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Analysis of Barrier and Driver Factors to Risk Monitoring and Control Implementation in Construction Projects

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ABSTRACT

Construction projects inherently involve risks. If proper risk management practices are employed, the likelihood of cost overruns can reach up to 80%. Risk monitoring and control are essential processes in risk management; however, their implementation needs to be improved in construction projects. This research analysed the main barriers and drivers for implementing risk monitoring and control in construction projects. A questionnaire survey was conducted using a Likert scale to measure respondents' perceptions. Data were collected from 71 respondents: top management, project managers, project risk managers, and risk officers. This study employs descriptive analysis and factor analysis to achieve the objectives. The results indicate that the 19 identified barriers to risk monitoring and control were categorised into four main factors: lack of practice, lack of risk awareness, lack of incentives and difficulty finding methods, and misperceptions about risk monitoring and control. Meanwhile, the 21 drivers were categorised into five main factors: management support, tools and information technology, organisational structure and communication, external environment, assigning responsibility, and contingency reserve.

Keywords: Barriers Factors, Factor Analysis, Risk Monitoring and Control.

Introduction

The construction industry is characterised by varying levels of complexity and dynamic nature, making it prone to uncertainty. These uncertain events yield negative and positive consequences for project performance, commonly called risks (PMI, 2017). Risks may arise during the life cycle of a construction project, potentially leading to a decrease in project performance (Obondi, 2022). Unmonitored or uncontrolled risks can result in cost overruns, scheduling delays, diminished project performance, and failure (Khan & Gul, 2017). If proper risk management practices are employed, the likelihood of cost overruns can reach up to 80%. To mitigate the adverse effects of risks on project objectives, the practice of managing risks is implemented, commonly known as risk management (Tessema et al., 2022).

The construction industry has implemented project risk management for over seven decades (Senesi et al., 2015). Monitoring and controlling risks is an integral part of the risk management process. There appeared to be a strong, positive, and significant correlation between project success and the application of project risk monitoring and control practices (Obondi, 2022). Nevertheless, implementing risk monitoring and control strategies could be more effective. A recent report from the Centre for Excellence in ERM at St. John's University highlighted that organisations rank risk monitoring among the top five areas needing improvement. Furthermore, findings from the 2019 State of Risk Oversight report by NC State indicate dissatisfaction with implementing risk monitoring and control (Strategic Decision Solutions, 2019). The challenge of insufficient project risk monitoring and control arises from a deficit in risk management capabilities and knowledge, a failure to promptly respond, monitor, and control identified risks, and a tendency for project managers to inadequately consider risks (Obondi, 2022).

Moreover, most research focuses solely on risk identification, assessment, and analysis, neglecting other crucial aspects of risk management, including risk monitoring and control (Cakmak & Tezel, 2019). The barrier and driver variables for implementing risk monitoring and control were obtained from a small amount of literature. The barrier variables include : lack of intermediate management support (Cakmak & Tezel, 2019) lack of disaster planning and recovery (Edwards, Serra, & Edwards, 2020); perception that risk monitoring increases costs and administration; lack of understanding of perceived value or benefits (Zhao, Hwang, & Low, 2015); insufficient resources (Chileshe & Kikwasi, 2013; Zhao et al., 2015); lack of knowledge (Hwang, Zhao, & Toh, 2014; Shibani et al., 2022); lack of expertise (Chileshe & Kikwasi, 2013); lack of education and training (Tummala, Leung, Mok, Burchett, & Leung, 1997; Zhao et al., 2015); lack of risk-based meetings (Obondi, 2022); lack of risk information (Chileshe & Kikwasi, 2013); ineffective risk reporting (Tang, Qiang, Duffield, Young, & Lu, 2007); ineffective coordination (Chileshe & Kikwasi, 2013); difficulty in interpreting the standards used (Tummala et al., 1997); difficulty in determining appropriate risk control tools and techniques (El-Sayegh, 2015); no incentives (Shibani et al., 2022); the irregularity in monitoring (Edwards et al., 2020); and lack of risk audits (Obondi, 2022). While, the driver variables to risk monitoring and control include commitment and support from top management; leadership style (Chileshe & Kikwasi, 2014); risk monitoring and control procedures (Edwards et al., 2020); organizational culture (Na Ranong & Phuenngam, 2009; Zhao, Hwang, & Low, 2013); integration of risk control and project control (PMI, 2009); monitoring schedule (Cretu, Stewart, & Berends, 2011); organizational structure and size (Kwaik, Sweis, Allan, & Sweis, 2023); effective resource allocation (Zhao et al., 2015); communication behavior (Zhao et al., 2015); contingency fund (Obondi, 2022); the existence of risk management plan (PMI, 2017); the existence of a project risk document (Larson & Gray, 2011; PMI, 2017); teamwork (Chileshe & Kikwasi, 2014); technology and information infrastructure support (Kwaik et al., 2023; Zhao et al., 2015); standards and guidelines (ISO31000, 2018; PMI, 2017); better decision making (Zhao et al., 2015); risk reassessment (Obondi, 2022); effective methods and tools (Chileshe & Kikwasi, 2014); legal and regulatory compliance requirements (Kikwasi, 2018; Zhao et al., 2015); customer needs (Chileshe & Kikwasi, 2014); and assignment of responsibilities (Cretu et al., 2011; Larson & Gray, 2011).

Research Methods

This research is exploratory. A questionnaire survey was conducted to analyse the central barrier and driver factors to implementing risk monitoring and control in construction projects. The survey consisted of a preliminary survey and a primary survey. An initial survey was conducted to verify the measurement variables and ensure their relevance to research purposes. Respondents in the initial survey were project managers who knew risk management and had more than 12 years of experience in construction projects (Chileshe et al., 2016). The questionnaire employed in this preliminary survey was semi-closed. Respondents were to select relevant variables and add some variables not listed in the questionnaire. The primary survey uses relevant variables resulting from the preliminary survey. The questionnaire used in this central survey is a closed type, where respondents provide only one answer selected as correct. The questionnaire used for this research comprises two sections. The first section gathers the respondents' background, while the second explores the central barrier and driver factors.

Respondents were given the task of rating using a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The population comprises all construction practitioners with extensive experience in risk management. The sample size in this study was determined using non-probability sampling, where the exact number of respondents was uncertain. The sampling technique is purposive sampling, wherein samples are selected based on specific criteria. The distribution of questionnaires is conducted online and offline. The respondents are top management, project managers, project risk managers, and risk officers.

This study employs descriptive analysis and factor analysis to achieve the objective. The collected data undergoes descriptive analysis to facilitate straightforward interpretation. The function of descriptive statistics is to describe an overview of the object under study using sample or population data. Factor analysis is used to analyse a relatively small number of factors capable of explaining many interconnected variables. The factor analysis process includes the following stages: (1) the variable feasibility test, which uses the KMO-MSA (Kaiser et al. of Sampling Adequacy) and Bartlett's test of sphericity; (2) extraction of a set of variables to generate a concise number of factors, (3) clarifies the variables associated with each formed factor, and (4) assigning a name to the formed factor that is deemed representative of the variable.

Results and Discussion

A total of 71 completed questionnaires were received from the primary survey. The profile of the respondents is listed in Table 1. In terms of gender, there were 60 men (85%) and 11 women (15%). Respondents had a master's educational background of 19 people (27%), 45 bachelor's degrees (63%), and seven others (10%). Respondents based on position, 9 (13%), 7 (10%), 24 (34%), 15 (21%), and 16 (22%), of the respondents held positions in top management, project manager, project engineering/risk manager, risk officer, others, respectively. Meanwhile, 28 respondents (39%) have experience for less than five years, 24 respondents (34%) have 5-10 years of work experience, six respondents (8%) have 10-15 years of work experience, and 13 respondents (18%) have work experience for more than 15 years.

Table 1
Profile of Respondents

Category	Classification	Number	Per cent
Gender	Man	60	85
	Woman	11	15
Education	Masters	19	27
	Undergraduate	45	63
	Other	7	10
Position	Top Management	9	13
	Project Manager	7	10
	Project Risk Manager	24	34
	Risk officer	15	21
	Other	16	22
Work experience	< 5 years	28	39
	5-10 Years	24	34
	10-15 Years	6	8
	>15 Years	13	18

The research sample has fulfilled the minimum requirements for the factor analysis. Furthermore, the selected respondents represent construction practitioners with extensive knowledge and experience in construction project risk management.

Grouping of Barriers to Risk Monitoring and Control

Several assumption tests were conducted to evaluate the suitability of the variables before proceeding with factor analysis. The feasibility of a variable is assessed through the Kaiser Meyer Olkin (KMO) and the Measures of Sampling Adequacy (MSA) value. This research obtained a KMO value of 0.855, while all variables exhibited an MSA value exceeding 0.5. The KMO-MSA value should exceed 0.5 for a good result. If a variable has an MSA value below 0.5, it is advisable to exclude and reanalyse the data to achieve MSA values for all variables greater than 0.5 (Hair et al., 2010). The Bartlett test of sphericity resulted in a value of 1272.952 with a significance level of 0.000. The Bartlett test of sphericity (Sig.) value should be less than 0.05 for better analysis, indicating that the matrix was not an identity matrix. Consequently, the collected data were deemed suitable for factor analysis (Hair, Black, Babin, & Anderson, 2010).

Following the feasibility of a variable, factor extraction was continued. This process groups several variables that are similar into concise factors. The extraction method employed is Principal Component Analysis (PCA). The number of factors formed can be seen from the components with an eigenvalue greater than 1. The extraction results show that the number of elements that have a total eigenvalue greater than 1 is four components. Thus, the 19 identified barriers were categorised into four factors (Table 2)—the four factors contributed to 74.211% of the total variance. Factor 1 accounted for 55.247% of the total variance, factor 2 accounted for 7.574%, factor 3 accounted for 6.107%, and factor 4 accounted for 5.282%. In addition, considering the commonalities value indicates the extent to which the formed factors can explain variance in a variable. All barriers exhibit commonalities values exceeding 0.5. Practical considerations suggest that a minimum communalities value of 0.5 is advisable. Furthermore, it clarifies the factor formed with the rotation factor. In this study, factor rotation uses the varimax, an orthogonal rotation technique, to minimise the number of indicators with high factor loadings on each factor.

Table 2
Result of Barrier Factors to Risk Monitoring and Control Implementation

	Barrier Grouping			
	1	**2**	**3**	**4**
Factor 1: Lack of practice				
Ineffective risk reporting	0.792			
Lack of risk-based meetings	0.784			
Lack of intermediate management support	0.724			
The irregularity in monitoring	0.707			
Lack of risk information	0.705			
Lack of disaster planning and recovery.	0.682			
Lack of risk audits	0.665			
Resistance to change	0.597			
Ineffective coordination	0.593			
Factor 2: Lack of risk awareness				
Lack of knowledge		0.811		
Lack of expertise		0.810		
Lack of risk awareness		0.786		
Lack of education and training		0.712		
Factor 3: No incentives and Having difficulty finding a method				
No incentives			0.835	
Difficulty in determining appropriate risk control tools and techniques			0.705	
Difficulty in interpreting the standards used			0.600	
Insufficient resources				
Factor 4 Misperceptions				
The perception that risk monitoring increases costs and administration				0.788

	Barrier Grouping			
	1	2	3	4
Lack of understanding of perceived value or benefits				0.777
Eigenvalue	10.497	1.439	1.160	1.004
Variance (%)	55.247	7.574	6.107	5.282
Cumulative variance (%)	55.247	62.821	68.928	74.211

In Tabel 2, barrier variables will be grouped into certain factors based on the most significant factor loading. Loadings factor greater than 0.5 are considered practically significant. In Table 2, factor loadings below 0.5 are hidden. The results indicate that factor 1 comprised nine variables and was interpreted as a lack of practice. Factor 2 consisted of four variables and was construed as needing more risk awareness. Factor 3 involved three variables and was interpreted as a lack of incentives and difficulty finding suitable methods. Factor 4 included two variables and was interpreted as misperceptions about risk monitoring and control.

The first barrier factor, lack of practice, consists of nine variables: ineffective risk reporting, lack of risk-based meetings, lack of intermediate management support, irregularity in monitoring, lack of risk information, lack of disaster planning and recovery, lack of risk audits, resistance to change, and ineffective coordination. Project risk monitoring and control practices, such as risk-based meetings, risk audits, and risk reporting, have been correlated with project success in construction projects. Although verbal risk reporting is considered the most direct and realistic method, it is also the least reliable and most inconsistent. Considering the various barriers to effective verbal communication, promptly following up such reports with more formal reporting methods is advisable. Lack of risk information stands as one of the obstacles faced by stakeholders in the construction industry. Additionally, there exists a reluctance among individuals to share risk information (Zhao et al., 2015). Which in turn can hinder effective risk monitoring and control.

The second barrier factor, lack of risk awareness, comprises four variables: lack of knowledge, lack of expertise, lack of risk awareness, and lack of education and training. Awareness of the risk management process and lack of experience are the most significant barriers that project stakeholders need to overcome. Implementing effective risk management involves fostering risk awareness and facilitating risk communication across the enterprise, providing decision-makers with comprehensive information.

The third barrier factor is the need for incentives and finding a method. This factor comprises three variables: no incentives, difficulty determining appropriate risk control tools and techniques, and difficulty interpreting the standards used. The need for incentives for improved risk management remains a significant obstacle in construction management in Lebanon (Shibani et al., 2022). Companies must provide training to staff and managers to increase their understanding of risk monitoring and control techniques.

The fourth barrier factor is misperceptions about risk monitoring and control. This factor consists of two variables: the perception that risk monitoring increases costs and administration and a lack of understanding of perceived value or benefits. Risk monitoring increases costs, and administration is deemed a biased perception or a misunderstanding of the implementation of risk management, including risk monitoring and control process, due to the difficulty in demonstrating real value or benefits.

Grouping of Drivers to Risk Monitoring and Control

Various tests were administered to assess the appropriateness of the variables before embarking on factor analysis. From the analysis results, the Bartlett Test of Sphericity value was 980.863 with a significance of 0.000. Thus, it meets the requirements because it is below 0.05. The Kaiser-Meyer-Olkin (KMO) value was 0.834; it meets the requirements because it is greater than 0.5. All MSA values are more significant than 0.5, so it meets the requirements. The number of factors was determined by examining the eigenvalues. According to the calculation results in Table 3, five components have eigenvalues greater than 1, resulting in five factors formed. The percentages of variation are explained by each of the five factors (44.408%, 9.489%, 7.374%, 5.960%, and 4.879%, respectively). The five factors formed were able to explain 72.109% of the variation. This is considered sufficient in terms of the total explained variation. The communalities value for all variables is more significant than 0.5.

Most researchers agree that leaving factors unrotated is insufficient. The rotation process is undertaken to resolve ambiguities among factors. Similar variables are grouped into a single factor, with the grouping determined by the most significant factor loading. Each grouping is named by considering the variables with high factor loadings and identifying commonalities among them. Factor 1 is called management support and comprises seven variables. Factor 2 is named tools and information technology, and it includes six variables. Factor 3, designated as organisational structure and communication, consists of three variables. Factor 4 is identified as the external environment and comprises two variables. Factor 5, named responsibility and contingency reserve, involves three variables.

Table 3
Result of Driver Factor to Risk Monitoring and Control Implementation

	Driver Grouping				
	1	**2**	**3**	**4**	5
Factor 1 Management Support					
Commitment and support from top management	0.777				
Organisational culture	0.760				
Monitoring Schedule	0.716				
Integration of Risk Control and Project Control	0.704				
Leadership style	0.700				

	Driver Grouping				
	1	**2**	**3**	**4**	5
Risk Monitoring and Control Procedures	0.651				
Teamwork	0.523				
Factor 2 Tools and information technology					
Standards and guidelines		0.809			
Risk reassessment		0.788			
Technology and information infrastructure		0.699			
Better decision making		0.663			
Effective methods and tools		0.574			
The existence of a project risk document		0.555			
Factor 3 Organizational Structure and Communication					
Organisational structure and size			0.817		
Effective Resource allocation			0.747		
Communication behavior			0.59		
Factor 4 External Environment					
Legal and regulatory compliance requirements				0.847	
Customer needs				0.847	
The existence of a risk management plan					
Factor 5 Responsibility and Contingency Reserve					
Assignment of Responsibilities					0.693
Contingency fund					0.647
Eigenvalue	9.326	1.993	1.548	1.251	1.025
Variance (%)	44.408	9.489	7.374	5.960	4.879
Cumulative variance (%)	44.408	53.897	61.271	67.230	72.109

Management support comprises seven variables: commitment and support from top management, organisational culture, monitoring schedule, integration of risk control and project control, leadership style, risk monitoring and control procedures, and teamwork. Top management support is vital in successfully implementing risk management in the construction industry. Stakeholders in Tanzania also acknowledge the importance of an appropriate management style that facilitates the formation of project risk management teams in both organisational and project environments.

Tools and information technology encompasses six variables: standards and guidelines, risk reassessment, technological and information infrastructure, better decision-making, practical methods and tools, and project risk documents. Standards, guidelines, and risk registers are integral inputs and tools for implementing risk monitoring and control (PMI, 2013). Emphasising the importance of a project risk document, particularly the risk register, this variable is the backbone of risk monitoring and control. There were positive and significant correlations between project success and using risk monitoring and control practice tools, such as risk reassessment. Furthermore, within this factor, the support of technological infrastructure underscores the role of advancements in information technology in facilitating effective risk management.

Organisational structure and communication have three variables: structure and size, reasonable resource allocation, and communication behaviour. Organisational structure and communication influence successful risk management implementation. Organisational size significantly impacts risk management implementation (Bohnert et al., 2019).

External environment reserve encompasses two variables: legal and regulatory compliance requirements, as well as customer needs. Literature across various industries suggests that the adoption of risk management is often motivated by a series of legal compliance and corporate governance requirements. Customer needs emerge as a critical success factor but in low ratings.

Responsibility and contingency reserve comprises two variables: assignment of responsibilities and contingency fund. Risk monitoring and control effectively necessitates assigning specific individual duties and ensuring accountability. A key aspect of controlling risk is the documentation of responsibilities. The recommended approach is to have responsible personnel approve using budget reserve funds and monitor their usage levels—management reserves established to cover unidentified risks.

Conclusion

The results indicate that the 19 identified barriers to risk monitoring and control implementation in construction projects were categorised into four factors: lack of practice, lack of risk awareness, lack of incentives and difficulty finding a method, and misperceptions about risk monitoring and control. The 21 identified drivers were categorised into five factors: management support, tools and information technology, organisational structure and communication, external environment, and assigning responsibility and contingency reserve.

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