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# Impact of Applying Risk Management Strategies on Construction Project Performance

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# أثر تطبيق استراتيجيات إدارة المخاطر على أداء المشاريع الإنشائية

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**Abstract:**
Risk management plays a crucial role in improving construction project performance, particularly in reducing schedule delays and enhancing overall project efficiency. This study aims to examine the impact of applying risk management practices on construction project performance. The study adopted a descriptive analytical approach using a structured questionnaire as the primary data collection instrument. The study population consisted of 100 participants working in construction projects, from which a total sample of 80 respondents was obtained, with 70 valid responses used for statistical analysis. The collected data were analyzed using the statistical package for social sciences (SPSS). The findings revealed a statistically significant relationship between the level of risk management implementation and construction project performance, particularly in terms of adherence to project schedules. The results also indicate that effective risk management practices contribute to improving project outcomes through better identification, assessment, response, and monitoring of risks. The study concludes that integrating systematic risk management procedures within construction project management can significantly enhance project performance and reduce delays.

**Keywords:** Risk Management, Construction Projects, Time Delay, Strategic Planning, Execution Efficiency.

**الملخص:**
تلعب إدارة المخاطر دورًا حاسمًا في تحسين أداء مشاريع البناء، خاصة في تقليل تأخيرات الجداول الزمنية وتعزيز الكفاءة العامة للمشروع. تهدف هذه الدراسة إلى فحص تأثير تطبيق ممارسات إدارة المخاطر على أداء مشاريع البناء. اعتمدت الدراسة المنهج الوصفي التحليلي باستخدام استبيان منظم كأداة رئيسية لجمع البيانات. تكوّن مجتمع الدراسة من 100 مشارك يعملون في مشاريع البناء، ومن بينهم تم الحصول على عينة إجمالية بلغت 80 مشاركًا، حيث استُخدمت 70 استجابة صالحة للتحليل الإحصائي. تم تحليل البيانات المجمعة باستخدام الحزمة الإحصائية للعلوم الاجتماعية (SPSS) أظهرت النتائج وجود علاقة ذات دلالة إحصائية بين مستوى تطبيق إدارة المخاطر وأداء مشاريع البناء، خاصة فيما يتعلق بالالتزام بالجداول الزمنية للمشاريع. كما تشير النتائج إلى أن الممارسات الفعالة لإدارة المخاطر تسهم في تحسين مخرجات المشروع من خلال تحسين عمليات تحديد المخاطر وتقييمها والاستجابة لها ومتابعتها. وتخلص الدراسة إلى أن دمج

إجراءات إدارة المخاطر بشكل منهجي ضمن إدارة مشاريع البناء يمكن أن يعزز بشكل كبير أداء المشاريع ويقلل من التأخيرات.

**الكلمات المفتاحية:** إدارة المخاطر، مشاريع البناء، التأخير الزمني، التخطيط الاستراتيجي، كفاءة التنفيذ.

**Introduction:**

Construction projects are among the most complex types of projects due to the large number of influencing factors involved in their execution. These complexities make construction projects particularly vulnerable to delays and schedule overruns. Global studies indicate that delay rates in construction projects may exceed 60%, resulting in significant financial losses and negatively affecting project sustainability and efficiency [1-3]. In this context, risk management has become a critical component of modern project management, as it enables project managers to identify potential risks, assess their impacts, and implement appropriate mitigation strategies to ensure adherence to project schedules and objectives.

Construction projects are inherently exposed to a broad spectrum of uncertainties that can adversely affect cost, time, quality, safety, and overall project success. These uncertainties arise from technical complexity, design modifications, financial constraints, contractual disputes, resource shortages, regulatory changes, environmental conditions, and unforeseen site-related challenges. In a sector characterized by multiple stakeholders, fragmented workflows, and high capital investment, even minor risks may escalate into major project disruptions if they are not properly identified and controlled. As a result, risk management has become a fundamental component of modern construction management, enabling project teams to anticipate potential threats and develop structured responses before they negatively influence project outcomes [4-6].

The application of risk management strategies in construction projects involves a systematic process of risk identification, assessment, mitigation, monitoring, and control throughout the project life cycle. Effective strategies may include contingency planning, schedule buffering, safety management protocols, contractual risk allocation, resource optimization, and continuous communication among project participants. When properly implemented, these strategies can reduce uncertainty, enhance decision-making, improve coordination, and strengthen the resilience of construction projects against internal and external disturbances [7-10]. In this context, risk management is no longer viewed merely as a defensive mechanism, but rather as a proactive managerial approach that contributes to achieving project objectives more efficiently and sustainably.

This study examines the role of risk management practices in enhancing construction project performance through an empirical field study conducted among technical and engineering staff working in construction projects. A total of 100 questionnaires were distributed, of which 70 valid responses were collected and analyzed using the statistical package for social sciences (SPSS). The study aims to investigate the relationship between the maturity level of risk management practices as an independent variable and construction project performance as a dependent variable, measured across its key dimensions: time performance, cost performance, and quality performance. The findings are expected to contribute to the development of more effective risk management strategies that enhance the efficiency and success of construction project execution.

**Literature review:**

Several studies have emphasized the importance of risk management in improving construction project performance, particularly in terms of cost, time, and quality. In [11], the study sought to examine the prevailing risk management strategies adopted in Yemeni building projects through a questionnaire-based survey administered to respondents from construction firms operating in Yemen. The findings revealed that risk management practices in these projects are generally not implemented in a systematic, deliberate, or continuous manner. Instead, most firms rely on reactive, temporary, informal, and poorly structured procedures, with limited or no dedicated resources allocated for effective risk management. Such practices were found to be inconsistent with internationally recognized risk management principles and frameworks. Despite these shortcomings, the study indicated that there is a general awareness of the importance of risk management among practitioners, along with a willingness to learn from previous project failures and experiences. The results further showed that commonly used approaches for risk identification and analysis include professional judgment and the use of historical data. In terms of response strategies, the construction sector in Yemen predominantly tends to avoid or transfer risks rather than adopt more comprehensive and proactive mitigation frameworks.

This study [12] investigates the practice of risk management in construction projects within the Somali Regional State of Ethiopia and identifies the most significant risk factors that require greater attention in project implementation. To achieve this objective, a questionnaire survey was administered

to construction professionals working in the region. The study provides an important regional perspective on how risk management is understood and applied in construction environments characterized by institutional and resource-related constraints. The findings indicate that risk management practices in construction projects across the Somali Regional State remain inadequate, largely due to limited professional knowledge and insufficient budgetary allocation for formal risk management activities. This suggests that risk management is not yet fully integrated into the project management framework of the region, thereby reducing the capacity of construction stakeholders to anticipate, assess, and mitigate project uncertainties in a structured and effective manner.

In this study [13], fifteen experts were invited to evaluate the risk factors identified from previous literature in order to verify their applicability to the Egyptian construction context. Following this preliminary assessment, thirty-five risk factors were selected through a pilot survey and subsequently distributed to ninety-five participants. The data collection process was structured using a five-point Likert scale, which facilitated the systematic evaluation and ranking of the identified risks according to their perceived significance. The primary objective of the study was to redefine and prioritize construction-related risks in light of the prevailing conditions in Egypt. The findings of the proposed model revealed several high-risk factors that have the potential to collectively undermine overall project performance. Among the most critical risks identified were contractors' funding difficulties, fluctuations in material prices, unrealistic estimations of project activity durations, and shortages of construction materials in the market. These factors were found to represent substantial threats to the timely and efficient delivery of construction projects.

**Contribution of the study:**

Despite the extensive body of literature on construction project management, limited empirical research has examined the integrated impact of different risk management dimensions on overall construction project performance, particularly within the Libyan construction sector. While previous studies have primarily focused on individual aspects of project management or specific risk factors, there remains a lack of comprehensive empirical investigations that analyze how multiple risk management processes collectively influence project outcomes. Therefore, this study seeks to address this gap by examining the combined effect of key risk management dimensions, risk identification, risk assessment, risk response, and risk monitoring, on construction project performance across its principal dimensions of time, cost, and quality. By focusing on active construction companies and employing rigorous statistical analysis, this study provides context-specific empirical evidence and practical insights that can support the development of more effective risk management strategies in the construction sector.

**Theoretical framework**:

Construction projects are inherently complex due to the large number of technical, organizational, and environmental factors that influence their execution. These complexities often make construction projects vulnerable to delays, cost overruns, and quality deficiencies. Therefore, effective project management requires not only technical expertise but also the systematic application of risk management practices to anticipate uncertainties and ensure successful project delivery.

**Risk**:

Risk can be defined as an uncertain event or condition that may occur in the future and, if it occurs, can have either positive or negative effects on project objectives such as time, cost, and quality [14,15]. In construction projects, risks arise from multiple sources including financial constraints, technical challenges, environmental conditions, and organizational factors.

**Construction projects:**

A construction project consists of a series of coordinated and interrelated activities carried out within defined constraints of time, cost, and quality. Due to the complexity of construction activities and the involvement of multiple stakeholders, effective management is essential to ensure that project objectives are achieved within the specified parameters [16].

**Risk management in construction projects**:

Risk management is a systematic process that involves identifying, analyzing, responding to, and monitoring potential risks that may affect project objectives. In construction projects, risk management plays a critical role in minimizing uncertainty and improving decision-making throughout the project lifecycle. Effective implementation of risk management practices increases the likelihood of completing projects within planned schedules, budgets, and quality standards [17].

**Risk management processes**:

Risk management in construction projects typically involves four main processes [18]:

- **Risk Identification:** identifying potential risks that may influence project objectives.
- **Risk Assessment:** evaluating the likelihood and potential impact of identified risks, often using analytical tools such as the probability–impact matrix.

- **Risk response planning:** developing strategies to address risks through avoidance, mitigation, transfer, or acceptance.
- **Risk monitoring and control:** continuously monitoring identified risks and evaluating the effectiveness of response strategies during project implementation.

**Risk register:**

A risk register is a structured document used to record identified risks, their probability and impact, response strategies, and responsible stakeholders. It serves as a key management tool that supports systematic risk monitoring and effective decision-making throughout the project lifecycle [19].

**Probability–impact matrix**:

The probability–impact matrix is widely used in construction risk management to classify risks according to their likelihood of occurrence and their potential impact on project objectives. This tool helps project managers prioritize risks and allocate resources efficiently to address the most critical risks [20].

**Risk response strategies**:

Risk response strategies are actions developed to manage identified risks**.** These strategies typically include:

- **avoidance:** eliminating the risk by changing project plans or processes.
- **mitigation:** reducing the probability or impact of the risk.
- **Transfer:** shifting the risk to another party, such as through insurance or contractual agreements.
- **Acceptance:** accepting the risk and preparing contingency plans if it occurs.

**Construction project performance**:

The effectiveness of risk management is often evaluated through construction project performance indicators. These indicators typically include adherence to the project schedule, control of project costs within the allocated budget, and achievement of the required quality standards [18-20]. Together, these dimensions, time, cost, and quality, represent the primary criteria used to assess the success of construction projects.

**Methodology**

**Research Design:** This study adopts a descriptive analytical research approach to examine the relationship between risk management practices and construction project performance. The descriptive method is used to describe the current level of risk management practices in construction projects, while the analytical method is employed to analyze the relationship between risk management dimensions and project performance. In this study, risk management practices represent the independent variable, whereas construction project performance represents the dependent variable.

**Study Population and Sample:**

The study population consisted of engineers and technical professionals involved in construction project activities. A total of 100 questionnaires were distributed to engineers, contractors, and consultants working in construction projects.

Out of the distributed questionnaires, 70 valid responses were collected and considered suitable for statistical analysis. The inclusion of different professional roles ensured diverse professional representation and provided a comprehensive understanding of risk management practices in construction projects.

The demographic characteristics of the respondents included several variables such as educational level, years of professional experience, project size, project type, and supervising authority, which helped provide a clearer understanding of the professional background of the respondents.

**Research Instrument:**

A structured questionnaire was used as the primary data collection instrument. The questionnaire items were developed based on previous studies in the fields of project management and risk management and were adapted to suit the context of construction projects.

The questionnaire was designed in accordance with the objectives of the study and consisted of three main sections:

**Demographic Information**:

This section collected background information about respondents, **including:**

- Educational level.
- Years of professional experience.
- Type of organization (contractor, consultant, or project owner).
- Project size.

**Risk Management Practices:**

This section measured the level of implementation of risk management dimensions**, including:**

- Risk Identification.
- Risk Assessment.

- Risk Response.
- Risk Monitoring.

**Construction Project Performance:**

This section measured construction project performance using key performance indicators related to:

- Time performance.
- Cost performance.
- Quality performance.

**Measurement Scale:**

This scale was used to assess respondents' perceptions of the level of risk management practices and construction project performance.

The questionnaire items were measured using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

**Study Variables:**

**Independent Variable:**

The independent variable in this study is Risk Management Practices, represented by four main dimensions:

- Risk Identification.
- Risk Assessment.
- Risk Response.
- Risk Monitoring.

The level of implementation of these dimensions in construction projects was measured using descriptive statistics, including the mean and standard deviation.

**Dependent Variable:**

The dependent variable is construction project performance, which was measured from the perspective of employees working in construction projects.

Project performance was assessed using 26 measurement items representing key performance indicators of construction projects related to time, cost, and quality.

The mean and standard deviation were calculated to determine the overall level of project performance.

**Statistical Analysis:**

collected data were analyzed using the Statistical Package for the Social Sciences (SPSS). Several statistical techniques were applied, including:

- **Descriptive statistics** (mean and standard deviation) to describe the characteristics of the sample and the level of study variables.
- **Cronbach's Alpha** to test the reliability and internal consistency of the questionnaire items.
- **Pearson correlation coefficient** to measure the strength and direction of the relationship between risk management practices and construction project performance.
- **Linear regression analysis** to examine the effect of risk management dimensions on construction project performance.
- **Coefficient of determination ($R^2$)** to determine the proportion of variance in project performance explained by risk management practices.

**Hypothesis testing:**

The study hypotheses were tested at a significance level of $\alpha = 0.05$ with a confidence level of 95%. The decision rule was based on comparing the observed significance value (sig.) With the adopted significance level (0.05). The null hypothesis was rejected and the alternative hypothesis was accepted if the observed significance value was less than 0.05.

- **Main hypothesis:** There is a statistically significant effect of risk management dimensions on construction project performance.
- **Null hypothesis ($H_0$):** There is no statistically significant effect of risk management dimensions (risk identification, risk assessment, risk response, and risk monitoring) on construction project performance.
- **Alternative hypothesis ($H_1$):** There is a statistically significant effect of risk management dimensions (risk identification, risk assessment, risk response, and risk monitoring) on construction project performance.

**Statistical analysis method:**

The collected data were analyzed using the statistical package for the social sciences (spss), version 29, to ensure the reliability and validity of the study results. To evaluate the internal consistency of the questionnaire items and confirm the reliability of the research instrument, Cronbach's alpha coefficient was calculated.

Descriptive statistical methods, including means and standard deviations, were used to summarize and describe the responses of the study sample. These measures helped determine the levels of risk management practices and construction project performance across the examined dimensions.

To analyze the relationships between the study variables, Pearson's correlation coefficient was employed to measure the strength and direction of the relationship between risk management practices and construction project performance. Furthermore, linear regression analysis was conducted to assess the effect of risk management dimensions on project performance.

In addition, the coefficient of determination ($R^2$) was used to determine the proportion of variance in construction project performance that can be explained by the independent variables representing risk management dimensions.

**Results:**

The statistical analysis of the data collected from 70 valid responses revealed a strong positive relationship between risk management practices and construction project performance. The Pearson correlation coefficient showed a value of $R = 0.850$, indicating a strong positive association between the variables. Furthermore, the coefficient of determination ($R^2 = 0.723$) indicates that risk management practices explain 72.3% of the variance in construction project performance.

The regression analysis results also confirmed the statistical significance of the model. The f-value reached 177.683 with a significance level of sig. = 0.000, which is lower than the accepted threshold of 0.05. These findings confirm that the regression model is statistically significant and that risk management practices have a substantial impact on construction project performance.

**Discussion:**

The findings of this study provide important insights into the role of risk management practices in improving construction project performance. Based on the analysis of questionnaire responses collected from professionals working in construction companies, the results indicate that the implementation level of risk management practices in the surveyed companies remains moderate, with an overall mean value of 2.93. This suggests that there is still a gap between current practices and the optimal level required for effective risk control.

The analysis of individual risk management dimensions revealed noticeable variations. The risk response dimension recorded the highest mean value (3.35), indicating that many companies tend to address risks reactively after their occurrence rather than adopting preventive risk management practices. In contrast, the dimensions of risk monitoring (2.81), risk assessment (2.78), and risk identification (2.71) recorded lower mean values, reflecting insufficient efforts in early risk identification, systematic analysis, and continuous monitoring of project risks.

Similarly, construction project performance recorded a moderate mean value of 3.08, which may be attributed to the limited integration among the different stages of risk management. Weak coordination between risk identification, assessment, response, and monitoring can negatively affect project performance, particularly in terms of schedule adherence, cost control, and quality achievement.

The statistical analysis confirmed the main hypothesis of the study, demonstrating a statistically significant effect of risk management dimensions on construction project performance ($R = 0.850$, $R^2 = 0.723$). These findings indicate that effective implementation of risk management practices plays a major role in improving project outcomes. The remaining percentage of unexplained variance may be attributed to other factors such as managerial efficiency, organizational structure, and external environmental conditions.

Furthermore, the regression analysis indicated that all risk management dimensions have a statistically significant influence on construction project performance, although their levels of impact vary. This finding highlights the importance of adopting an integrated risk management approach that combines risk identification, assessment, response, and monitoring to enhance the overall performance of construction projects.

Accordingly, the null hypothesis ($H_0$), which assumed that risk management practices have no statistically significant effect on construction project performance, is rejected. The alternative hypothesis ($H_1$) is accepted, confirming that risk management dimensions have a statistically significant effect on construction project performance. These findings emphasize the importance of implementing systematic and structured risk management practices in construction projects in order to improve project outcomes and ensure successful project delivery.


**Figure 1:** Mean values of risk management dimensions.

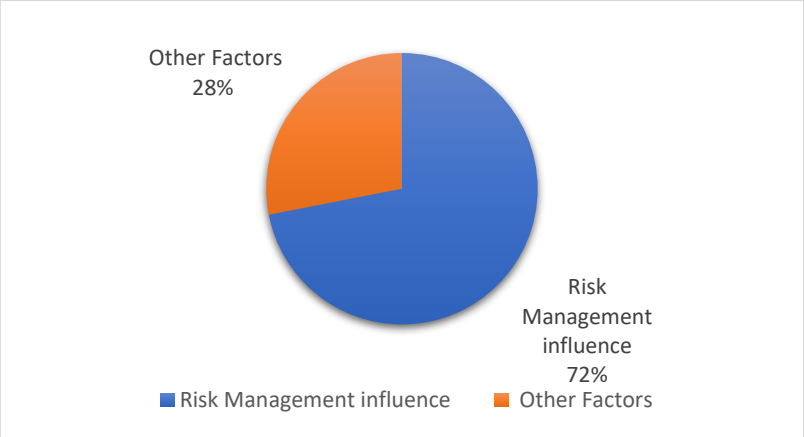


**Figure 2:** Explained variance in construction project performance ($R^2$)

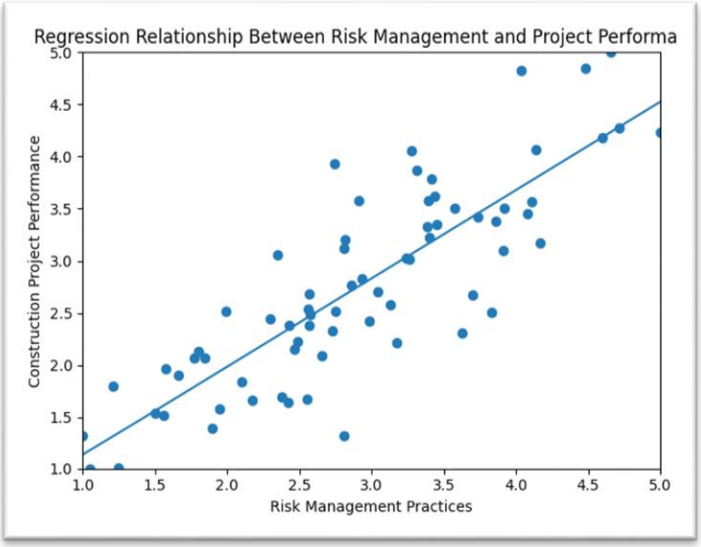


**Figure 3:** Regression relationship between risk management and project performance

**Conclusion:**

This study investigated the effect of risk management practices on construction project performance within construction companies. Based on the analysis of data collected from 70 valid responses and the application of appropriate statistical techniques, the findings provide strong empirical evidence of the significant role of risk management in improving construction project outcomes.The results indicate that the level of risk management implementation in the surveyed construction projects remains moderate, suggesting a gap between current practices and the optimal level required for effective project control. Despite this moderate level of implementation, the statistical analysis revealed a strong and statistically significant positive relationship between risk management practices and construction project performance.

The findings further demonstrate that improvements in risk management practices can significantly enhance project performance, particularly in terms of schedule adherence, cost control, and quality achievement. In addition, the results highlight that the combined dimensions of risk management risk identification, risk assessment, risk response, and risk monitoring :play a crucial role in explaining variations in construction project performance. Overall, the study confirms that adopting a systematic and integrated approach to risk management is essential for improving construction project outcomes. Effective implementation of risk management practices enables project managers to better anticipate potential uncertainties, respond proactively to project risks, and enhance the likelihood of successful project delivery. The findings of this study provide valuable insights for construction companies, project managers, and decision-makers seeking to improve project performance through structured and proactive risk management strategies.

**Recommendations:**

Based on the findings of this study, the following recommendations are proposed to improve the effectiveness of risk management practices in construction projects:

- construction companies should strengthen the implementation of formal risk management practices by integrating risk management procedures into the overall project management framework.
- greater attention should be given to the early stages of risk management, particularly risk identification and risk assessment, in order to prevent potential project disruptions before they occur.
- construction organizations should adopt a systematic and integrated risk management approach that combines risk identification, assessment, response, and monitoring throughout the entire project lifecycle.
- project managers should utilize modern project management tools and software, such as primavera and Microsoft project, to improve risk monitoring and schedule control.
- training programs and professional development initiatives should be introduced to enhance the risk management capabilities of engineers and project managers working in construction projects.
- construction companies should promote a proactive risk management culture, encouraging early detection of potential risks and continuous monitoring to minimize negative impacts on project time, cost, and quality.

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