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ENHANCING CONSTRUCTION PROJECT SUCCESS THROUGH PROACTIVE RISK MANAGEMENT IN YEMEN: A QUANTITATIVE ANALYSIS

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Abstract

This quantitative study in Yemen explores the critical link between proactive risk management and construction project success. Employing Structural Equation Modeling (SEM) with data collected from 171 construction professionals across various levels, the research investigates the impact of key proactive elements like early identification, analysis, response, and monitoring. The findings reveal a strong positive correlation between robust risk management practices and successful project outcomes. Notably, the study identifies early mitigation strategies (Hypothesis H5) as the most impactful element. These results translate into actionable recommendations for Yemeni construction practitioners. By implementing proactive risk management, companies can enhance decision-making processes, potentially leading to improved project performance through reduced delays, cost overruns, and safety incidents. Ultimately, the study contributes to advancements in Yemeni construction's risk management practices, offering valuable insights for stakeholders seeking to improve project success rates.

Keywords: Construction Projects Success, Proactive Risk management, Yemen, and Quantitative Analysis.

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INTRODUCTION

According to Gamil & Abd Rahman, (2023), the construction sector in Yemen is critical to the country's infrastructural development and economic progress. Yemen's civil unrest and instability have severely impacted its infrastructure, creating an urgent need for reconstruction and development (Alashwal & Al-Sabahi, 2019). For instance, the Word Bank, (2022) reported that Yemen's infrastructure damage due to conflict has resulted in an estimated $20 billion loss, underscoring the critical role of the construction industry in national recovery efforts. In this context, effective risk management strategies are essential for addressing major project components such as time, cost, quality, and stakeholder participation (Alsaadi & Norhayatizakuan, 2021). By proactively managing risks, construction projects can enhance decision-making processes and improve the likelihood of project success (A Kassem et al., 2020).

Yemen's construction sector is a crucial driver of employment and economic growth in the country. It stands as the fourth most significant source of employment, accounting for roughly 9-10% of the workforce. This sector has been expanding at an impressive average annual rate of approximately 5.4% (Bahamid et al., 2020). Despite this growth, inadequate risk management procedures can lead to significant issues such as cost overruns, delays, and inefficient resource use, which jeopardize project success (Nasreddine Ali Algremazy et al., 2023). Given the high stakes, particularly in post-conflict rebuilding, adopting robust risk management practices is paramount (Bahamid et al., 2020).

Bahamid et al., (2022) indicate that 47% of finished projects in Yemen were late, while 40% of overall projects ran over budget. The rebuilding efforts in Yemen, which include projects like the reconstruction of the Aden port and various urban development initiatives funded by international donors, (Bahamid et al., 2022), highlight the importance of comprehensive risk management systems to mitigate risks and ensure project delivery within budget limits. Despite continued attempts to improve project management approaches, Misnan et al., (2024) identify research gaps in the integration of risk management practices in construction projects.

Shibani et al., (2022) recognized many aspects that impact project risk management in the construction industry, including market circumstances, technology limits, and human components. Effective risk identification and management, as underlined by (Jarrah et al., 2022), require a thorough grasp of risk landscapes and mitigation techniques. Given the complexity of building projects, (U. Ahmad et al., 2022), address the importance of a proactive approach to risk management, which includes risk identification, assessment, mitigation, and monitoring. Addressing risks such as project delays, budget overruns, and regulatory compliance improves the odds of construction projects being completed on time and at an affordable cost, (Dlamini & Cumberlege, 2021).

Yemen's construction sector presents distinct challenges and opportunities in the current socioeconomic context, Alashwal & Al-Sabahi, (2018), necessitating tailored risk management solutions to navigate uncertainties and achieve project goals. Research on risk management in construction projects emphasizes the integration of theoretical frameworks with practical applications to bridge gaps in current practices and develop adaptable strategies (Alashwal & Al-Sabahi, 2018). Wu et al., (2019) emphasized that Effective management methods are critical to the success of construction projects, with efficient project scheduling and time management being vital for predicting delays and implementing timely mitigation measures. In infrastructure projects, meticulous planning and risk assessment are crucial for timely completion and cost-effective outcomes, as demonstrated in recent residential and urban development projects in Yemen (Khahro et al., 2023).

As described by Le et al., (2020), the goal of theoretical research on risk management in construction projects is to provide a comprehensive understanding of risk management performance and its impact on project success. Ferreira de Araújo Lima et al., (2021) proposed a unified taxonomy of risk management approaches for construction projects, emphasizing the importance of adaptive solutions tailored to individual project requirements. The dynamic nature of construction projects, influenced by technological advancements and market dynamics, necessitates flexible and responsive risk management strategies (Saleh M. A. Alshehhi et al., 2024).

Yemen's construction sector is at a critical juncture, and robust risk management practices are essential for fostering sustainable development and infrastructure improvement. By addressing the unique challenges and opportunities within the Yemeni context, this study aims to enhance risk management in construction projects and provide practical insights for industry stakeholders and decision-makers.

LITERATURE STUDY

Risk Management Overview

Risk management is a crucial element in the success of construction projects (Nasreddine Ali Algremazy et al., 2023). This literature review explores the importance of risk management in construction projects, focusing on fundamental concepts, previous research outcomes, and hypotheses. The review aims to improve risk management practices in the Yemeni construction industry by summarizing and evaluating existing knowledge. The proactive risk management process is examined through the following four variables:

1. Risk Identification

The theoretical foundation of risk identification in construction projects is rooted in the integration of industry practices with theoretical frameworks (Rachmadhani et al., 2023). This approach enables stakeholders to develop a comprehensive understanding of risk dynamics and strategies (Nguyen et al., 2021). By combining practical insights with theoretical principles, a holistic view of risk in construction projects can be achieved. Proactive identification of risks allows project teams to anticipate potential threats early in the project lifecycle, enhancing project success (Alsaadi & Norhayatizakuan, 2021). Previous research has shown the importance of early risk identification in improving project outcomes. Tahir et al., (2020) examined the construction industries in Pakistan and highlighted how effective risk identification strategies positively impacted project results. Similarly, Nasreddine Ali Algremazy et al., (2023) demonstrated that proactive risk identification in Libyan construction projects led to better project performance. In Yemen, S. A. Ahmad et al., (2013) recognized significant residential and commercial developments in Sana'a are being funded by foreign investors, with the Yemeni government contributing approximately US$ 2 billion to infrastructure, in contrast to US$ 250 million from donor agencies, these reconstruction project exemplifies the critical role of early risk identification in mitigating challenges posed by ongoing conflict and logistical constraints.

2. Risk Analysis

Risk analysis involves assessing the identified risks to understand their potential impact and likelihood. Advanced risk assessment techniques, such as quantitative risk analysis and simulation models, enable project teams to prioritize risks and develop appropriate mitigation strategies (Nguyen et al., 2021). Several studies have explored the impact of rigorous risk analysis on project performance. Kassem, (2022) examined the risk variables influencing project performance in Yemen, using statistical tools to highlight the significance of thorough risk analysis. Nguyen et al., (2021) investigated the link between stakeholder participation in risk analysis and project performance, providing valuable insights for better project management. The Marib Dam restoration project in Yemen utilized extensive risk analysis to address potential structural failures and water management issues, leading to a more resilient reconstruction plan (Adamo et al., 2020).

3. Risk Response

Risk response involves developing strategies to mitigate, transfer, accept, or avoid risks. This step is crucial for minimizing the impact of risks on project objectives. Effective risk response strategies enhance project resilience and adaptability (Alsaadi & Norhayatizakuan, 2021). Research has shown that structured risk response processes improve project performance. Alsaadi & Norhayatizakuan, (2021) emphasized the importance of organized risk response strategies in small construction enterprises. , Adeleke et al., (2018) discussed the role of knowledge management in formulating effective risk response strategies in Nigerian construction projects, leading to better project outcomes. In Yemen, "Contractor" was identified as one of the top factors affecting construction projects, with defects and rework causing financial losses and delays, underscoring the need for effective risk responses and adaptive measures to ensure timely and cost-efficient project completion (Hakami, 2021).

4. Risk Monitoring

Risk monitoring involves continuously tracking identified risks, reassessing their status, and identifying new risks throughout the project lifecycle. This ensures that risk management remains dynamic and responsive to changing project conditions (Nguyen et al., 2021). Studies have highlighted the importance of ongoing risk monitoring for project success. Boateng et al., (2022) emphasized the role of continuous risk monitoring in Ghanaian construction enterprises, showing its positive impact on project management performance. Bahamid et al., (2022) stressed that ongoing risk monitoring is crucial for the success of post-conflict rebuilding projects, such as those in Yemen. Ivanov & Aldeen, (2018) indicate that a significance index: 60%-80%, with key factors, such as inadequate planning review and lack of control over contract management, rank highest, these construction projects in Yemen illustrates the importance of continuous risk monitoring, which allowed for timely adjustments in response to emerging urban planning challenges.

These studies, provide significant contributions to the subject of risk management in construction projects. While many additional studies exist, the research articles presented useful insights and conclusions that have expanded the understanding of successful risk management strategies in construction sectors in Yemen.

Hypotheses

This study proposes a comprehensive framework with five hypotheses to examine the impact of risk management techniques on construction project outcomes in Yemen. Each hypothesis is grounded in gaps identified through a thorough literature review, linking theoretical insights to practical applications as follows:

H1: Enhanced Risk Identification Improves Risk Management Performance

The literature underscores the critical role of early risk identification in preventing project failures. Studies indicate that proactive risk identification can significantly improve project outcomes by anticipating potential threats early in the project lifecycle (Alsaadi & Norhayatizakuan, 2021; Nasreddine Ali Algremazy et al., 2023). Addressing gaps in proactive risk identification practices is essential for enhancing overall risk management performance.

H2: Enhanced Risk Analysis Improves Construction Risk Management Performance

Rigorous risk analysis is crucial for understanding the potential impact and likelihood of identified risks. The Marib Dam restoration project, among others, demonstrates that thorough risk analysis enables the creation of resilient reconstruction plans (Adamo et al., 2020). This hypothesis targets the need for improved risk analysis practices to prioritize and mitigate risks effectively (Nguyen et al., 2021 and Kassem, 2022).

H3: Enhanced Risk Response Improves Construction Risk Management Performance

The literature highlights the significance of structured risk response strategies in mitigating risks. For instance, effective risk responses are essential for minimizing financial losses and delays in construction projects (Adeleke et al., 2018; Hakami, 2021). This hypothesis seeks to address the gap in developing and implementing effective risk response strategies to enhance project performance (Alsaadi & Norhayatizakuan, 2021).

H4: Enhanced Risk Monitoring Improves Construction Risk Management Performance

Continuous risk monitoring ensures dynamic and responsive risk management, crucial for adapting to changing project conditions. The Sana'a Urban Development Project illustrated the importance of ongoing risk monitoring in managing emerging challenges (Ivanov & Aldeen, 2018). This hypothesis addresses the need for sustained risk monitoring practices to maintain robust risk management performance (Boateng et al., 2022; Bahamid et al., 2022).

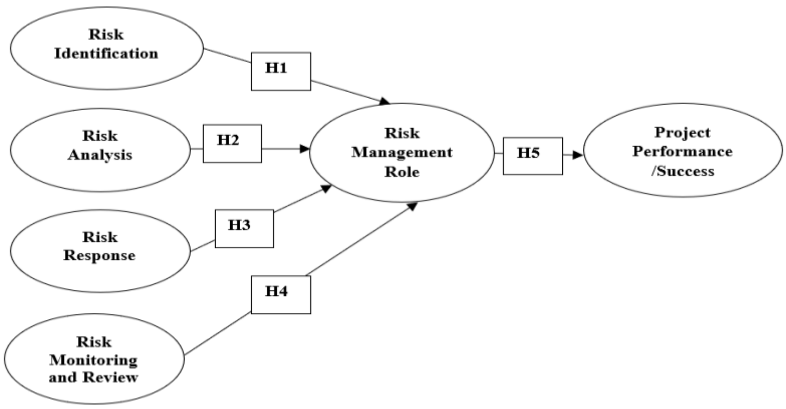
H5: Improved Risk Management Performance Enhances Overall Project Success

There is a well-documented direct link between effective risk management and project success. Robust risk management practices lead to better project outcomes, especially in complex and high-stakes environments like post-conflict Yemen (Bahamid et al., 2020; Boateng et al., 2022). This hypothesis posits that enhancements in risk identification, analysis, response, and monitoring will directly contribute to the success of construction projects by improving time, cost, quality, and scope outcomes.

Research Model

Based on the research model (Figure 1), there is one dependent variable (Project Success) and one main independent variable (Risk Management), which consists of four sub-independent variables (Risk Identification, Risk Analysis, Risk Response, and Risk Monitoring and Review). The dependent variable is measured by four components: Time, Cost, Quality, and Scope. The model illustrates the relationships between these variables, highlighting how effective risk management practices can lead to improved project success.

Figure 1. Research Conceptual Mode



Source: Research Conceptual Model, Author 2024

RESEARCH METHODOLOGY

Data Collection

Primary data was determined using Hair et al.'s (2013) guidelines, suggesting 5-10 times the number of questionnaire items. With a questionnaire of 20 items, a multiplication factor of 8.65 resulted in a required sample size of 173 respondents. Ultimately, data from 171 respondents were collected, deemed adequate for statistical analysis. These respondents were selected based on criteria to ensure representation across management levels and roles within the Yemeni construction industry. They included individuals from low, medium, and high management levels, engaged in various roles such as consultants, main contractors, and subcontractors. Additionally, they participated in diverse projects, including infrastructure and residential developments, reflecting the industry's breadth. These criteria ensured a diverse and comprehensive sample, capturing insights into risk management practices (Alashwal & Al-Sabahi, 2018).

Materials and Equipment Specifications

The utilizing electronic distribution of questionnaires ensured efficient data collection from a geographically dispersed sample of construction companies. Standardized scales and closed questions facilitated quantitative data collection, enhancing understanding of the hypothesized relationships.

Approaches and Procedures

The research methodology followed a structured approach, commencing with the identification of research objectives and problem areas, informed by existing literature. Data analysis employed SmartPLS software to identify patterns and trends, ensuring rigorous examination of correlations among variables.

Data Analysis Methods

The data analysis techniques included SmartPLS version 3 for partial least squares structural equation modeling (PLS-SEM), aligning with the study's methodological approach. This facilitated hypothesis validation and thorough examination of relationships between latent variables, ensuring the reliability of conclusions.

Variables Operationalization and Measurement

The key variables such as risk identification, analysis, response, and monitoring were measured using Likert scales, categorical responses, and quantitative coding. Drawing from relevant literature, the questionnaire design ensured alignment with the study's hypotheses, fostering a comprehensive understanding of risk management processes and their impact on project success.

Table 1. Variables Measurement

Variables	Indicators Code and Measurement	References
Fours Sub-Main Independent Variables (RI, RA, RR, & RMC)		
1. Risk Identification	**RI1**: Identifying the risk requiring the most attention by quantifying their relative contribution to the overall project risk.	Boateng et al., (2022), Zafar et al. (2019), and Gurmu (2020).
	RI2: Identify the level of importance of the project schedule (time) to my organization.	Nguyen et al., (2021), Park et al. (2017), Luyet et al. (2012)
	RI3: The project management team Identify the project objectives and implications to all stakeholders.	Nguyen et al., (2021) and Aitken and Crawford (2007)
2. Risk Analysis	**RA1**: Analyze risks as and when they occur.	Boateng et al., (2022), Zafar et al. (2019), and Gurmu (2020).
	RA2: Overall financial (cost) analysis the impact on the project's stakeholders.	Nguyen et al., (2021), Park et al. (2017), Luyet et al. (2012)
	RA3: The project management team analysis actively built a good relationship with stakeholders.	Nguyen et al., (2021) and Aitken and Crawford (2007)
3. Risk Response	**RR1**: Response to risks as and when they arise.	Boateng et al., (2022), Zafar et al. (2019), and Gurmu (2020).
	RR2: Level of stakeholder (scope) agreement response about the project outcomes.	Nguyen et al., (2021), Park et al. (2017), Luyet et al. (2012)
	RR3: The project management team response to operate an effective communication system.	Nguyen et al., (2021) and Aitken and Crawford (2007)

Source: Variables Measurement and References, 2024

Table 1. Variables Measurement (Continue)

Variables	Indicators Code and Measurement	References
4. Risk Monitoring and Control	**RMC1**: Monitor and review risk, not specifically all, but as part of the general management of the project.	Boateng et al., (2022), Zafar et al. (2019), and Gurmu (2020).
	RMC2: Monitoring and control the level of stability (quality) of the overall project context by monitoring and control.	Nguyen et al., (2021), Park et al. (2017), Luyet et al. (2012)
	RMC3: Monitoring and control stakeholder interests that were carefully considered throughout the project lifecycle and empowered to participate in the decision-making process	Nguyen et al., (2021) and Aitken and Crawford (2007)
One Main Independent Variable (RM)		
1. Risk Management	**RM1**: In our company, there is safety during construction.	Adeleke et al., (2018)
	RM2: In our company, there is a database for estimating activities.	
	RM3: In our company, there is proper site management and supervision.	
	RM4: In our company, there is contract negotiation.	
One Dependent Variable (PP)		
1. Project Success/ Performance (PS/PP)	**PP1**: The project was delivered on **schedule**.	Nguyen et al., (2021), Shenhar et al. (2001), Bond (2015), and Pmi (2008)
	PP2: The project was delivered on **budget**.	
	PP3: The project **scope** expectations were met.	
	PP4: The project's **quality** objectives were met.	

Source: Variables Measurement and References, 2024

Results and Analysis

The findings examined into the relationship between risk management and project performance in construction projects, collecting data using online surveys issued to 173 respondents, with 171 included after excluding two from major enterprises. The quantitative analysis was carried out with SmartPLS version 3 software. The study used SmartPLS 3 for partial least squares structural equation modeling (PLS-SEM) analysis, which was consistent with its methodological approach. This program enabled a full examination of research components and linkages, including outer model assessment, inner model evaluation, and hypothesis validation, (Hair et al., 2021).

Quantitative Analysis

This Richter et al. (2023) have reported that the Smart-PLS 3 program is utilized for the analysis of study data. Using software like AMOS and Lisrel, partial least squares structural equation modeling (PLS-SEM) is an alternative to traditional structural equation modeling methods like Covariance Based (CB)-SEM. There are three main stages tested to the analysis such as outer model test, inner model test, and hypothesis test as follows:

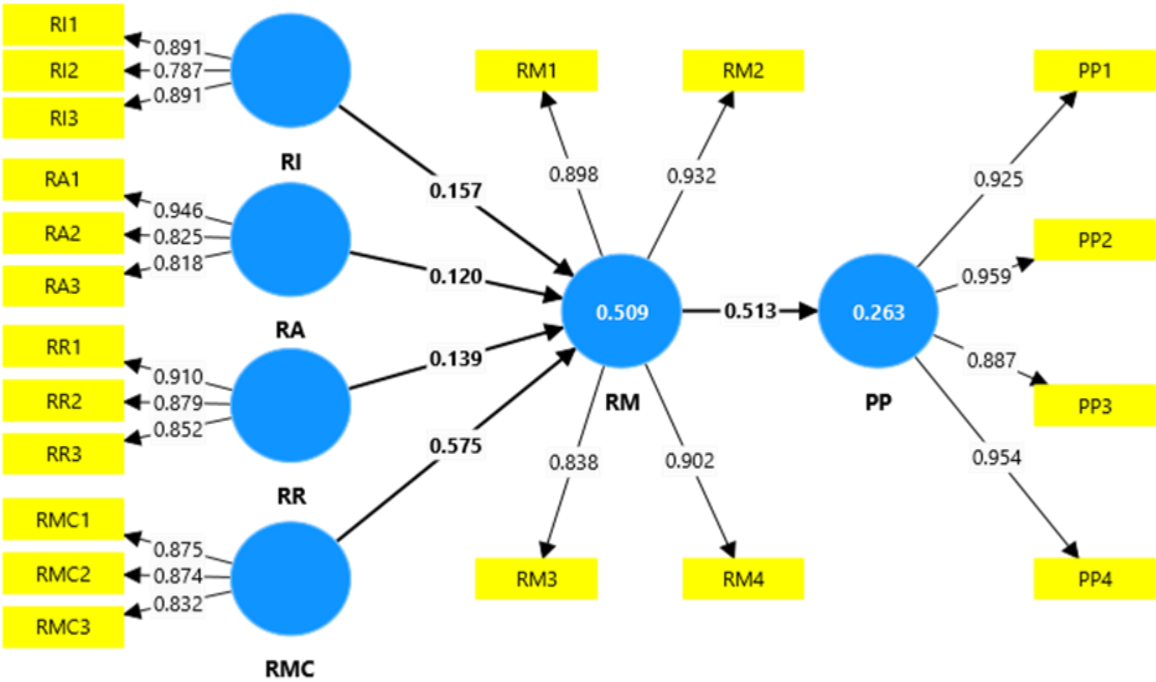
Outer Model Test

The outer model test assessed the relationship between indicators and latent variables Hair et al., (2021) including Risk Identification (RI), Risk Analysis (RA), Risk Response (RR), Risk Monitoring and Control (RMC), Risk Management (RM), and Project Performance/Success (PP), ensuring alignment with study objectives.

Indicator Reliability test

The reliability of indicators was tested, with validity determined by outer loading values exceeding 0.572. All twenty indicators met this criterion, ensuring the reliability of sub-primary independent variables and the major independent variable, risk management (RM). Model adjustments were made based on data processing results, maintaining a strong analytical framework focused on dependability and validity. The following is a conceptual diagram of the SEM model, which is presented in Figure 2 below:

The validity and reliability tests, depicted in Figure 2, assessed the loading factor values of construct indicators. All indicators demonstrated loading factor values above 0.5, ensuring validity and reliability. Each construct item within risk management, risk analysis, risk response, risk monitoring and control, and project success formed its own latent variable. Project success (PP) indicators exhibited high outer loadings (0.887 to 0.959), indicating significant reliability. Risk analysis indicators showed outer loadings ranging from 0.818 to 0.946, accurately assessing the construct. Risk identification indicators ranged from 0.787 to 0.891, with all meeting the minimum requirement. Risk management indicators displayed outer loadings between 0.838 to 0.932, ensuring reliability. Risk monitoring and control indicators ranged from 0.832 to 0.875, indicating high reliability, while risk response indicators ranged from 0.852 to 0.910, demonstrating significant contributions to the construct and meeting validity standards



Source: Result of SEM Model, SmartPLS, 2024

Figure 2. Validablity of SEM Model Conceptual Diagram

Internal Consistency Reliability Test

The following are the results of the internal consistency test using composite reliability, Cronbach's alpha, and Average Variance Extracted (AVE) indicators, including data for the six research indicators.

Table 2. Reliability of SEM Model Conceptual Diagram

Construct	Composite Reliability (rho_a) > 0.6	Composite Reliability (rho_c) > 0.6	Cronbach's Alpha > 0.6	Average Variance Extracted (AVE) > 0.6	Adequacy
PP	0.955	0.963	0.949	0.868	Reliable
RA	1.323	0.899	0.864	0.748	Reliable
RI	0.822	0.893	0.818	0.736	Reliable
RM	0.922	0.940	0.915	0.797	Reliable
RMC	0.827	0.895	0.825	0.741	Reliable
RR	0.863	0.912	0.855	0.775	Reliable

Source: Result of Internal Consistency Reliability Test, SmartPLS, 2024

The above Table 2 presents the results of the internal consistency test using composite reliability, indicating values of 0.60 for each indicator, supporting the test's validity. Project Performance (PP) displayed high internal consistency with composite reliability values of 0.955 (rho_a) and 0.963 (rho_c). Despite Risk Analysis (RA) showing a slightly elevated rho_a of 1.323, its rho_c of 0.899 suggests reliability, albeit potential redundancy. Risk Identification (RI) and Risk Management (RM) demonstrated strong internal consistency, with RI scores of 0.822 and 0.893 and RM ratings of 0.922 and 0.940, respectively. Similarly, Risk Monitoring and Review (RMC) and Risk Response (RR) exhibited high dependability, with RMC scores of 0.827 and 0.895 and RR scores of 0.863 and 0.912, respectively. Cronbach's alpha values further supported internal consistency, with all constructs surpassing the adequacy level of 0.60. Specifically, PP, RA, RI, RM, RMC, and RR showed robust internal consistency with values ranging from 0.818 to 0.949, demonstrating reliability and consistency in measuring their respective constructs. Additionally, the internal consistency test using Average Variance Extracted (AVE) values confirmed the reliability of all constructs, with values above 0.60 indicating strong internal consistency across all tests.

Discriminant Validity Test

The discriminant validity test, which used the Fornell-Larcker criteria, evaluated the association between markers of distinct constructs. The test evaluated the Average Variance Extracted (AVE) values with squared correlations, square roots of AVE, and correlations between constructs. Hair et al., (2021).

Table 3.
Validablity of Fornell-Larcker Test Result

Construct	**Fornell Lacker Test**						**Adequacy**
	PP	RA	RI	RM	RMC	RR	
PP	**0.932**						Valid
RA	0.170	**0.865**					Valid
RI	0.471	0.155	**0.858**				Valid
RM	0.513	0.251	0.297	**0.893**			Valid
RMC	0.346	0.143	0.193	0.667	**0.861**		Valid
RR	0.253	0.174	0.072	0.355	0.319	**0.880**	Valid

Source: Result of Fornell-Larcker Test, SmartPLS, 2024

The discriminant validity test employs the Fornell-Larcker measure, specifically the comparison value between the AVE value and the correlation value quadrant between constructs, or comparing the AVE roots with the correlation value quadrant between constructs, as shown in Table 3 Fornell-Lacker. Each latent variable must be greater than the correlation between latent variables. Table 3 reveals that the Fornell-Lacker value in the Thai model, namely the correlation between the latent variables, is stronger than the Fornell-Lacker value for other variables. For example, Risk Management (RM) has a Fornell-Larcker value of 0.893 to Risk Management, which is greater than Risk Management to Risk Monitoring and Control's value of 0.667.

Inner Model Test

Inner model analysis (structural analysis of the model) ensures that the structural model built is robust and accurate. The evaluation of the internal model can be seen from several indicators, which in this study used the multicollinearity test, f-square, coefficient of determination (R2), and path coefficient.

Table 4.
Significant and Strong Inner Model Result

Variable	**Variance Inflation Factor (<10)**	**F-Square (> 0.35)**	**Path Coefficients (-1 → +1)**	**R-square (0 → 1)**	**Adequacy**
RA-RM	1.059	0.028	0.120		Significant (+)
RI-RM	1.057	0.048	0.157		Significant (+)
RM-PP	1.000	0.357	0.513		Significant (+)
RMC-RM	1.156	0.582	0.575		Significant (+)
RR-RM	1.135	0.035	0.139		Significant (+)
PP				**0.563**	Moderate Model
RM				**0.759**	Strong Model

Source: Result of Inner Model, SmartPLS, 2024

Table 4 demonstrates the research result from four various tests of Inner Model, the multicollinearity test checks correlations among independent variables, crucial for accurate estimation, was the first test. The second test is Variance Inflation Factor (VIF) values below 10 indicate no multicollinearity issues, ensuring model reliability. The third test is F-Square values which indicate interaction levels between variables. Values over 0.35 suggest substantial influence, while below 0.02 are negligible. In our analysis, the relationship between Risk Monitoring and Control (RMC) and Risk Management (RM) had an F-Square value of 0.582, signifying a high level of influence. Conversely, the effect of Project Success (PP) on Risk Management (RM) was smaller, with an F-Square value of 0.357. Path coefficients reveal correlation strengths, ranging from -1 to +1. Closer to +1 implies stronger relationships as the test number four. In our model, the path coefficient for Risk Monitoring and Control (RMC) to Risk Management (RM) was 0.575, indicating a robust correlation. Furthermore, the coefficient of determination (R-square) measures how much an exogenous construct explains variations in an endogenous construct. High values, like PP's 50.9%, show significant influence. Therefore, Risk Management (RM) significantly shapes project outcomes. In summary, the inner model test ensures the model's reliability, demonstrating its ability to explain project success variations by capturing variable relationships effectively.

Hypothesis Test

The hypothesis testing involved evaluating t-values and p-values to determine the significance of relationships between independent and dependent variables. T-values greater than 1.96 indicated significant relationships, while p-values below 0.05 also signified significance.

Table 5. Hypothesis Testing with T-Values

Variables	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Value < 1.96	Adequacy
RA - RM	0.170	0.119	0.079	2.517	Significant (+)
RI - RM	0.157	0.156	0.102	**1.545**	Insignificant (-)
RM - PP	0.513	0.520	0.085	6.042	Significant (+)
RMC - RM	0.575	0.570	0.123	4.663	Significant (+)
RR - RM	0.139	0.143	0.059	2.346	Significant (+)

Source: Result of Mean, Standard Deviation, and T-Value, SmartPLS, 2024

In Table 5, most t-values for inter-variable impacts were > 1.96, indicating significance, except for a few insignificant ones. This is because the first three question in the questionnaire and impact in this study.

Table 6. Hypothesis Testing with P-Values

Variables	Original Sample (O)	Sample Mean (M)	Standard Deviation	P-Values < 0.05	Adequacy
RA - RM	0.170	0.119	0.079	0.029	Significant (+)
RI - RM	0.157	0.156	0.102	**0.122**	Insignificant (-)
RM - PP	0.513	0.520	0.085	0.000	Significant (+)
RMC - RM	0.575	0.570	0.123	0.000	Significant (+)
RR - RM	0.139	0.143	0.059	0.019	Significant (+)

Source: Result of Mean, Standard Deviation, and P-Value, SmartPLS, 2024

Similarly, Table 6 revealed that most p-values were < 0.05, affirming significance for inter-variable impacts. Only a tiny part (RI-RM) of these variables' influence was not insignificant (p-value > 0.05) due to first responders

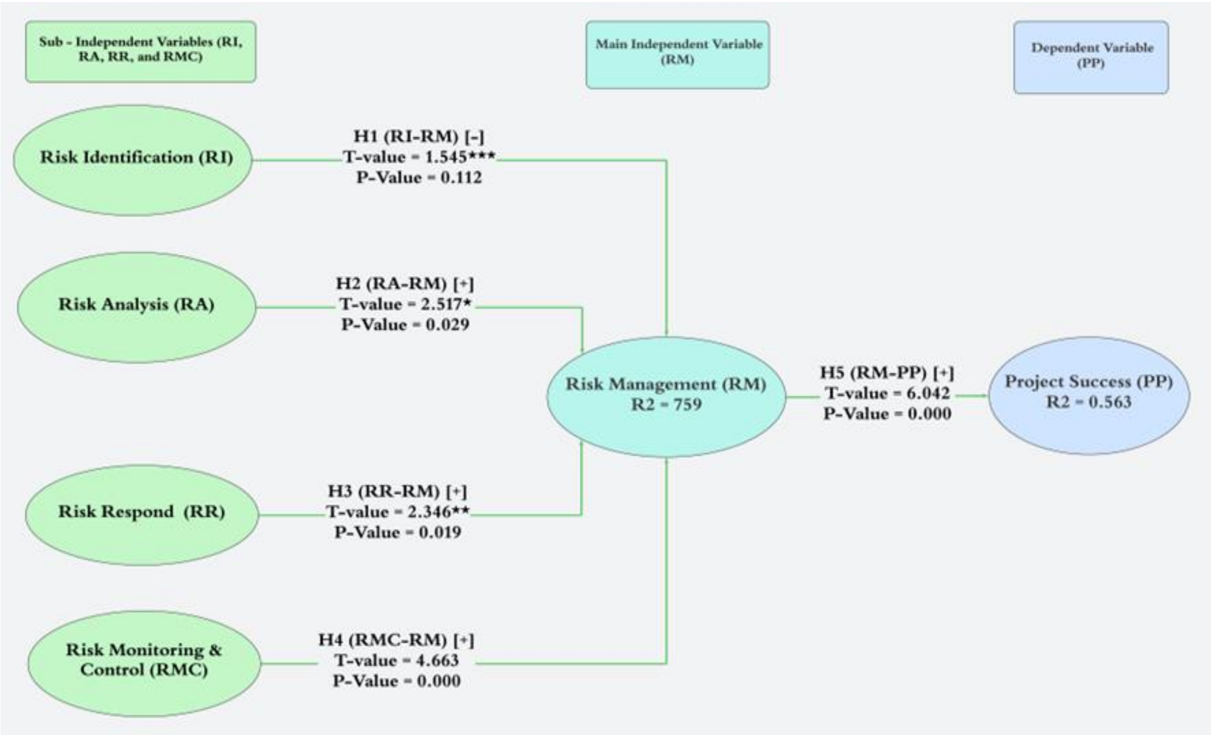
Table 7.
Final Hypothesis Result and Analysis

Hypothesis	Variables	Path Coefficient -1 → +1	T-Value >1.96	P-Value >0.05	Hypothesis Verification
H1: Risk Identification (RI) has a positive relationship on Risk Management	RI-RM	0.120	**1.545**	**0.122**	H1 is **Not** Supported
H2: Risk Analysis (RA) has a positive relationship on Risk Management	RA-RM	0.157	2.517	0.029	H2 is Supported
H3: Risk Respond (RR) has a positive effect on Risk Management	RR-RM	0.513	2.346	0.019	H3 is Supported
H4: Risk Monitoring and Control (RMC) has a positive effect on Risk Management	RMC-RM	0.575	4.663	0.000	H4 is Supported
H5: Risk Management has a positive effect on Project Succuss	RM-PP	0.139	6.042	0000	H5 is Supported

Source: Result of Hypothesis Result and Analysis, SmartPLS2024

Table 7 and Figure 3 summarized the hypothesis verification results, indicating the relationship between each variable pair and its significance. While hypotheses 2, 3, 4, and 5 were supported by significant positive relationships, hypothesis 1 was not supported due to a negative relationship between Risk Identification (RI) and Risk Management (RM). This inconsistency highlighted the complexity of the relationships among variables. The analysis further illustrated the variation in research results among the variables. Despite hypothesis 1's lack of support for all variables, hypotheses 2, 3, 4, and 5 demonstrated positive and significant effects across most variable pairs. Notably, Risk Analysis (RA), Risk Monitoring and Control (RMC), and Risk Management (RM) had consistent positive impacts on each other and on Project Success (PP), affirming their crucial roles in project outcomes. overall, while one relationship (hypothesis 1) did not align with expectations, the majority of relationships supported hypotheses 2 to 5, emphasizing the importance of Risk Analysis, Monitoring, and Management in influencing project success. These findings contribute to a nuanced understanding of the dynamics between variables and their implications for project management.

Figure 3.
Result of Hypothesis Model



Source: Result of Hypothesis Model, Author Design, 2024

Discussion of the Findings

This study sheds light on the significance of proactive risk management practices on construction project success in Yemen. By investigating the relationship between risk management performance and project outcomes, this study provided empirical evidence supporting the hypotheses:

H1: Enhanced Risk Identification Improves Risk Management Performance. The analysis revealed that proactive risk identification significantly contributes to risk management performance. This aligns with previous studies (Alsaadi & Norhayatizakuan, 2021; Nasreddine Ali Algremazy et al., 2023) which emphasize the importance of early risk identification in anticipating potential threats and improving project outcomes. In the Yemeni context, the unique challenges posed by ongoing conflict and logistical constraints make early risk identification even more critical, However, the findings of this study, along with previous studies, demonstrated the significant value of proactive risk management practices across various regions.

H2: Enhanced Risk Analysis Improves Construction Risk Management Performance. The findings support the hypothesis that rigorous risk analysis positively impacts construction risk management performance. This is consistent with Adamo et al., (2020) and Kassem, (2022), who highlighted the importance of thorough risk analysis in creating resilient reconstruction plans. This study's results underscore the need for detailed and comprehensive risk assessments to prioritize and mitigate risks effectively.

H3: Enhanced Risk Response Improves Construction Risk Management Performance. Effective risk response strategies were found to be vital for mitigating risks and enhancing project resilience, corroborating the literature (Adeleke et al., 2018; Hakami, 2021). Structured risk response processes are essential for minimizing financial losses and delays, particularly in Yemen's high-risk environment.

H4: Enhanced Risk Monitoring Improves Construction Risk Management Performance. Continuous risk monitoring and control were shown to be crucial for proactive risk management throughout the project lifecycle. This finding is in line with previous research such as Boateng et al., (2022) and Bahamid et al., (2022), which highlighted the importance of ongoing risk monitoring in managing emerging challenges. Effective risk monitoring ensures that risk management remains dynamic and responsive to changing project conditions.

H5: Improved Risk Management Performance Enhances Overall Project Success. This study confirmed a strong positive correlation between improved risk management performance and overall project success. This supports the hypothesis that robust risk management practices lead to better project outcomes, especially in complex environments like post-conflict Yemen (Bahamid et al., 2020; Boateng et al., 2022). Enhanced risk identification, analysis, response, and monitoring collectively contribute to improved time, cost, quality, and scope outcomes in construction projects.

This study added to the existing literature by providing empirical evidence on the importance of proactive risk management in the construction industry within a challenging context like Yemen. These findings offer new insights into how specific risk management practices can directly influence project success. By using advanced analytical tools such as SmartPLS and SEM, this study provided a robust quantitative analysis that enhances the understanding of risk management's role in project performance. This study highlights the critical role of contextual factors in shaping the effectiveness of risk management practices. While the importance of risk identification, analysis, response, and monitoring is well-documented, the unique challenges in Yemen underscore the need for tailored risk management strategies. The significant relationship found in hypothesis H5, with a Path Coefficient of 0.139, a T-Value of 6.042, and a P-Value of 0.00, underscores the substantial impact of effective risk management on project success in the broader context.

Several limitations should be considered when interpreting the findings. This study is based on self-reported data from 171 respondents, which may introduce biases. Additionally, the specific socio-political context of Yemen may limit the generalizability of the findings to other regions. The reliance on quantitative methods, while robust, may overlook nuanced qualitative insights that could further illuminate the risk management processes. Future research should aim to include a larger and more diverse sample, consider longitudinal studies to assess changes over time, and incorporate qualitative methods to gain deeper insights. Moreover, a significant positive correlation between risk management and project success was identified. Factors such as risk response and monitoring and review were highly correlated with project success, highlighting the critical role of robust risk management practices. This study underscored the importance of rigorous quantitative analysis using tools like SmartPLS in assessing risk management's effects on project outcomes, especially in challenging contexts like Yemen. It provided valuable insights for practitioners, researchers, and industry experts seeking to enhance project performance through effective risk management strategies

Conclusion

This study conveys a striking message: strong risk management methods are critical to successful construction projects in Yemen's changing environment. These results provided empirical evidence that proactive techniques, such as precise risk identification, detailed risk analysis, strategic risk response, and continual risk monitoring, considerably improve project performance. This study provides a realistic path for Yemeni construction professionals looking to overcome the intricacies of their sector. Integrating these techniques throughout the project's lifespan is critical. This begins with rigorous risk assessment throughout the planning stages, which is an important step in predicting possible roadblocks. Using modern analytical techniques like SmartPLS and SEM enables accurate risk assessment, which leads to informed decision-making. Creating adaptive risk response plans ensures that proactive mitigation techniques are in place to handle unexpected situations. Finally, continual risk monitoring throughout the project lifespan promotes a dynamic approach, allowing for rapid modifications as conditions change. Yemeni construction professionals that follow these instructions will get several rewards. Improved project decision-making allows them to handle uncertainty with more confidence. A proactive approach to risk management improves resilience to unanticipated difficulties, reducing interruptions and delays. Finally, effective risk management procedures pave the road for increased project success in a complicated and ever-changing context like Yemen. This study not only adds useful insights to the current body of information, but it also provides Yemeni construction professionals with the skills they need to thrive in a demanding industry.

Referenc

A Kassem, M., Khoiry, M. A., & Hamzah, N. (2020). Assessment of the effect of external risk factors on the success of an oil and gas construction project. Engineering, Construction and Architectural Management, 27(9), 2767–2793. https://doi.org/10.1108/ECAM-10-2019-0573

Adamo, N., Al-Ansari, N., Sissakian, V., Laue, J., & Knutsson, S. (2020). Dam Safety : General Considerations. Journal of Earth Sciences and Geotechnical Engineering, 10(6), 1–21. https://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-79785

Adeleke, A. Q., Bahaudin, A. Y., Kamaruddeen, A. M., Bamgbade, J. A., Salimon, M. G., Khan, M. W. A., & Sorooshian, S. (2018). The Influence of Organizational External Factors on Construction Risk Management among Nigerian Construction Companies. Safety and Health at Work, 9(1), 115–124. https://doi.org/10.1016/j.shaw.2017.05.004

Ahmad, S. A., Usama, H. I., Farag, M. A., & Abdelhafez, L. M. (2013). Evaluation of Risk Factors Affecting Time and Cost of Construction Projects in Yemen. International Journal of Management Reviews, 4(5), 168–178.

Ahmad, U., Sami, B., & Khan, A. A. (2022). Risk Identification and Assessment in Sustainable Housing Project: A Case of Housing Sector in Pakistan. Journal of Accounting and Finance in Emerging Economies, 8(2), 275–286. https://doi.org/10.26710/jafee.v8i2.2288

Alashwal & Al-Sabahi. (2019). Risk factors in construction projects during unrest period in Yemen. Journal of Construction in Developing Countries, 23(2), 43–62. https://doi.org/10.21315/jcdc2018.23.2.4

Alsaadi & Norhayatizakuan. (2021). The impact of risk management practices on the performance of construction projects. Estudios de Economia Aplicada, 39(4). https://doi.org/10.25115/eea.v39i4.4164

Bahamid, R. A., Doh, S. I., Al-Sharafi, M. A., & Rahimi, A. R. (2020). Risk Factors Influencing the Construction Projects in Yemen from Expert's Perspective. IOP Conference Series: Materials Science and Engineering, 712(1). https://doi.org/10.1088/1757-899X/712/1/012007

Bahamid, R. A., Doh, S. I., Khoiry, M. A., Kassem, M. A., & Al-Sharafi, M. A. (2022). The Current Risk Management Practices and Knowledge in the Construction Industry. Buildings, 12(7). https://doi.org/10.3390/buildings12071016

Boateng, A., Ameyaw, C., & Mensah, S. (2022). Assessment of systematic risk management practices on building construction projects in Ghana. International Journal of Construction Management, 22(16), 3128–3136. https://doi.org/10.1080/15623599.2020.1842962

Dlamini, M., & Cumberlege, R. (2021). The impact of cost overruns and delays in the construction business. IOP Conference Series: Earth and Environmental Science, 654(1). https://doi.org/10.1088/1755-1315/654/1/012029

Ferreira de Araújo Lima, P., Marcelino-Sadaba, S., & Verbano, C. (2021). Successful implementation of project risk management in small and medium enterprises: a cross-case analysis. International Journal of Managing Projects in Business, 14(4), 1023–1045. https://doi.org/10.1108/IJMPB-06-2020-0203

Gamil, Y., & Abd Rahman, I. (2023). Impact of poor communication on dispute occurrence in the construction industry: a preliminary exploratory study of Yemen construction industry. International Journal of Construction Management, 23(16), 2729–2735. https://doi.org/10.1080/15623599.2022.2092388

Hair et al. (2021). Handbook of Market Research. In Handbook of Market Research (Issue July). https://doi.org/10.1007/978-3-319-05542-8

Hakami, W. G. (2021). Significant risk factors affecting construction projects in Yemen. *Umm Al-Qura University Journal of Engineering & ..., 12(2), 14–25. https://drive.uqu.edu.sa/_/jea/files/12-2/3.pdf*
Ivanov, N., & Aldeen, A. M. A. S. (2018). Construction in the Republic of Yemen: Problems of Development and Solutions. IOP Conference Series: Materials Science and Engineering, 365(6). https://doi.org/10.1088/1757-899X/365/6/062015
Jarrah, M. AL, Jarah, B., & Altarawneh, I. (2022). Toward successful project implementation: Integration between project management processes and project risk management. Problems and Perspectives in Management, 20(3), 258–273. https://doi.org/10.21511/ppm.20(3).2022.211
Kassem, M. A. (2022). Risk Management Assessment in Oil and Gas Construction Projects Using Structural Equation Modeling (PLS-SEM). Gases, 2(2), 33–60. https://doi.org/10.3390/gases2020003
Khahro, S. H., Shaikh, H. H., Zainun, N. Y., Sultan, B., & Khahro, Q. H. (2023). Delay in Decision-Making Affecting Construction Projects: A Sustainable Decision-Making Model for Mega Projects. Sustainability (Switzerland), 15(7). https://doi.org/10.3390/su15075872
Le, N., Chong, O., & Kashiwagi, D. (2020). Success Factors for Project Risk Management in Construction Projects: A Vietnam Case Study. Journal for the Advancement of Performance Information and Value, 12(2), 63. https://doi.org/10.37265/japiv.v12i2.126
Misnan et al. (2024). Influence of Psychological Well-Being and School Factors on Delinquency, During the Covid-19 Period Among Secondary School Students in Selected Schools in Nakuru County: Kenya. VII (2454), 1175–1189. https://doi.org/10.47772/IJRISS
Nasreddine Ali Algremazy, Ideris, Z., Alferjany, M. A., & Akram, A. (2023). The Effect of Risk Management Practices on Project Performance: A Case Study of the Libyan Construction Industry. International Journal of Professional Business Review, 8(6), e01420. https://doi.org/10.26668/businessreview/2023.v8i6.1420
Nguyen, T. S., Mohamed, S., & Mostafa, S. (2021). Project stakeholder's engagement and performance: a comparison between complex and non-complex projects using SEM. Built Environment Project and Asset Management, 11(5), 804–818. https://doi.org/10.1108/BEPAM-11-2020-0181
Rachmadhani, M. M., Immawan, T., Mansur, A., & Choi, W. (2023). Risk Management Framework Design Based on ISO 31000 and SCOR Model. Spektrum Industri, 21(1), 41–51. https://doi.org/10.12928/si.v21i1.93
Saleh M. A. Alshehhi et al., 2024. (2024). The Impact of Risk Management On The Performance Of Construction Projects. Estudios de Economia Aplicada, 39(4), 5994–6003. https://doi.org/10.25115/eea.v39i4.4164
Shibani, A., Hasan, D., Saaifan, J., Sabboubeh, H., Eltaip, M., Saidani, M., & Gherbal, N. (2022). Financial risk management in the construction projects. Journal of King Saud University - Engineering Sciences, https://doi.org/10.1016/j.jksues.2022.05.001
Tahir et al. (2020). Effects of Risk Management Practices on Project Success in the Construction Industry of Pakistan. Management and Production Engineering Review, 8(1), 30–37. https://doi.org/10.1515/mper-2017-0004
Word Bank. (2022). Yemen Country Economic Memorandum 2022: Glimmers of Hope in Dark Times. Yemen Country Economic Memorandum 2022: Glimmers of Hope in Dark Times. https://doi.org/10.1596/39914
Wu, X., Zhao, W., Ma, T., & Yang, Z. (2019). Improving the efficiency of highway construction project management using lean management. Sustainability (Switzerland), 11(13), 1–27. https://doi.org/10.3390/su11133646