigation of future risks (Meno, 2020).

The objective of this research was to create and validate a path analysis model that accounts for the impact of buyer–supplier collaboration, commitment from top management, and organizational culture on risk management in construction companies located in the Davao Region. Specifically, the study assessed the degree of buyer–supplier collaboration, the level of commitment from top management, and the dominant organizational culture that influences risk-related behaviors within these construction firms. Additionally, the research sought to evaluate the current status of risk management

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practices in the region and to analyze the separate effects of buyer–supplier collaboration, top management commitment, and organizational culture on risk management strategies. Ultimately, this study aimed to develop an optimal structural equation model that illustrates the causal relationships among these variables and identifies the most significant predictors of effective risk management in the construction industry.

Moreover, research has been very limited and fragmented in the Philippine setting, with almost no evidence from the Davao Region, where construction firms contend with highly complex supply chains, variable leadership, and diverse cultures. Such a lack of comprehensive empirical models is a significant gap that this study seeks to address by developing and validating a structural equation model to capture the combined effects of these organizational predictors on risk management capability, thus offering new insights to both local and international construction risk literature. This study aimed to develop and validate a causal model explaining how buyer–supplier collaboration, top management commitment, and organizational culture influence risk management in construction firms in the Davao Region.

The proposed framework explains how these related variables shape risk management capability, thereby assisting construction firms in institutionalizing risk governance practices and improving their overall resilience and performance in a volatile project environment.

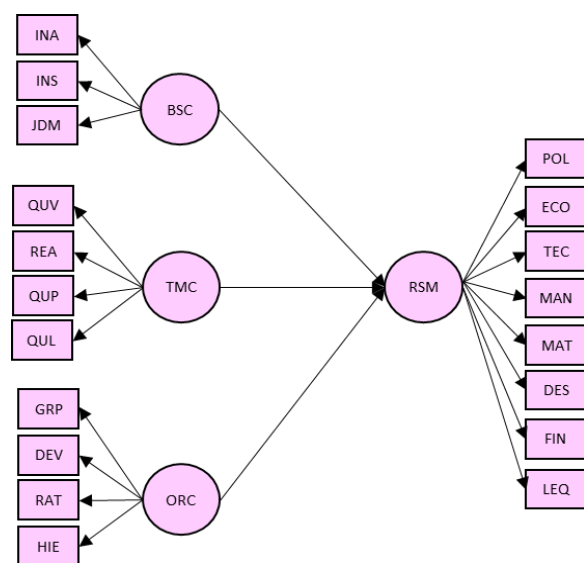


Fig. 1. A model showing direct causal relationship of buyer-supplier collaboration, top management commitment and organizational culture to risk management

Legend

BSC - Buyer-Supplier Collaboration
 INA - Incentive Alignment
 INS - Information Sharing
 JDM - Joint Decision Making

ORC - Organizational Culture
 GRP - Group
 DEV - Developmental
 RAT - Rational
 HIE - Hierarchical

TMC - Top Management Commitment
 QUV - Quality Vision
 REA - Resource Allocation
 QUP - Quality Policies
 QUL - Quality Leadership

RSM - Risk Management
 POL - Political
 ECO - Economic
 TEC - Technology
 MAN - Management
 MAT - Material
 DES - Design
 FIN - Finance
 LEQ - Labor and Equipment

2. Method

The participants were selected using a scientific approach and stratified sampling techniques. There were 401 key employees in operational roles at construction companies in Region XI, occupying positions such as project engineer, safety officer, materials engineer, and operations manager. Bagozzi and Yi (2012) suggest that a sample size of 200 or more is ideal for Structural Equation Modeling (SEM). In addition, Hair, Ringle, & Sarstedt (2013) recommend using SEM with larger samples to reduce measurement error. If the sample is too small, the relationships tested will not be valid, and a new model will have to be developed, as suggested by Creswell & Garrett (2008). Thus, a sample size of 400 is both justified and appropriate. They do not qualify because their field of study does not provide them with the necessary knowledge to assess construction operational risk management critically.

Stratified random sampling was used to make sure that key personnel from the selected construction firms in Davao Region were adequately represented. The respondents were key personnel directly involved in construction operations and risk management — project managers, site engineers, and safety officers. Stratification was based on the participating construction firms so that each organization was proportionately represented in the sample. Respondents were chosen within each stratum via simple random sampling to minimize selection bias and increase the representativeness of the data. This kind of sampling is appropriate because it provides more precise estimates, makes the reliability of comparisons across groups higher, and assures that important subgroups of the population are well represented, thereby making the study's findings more generalizable.

Primary data was collected using an adopted survey instrument. The different components of the instrument to be adopted and lifted from various related studies: buyer-supplier collaboration (Nyaga *et al.*, 2010), top management commitment (Wanyoike, 2016), organizational culture (Cameron & Quinn, 2011), and risk management (Adeleke *et al.*, 2019). The five orderable gradations of variables with respective response options, range of means, descriptions, and interpretation.

The validation process was conducted, followed by pilot testing. Cronbach's alpha was used to assess the questionnaire's reliability. The coefficient for Cronbach's alpha typically falls between 0 and 1. It was observed that as the internal consistency among the items in a particular scale increase, the Cronbach's alpha coefficient approaches one (Simon & Choi, 2018). The following are the guidelines for Cronbach's alpha concerning questionnaire reliability as proposed by George and Mallery (2018): A result that is equal to or greater than 0.90 is considered excellent; 0.80 indicates good; 0.70 is acceptable; 0.60 is questionable; 0.50 is deemed poor; and anything below 0.50 is categorized as unacceptable. The Cronbach's alphas of each construct are buyer-supplier collaboration (0.934), top management commitment (0.956), organizational culture (0.926), and risk management (0.958).

The research instrument obtained expert validation, with an overall mean score of 4.88, indicating excellent content validity

and confirming its adequacy for measuring the study variables. These were restructured and modified in accordance with the expert validators' suggestions. The responses in this study were labeled on a five-point scale. A mean score of 4.21 to 5.00 indicates Very High, meaning the statement is highly observed. A mean of 3.41 to 4.20 indicates High and indicates that the statement is often observed. A mean of 2.61 to 3.40 indicates Moderate, suggesting that the statement is sometimes observed. A mean of 1.81 to 2.60 indicates Low, indicating that the statement is seldom observed. Finally, a mean of 1.00 to 1.80 reflects Very Low and states that the statement is rarely observed.

3. Results and Discussions

This section shows the links between the study variables. To select the best-fit model for risk management practices, five structural models were considered. Each model was accepted or rejected based on its goodness-of-fit. The modeling process aimed to pick out the structural model that best captures the relationships among buyer–supplier collaboration, top management commitment, organizational culture, and risk management. A model is deemed acceptable if it shows consistency between the hypothesized relationships and the observed data.

Table 1 presents the goodness-of-fit indices for the five models developed. Only Model 5 of the set of models checked met all the necessary goodness-of-fit criteria. It had a p-value of 0.145, which is greater than the threshold of 0.05, indicating that the model fits the data. The CMIN/DF statistics of 1.736 is less than 2, the criterion for a good fit between the model and the data. Other aspects, such as the Goodness-of-Fit Index (GFI = 0.961), Comparative Fit Index (CFI = 0.967), Normed Fit Index (NFI = 0.962), and Tucker-Lewis Index (TLI = 0.959), all exceed the 0.95 benchmark, indicating very strong model fit. The Root Mean Square Error of Approximation (RMSEA = 0.028) is less than 0.05, and the P-close value is 0.131. > 0.05, confirming a good fit of the model to the data. Models 1 to 4 did not meet the criteria for a good fit because the goodness-of-fit indices were low, and the RMSEA values were high; hence, they were not accepted. In model refinement, the initial structure was modified by dropping nonsignificant paths and increasing the relationship between variables, under theoretical guidance and based on modification indices. This led to the structure that held the Model Fit indices within the recommended levels.

Figure 2 represents the final best-fit structural equation model. It shows the relationships among buyer–supplier collaboration (BSC), top management commitment (TMC), organizational culture (ORC), and risk management (RSM). The exogenous latent variables have direct and significant effects on the model, showing that all three exogenous latent variables have an impact on risk management. Of them, organizational culture ($\beta = 0.33$) has the most robust direct effect on risk management; top management commitment follows ($\beta = 0.26$) and buyer–supplier collaboration ($\beta = 0.30$) — both internal workings of the company and external teamwork play equally large roles in how construction companies manage risk.

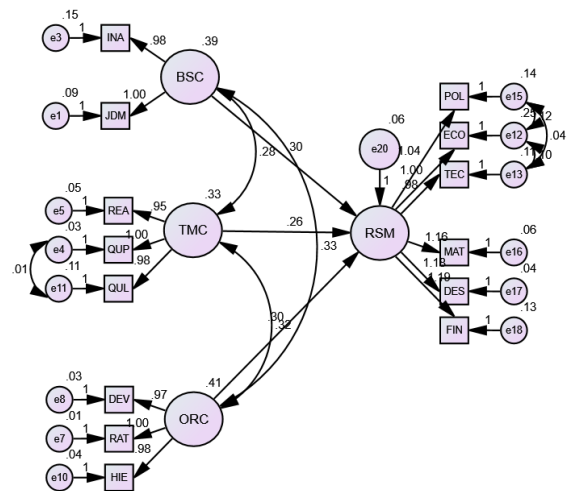


Fig. 2. Best Fit Model for risk management

Figure 2 for the final best-fit structural equation model that explains the causal relationships among buyer–supplier collaboration, top management commitment, and organizational culture and risk management in construction firms in Davao Region. The model shows that all three exogenous variables have direct and significant effects on risk management. Of the three, organizational culture is the most influential predictor ($\beta = 0.33$), followed by buyer–supplier collaboration ($\beta = 0.30$), and then top management commitment ($\beta = 0.26$). In other words, the practice of risk management will be effective when there are shared values in the organization, as well as collaboration and leadership commitment. Of the three predictors, organizational culture has the greatest influence, arguing that a flexible working environment, structured

Table 1
Summary of Goodness of Fit measures

Goodness-of-Fit Index	Criterion	Model 1	Model 2	Model 3	Model 4	Model 5
P-value	> 0.05	.000	.000	.000	.000	.145
CMIN/DF	< 2.00	18.112	11.853	11.853	2.774	1.736
GFI	> 0.95	.615	.676	.676	.910	.961
CFI	> 0.95	.786	.867	.867	.903	.967
NFI	> 0.95	.776	.857	.857	.938	.962
TLI	> 0.95	.754	.844	.844	.948	.959
RMSEA	< 0.05	.207	.165	.165	.041	.028
P-close	> 0.05	.000	.000	.000	.007	.131

Legend:

CMIN/DF – Chi Square/Degrees of Freedom
GFI – Goodness of Fit Index
RMSEA – Root Mean Square of Error Approximation

NFI – Normed Fit Index
TLI – Tucker-Lewis Index
CFI – Comparative Fit Index

controls, and performance focus enhance the organization's risk management capabilities.

The model also shows moderate correlations between the exogenous variables, which means that collaboration has some relationship with leadership and organizational culture in their roles in promoting an integrated approach to risk management. In general, the model supports the idea that effective risk management is more than just technical controls over risk; it is mostly about organizational capabilities and strategic relationships. This finding is in line with Hair *et al.* (2022), who argue that structural equation modeling tests the most influential latent constructs by testing them simultaneously and examining measurement quality and structural relationships.

4. Conclusion and Recommendations

This study had several findings. The top management commitment and organizational culture had the highest overall mean among the exogenous variables that affect risk management. This indicates that support from leadership and the internal values of the organization strongly exist among construction firms in the Davao Region. They give a big push for leadership-driven initiatives and structured organizational practices in risk management. From the results, it means that when leaders provide active support for quality policies and resource allocation and create accountability, the organization will be very well placed to anticipate and mitigate project-related risks. The same applies to strong adaptability, and shared values reinforce risk awareness and coordinated responses to uncertainties.

Correlation analysis results prove that buyer-supplier collaboration, top management commitment, and organizational culture have a significant relationship with risk management. This further proves that risk mitigation's success is dependent on both internal and external organizational factors. It therefore means that construction firms can gain from integrating systems of collaboration, leadership engagement, and cultural alignment to improve their risk management practice. The results of structural equation modeling show that the final model had a good fit because all indices were within acceptable ranges, thereby confirming its validity in explaining risk management practices. Among the predictors, organizational culture was the most significant influence, followed by buyer-supplier collaboration and top management commitment. This shows that while collaboration and leadership matter, the underlying organizational culture is what sustains effective risk management practices over time. Therefore, the study concludes that risk management in construction firms can be best described as a combination of relational, managerial, and cultural dimensions. As such, the null hypothesis that there is no best-fit model for risk management practices is rejected.

The mean for buyer-supplier collaboration is relatively low compared with other variables; therefore, construction firms must strengthen partnerships with suppliers and other stakeholders to improve information sharing and align incentives. Moreover, encourage the sharing of decision-making responsibilities. These joint practices will improve

coordination and reduce ambiguities between project phases. Given the significant impact of top management commitment, it is suggested that leaders continue to support the role in risk management by allocating resources appropriately, reinforcing quality policies, and taking a visible role in promoting risk-aware behavior. Such programs as leadership training and capacity building would only further enable them to integrate risk management into strategic decision-making. Given organizational culture as the major predictor, firms should work to nurture a balanced environment, culture that includes form, responsibility, and flexibility. From a strategic perspective, regulators and supervisors may develop methodologies and procedures for integrated risk management within the sector, particularly for small and medium enterprises.

The above, therefore, calls on future researchers to consider other variables that may influence risk management, such as technological capability, the regulatory environment, and project complexity. The study can be replicated in other regions or industries to provide a more comprehensive understanding of risk management dynamics. Future research can also examine the indirect effects more deeply, and using mediating variables through advanced modeling techniques would undoubtedly enhance current knowledge in the field.

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