

Risk and Crisis Dynamics in Construction Projects within Jordanian Free Zones

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Abstract: This study has discussed risk and crisis dynamics in construction projects in Free Zones in Jordan. These projects are subjected to recurring internal and external risks that impact cost, time, and quality. This problem has rarely been addressed in previous studies. This study aims to determine the causes and levels of risks and to determine how risk management can affect the success of a project. The study used an analytical descriptive methodology using a questionnaire distributed to 122 participants and 8 case studies. The data were analyzed using SPSS and AMOS. The results indicated that risk management had a significant impact on the success of the project, as indicated in 43.3% of the variance. The strongest predictors were risk evaluation and response. Similarly, case studies verified the effects of environmental risks, design errors, permit restrictions, and weak coordination. The study suggests using more powerful risk assessment, dedicated risk-management departments, improved planning, and quicker response protocols. The findings imply that systematic management of risks can enhance the performance of a project in a free-zone construction setting.

Keywords: Construction Projects; Crisis Management; Jordanian Free Zones; Project Success; Risk Management

1. Introduction

Construction projects in Jordanian free zones are high-stakes, complex environments with infrastructure development, investment activities, and regulatory constraints intersecting. These projects are often subjected to uncertainties that may derail timelines, overrun costs, and affect quality. When risks and crises arise, either through environmental shock, regulatory delay, or internal inefficiency, it may be a significant hindrance to the completion of such a project and to the overall success of the development work. This issue is even more critical when these risks are not systematically identified, measured, and managed, particularly in environments where construction activities are closely related to the performance of the national economy.

The construction projects are also uncertain in their nature because of long implementation periods and exposures to dynamic economic, political, and technological conditions (Wu et al., 2025). These uncertainties are further escalated in the context of free zones with operational constraints, logistical complexities, and timelines driven by investment. A free zone is a special economic zone where business entities benefit from exemptions in customs and taxes (Rowbotham, 2022). This makes infrastructure development projects in free zones crucial in national development strategies (Alansary and Al-Ansari, 2023). In Jordan, free zones inject more than six billion Jordanian dinars into the economy each year, hence the role in ensuring efficient and resilient construction operations (The Free Zone Company, 2019).

Construction project risks and crises can be either internally or externally originated. Internal risks include the absence of great planning, design errors, or specialized labor (Masso et al., 2020). Masso et al. (2020) elaborate on them by indicating that they involve regulatory obstacles, and global crises such as pandemics, and environmental conditions. In this context, the COVID-19 pandemic revealed how unforeseen events in the world can severely disrupt



the construction workflow and supply chains and influence the availability of labor (Iqbal, 2021; Ogunnusi et al., 2020). Similarly, environmental risks like floods and geographical barriers are considered a significant cause of the delay in project completion and losses (Simonovic et al., 2021).

Although risks are unavoidable, the proper management of risks and crises can greatly enhance the project outcomes by decreasing the uncertainty and increasing preparedness (Ongesa et al., 2025). Nonetheless, there is a paucity of studies specifically on the nature, causes, and levels of the risks in the Jordanian free zones and their direct influence on the project success. Thus, this study seeks to offer a detailed insight into risk and crisis dynamics regarding the topic under investigation. It outlines the nature of risks and crises that can arise in construction projects in the Jordanian free zones, identifies the internal and external causes of risks and crises, assesses the level of risk in such projects, and conducts a case study of the real-life risks and crises involved in a construction project. By fulfilling these objectives, the study fills the gap between the theoretical risk management frameworks and practical issues in the context of free-zone construction environments, providing insights that can improve planning, make better decisions, and perform project activities.

1.1 Statement of the Problem

The construction projects in the Jordanian free zones are subjected to a plethora of risks and crises that can have an adverse effect on their cost, time, and quality performance. These risks are both internal and external in nature. They have several manifestations, such as poor planning, absence of expert risk-management personnel, design flaws, environmental factors, and regulatory issues, including permit restrictions, limited working hours (Masso et al., 2020). Moreover, the implementation of projects has been further complicated by such global crises as the COVID-19 pandemic and environmental risks like floods (Simonovic et al., 2021).

Even though previous studies have gained some insights into the risk management in construction projects, there remains a gap in the Jordanian context. The literature overlooks addressing the challenges facing the construction projects in Jordanian free zones, especially in terms of identifying the nature of risks, their causes, their magnitude, and their effects on the success of a project. This gap constrains the decision-makers to devise effective risk and crisis management strategies that can be effective in this environment. Thus, this research aims to fill this gap by contributing a detailed analysis of risks and crises in free-zone construction projects and the discussion of how effective managerial practices can improve the outcomes of the projects. The research hypothesizes that enhanced preparedness, less uncertainty, and greater project success can be achieved through a better identification, measurement, and management of risks, as supported by real case studies.

1.2 Study Hypotheses

H01: There are no statistically significant impacts of Risk Management (determine risk, evaluation risk, and response risk) on Project Success among the construction projects.

H01-1: There are no statistically significant impacts of Risk Management (determine risk, evaluation risk, and response risk) on the Project Cost among the construction projects.

H01-2: There are no statistically significant impacts of Risk Management (determine risk, evaluation risk, and response risk) on the Project Quality among the construction projects.

H01-3: There are no statistically significant impacts of Risk Management (determine risk, evaluation risk, and response risk) on the Project Time among the construction projects.

H02: There are no statistically significant differences in the level of project success related to (Job, Experience in the Engineering Field, and Educational Background).

H03: There are no statistically significant differences in the level of Risk Management related to Job, Experience in the Engineering Field, and Educational Background.

1.3 Study Model

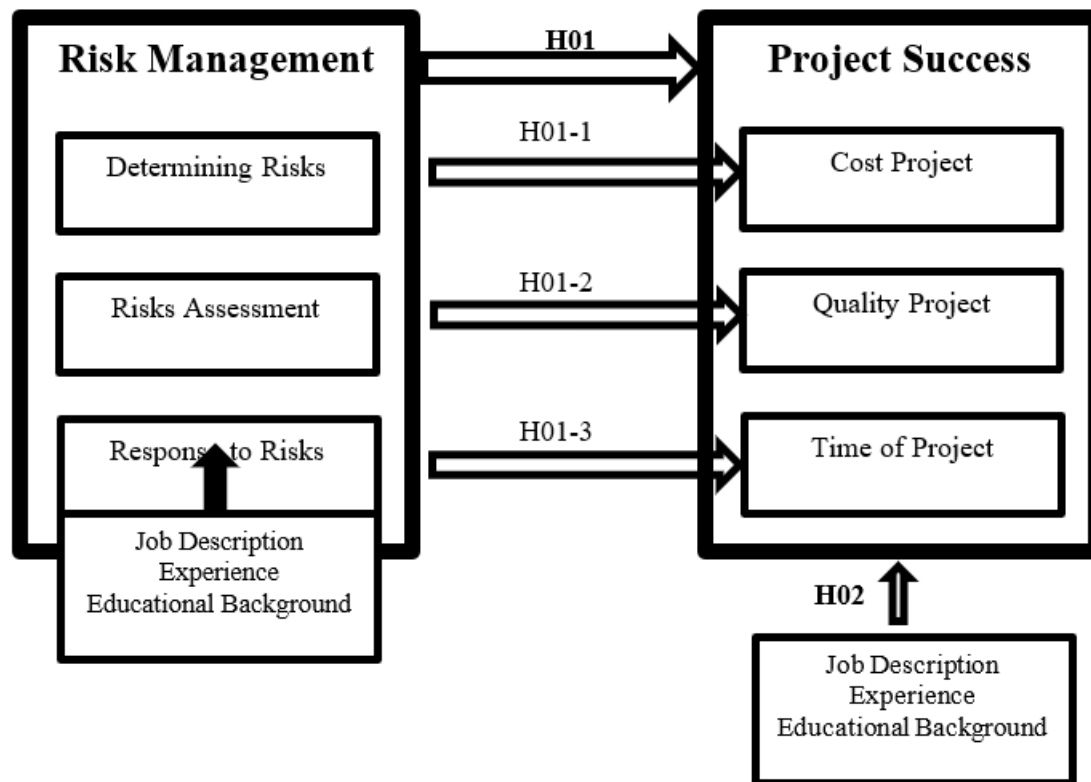


Figure 1: Study Model Based on Masso et al. (2020) and Alves et al. (2021)

2. Literature Review

Risk and crisis management have become a major issue of concern in construction project management since construction projects are generally subjected to uncertainty, complexity, and unstable internal and external conditions. The design changes, economic fluctuations, environmental conditions, performance of the contractors, safety concerns, regulatory processes, and unexpected events such as epidemics and floods affect such projects (PMI, 1996). These risks can become more acute in the Jordanian free zones due to the connection of construction activity to investment activity, the development of infrastructure, limited access, and the need to sustain services to the investors (). Thus, it is critical to address the risk, crisis management, project success, and risks associated with construction to understand the development of risks and their impact on the success of projects and their management.

The general definition of risk is an uncertain event that can have both a positive and a negative impact on project goals. According to the Project Management Institute, project risk refers to an uncertainty event or condition that, when it occurs, will impact at least one of the project objectives, such as cost, time, scope, or quality (Foroutan Mirhosseini et al., 2022). As further explained in PMI (2017), project risk management involves planning, identifying, analyzing, response planning, implementation, and monitoring that seek to increase positive risks and reduce negative risks. Pomaza-Ponomarenko et al. (2023) also outline project risk management as a series of principles and practices that can be utilized to identify, analyze, and respond to risk factors to maximize project success and minimize failure. Risk management is also defined by Meyer and Reniers (2025) as a process of addressing risks to achieve goals by maximizing opportunities and minimizing adverse effects.

Risk and crisis are not identical since risk is a possible, doubtful event, whereas a crisis is a serious situation that endangers the normal functioning of individuals, institutions, or even a society. According to Meyer and Reniers (2025), a crisis is a situation that threatens institutions by factors that are beyond their normal routine capacity. A construction project can face a crisis when risks are not identified at early stages or when unexpected events have a

severe impact on implementation. In this respect, Ebekozién et al. (2024) elaborate that crisis and risk management involve three key steps: preparation before occurrence, response during occurrence, and learning after occurrence. In addition, Iftikhar et al. (2023) also divide crisis management into prevention, preparation, response, and recovery, which suggests that crisis management should be embedded into project planning, but not treated as a delayed response.

Cost, time, and quality have been traditionally used to measure project success. Pinto et al. (2022) claim that project success should be based on the objectives of the stakeholders throughout the project life cycle. In the same vein, Metwally et al. (2025) elaborate that the success of project management should be anchored in delivering the project within the specified cost, time, and quality requirements. Likewise, Pomaza-Ponomarenko et al. (2023) maintain that project success has shifted its traditional measurement from time, cost, and quality to broader dimensions to satisfy stakeholders. In this respect, Sanyaolu et al. (2023) distinguish project efficiency, which comprises scope, schedule, and budget, and stakeholder success to achieve the expectations of stakeholders. This is especially relevant in free-zone construction projects where the success of the project does not merely imply the completion of the infrastructure but also the satisfaction of investors, contractors, government agencies, and users.

Engineering and construction projects experience diverse and complex challenges. According to Salem (2020), projects are structured activities that are introduced within a given time frame in order to accomplish certain goals. Moreover, Ghamarimajd et al. (2025) indicate that complex engineering projects entail interacting systems and stakeholders, which raises the potential of risks and crises. Likewise, Masso et al. (2020) point out that larger and more complex projects are associated with a greater level of risk, and such complex projects require risk management to achieve successful project management. Hillson (2024) further opines that risk management also enhances project objectives and budget management, particularly in uncertain projects. In addition, Alves et al. (2021) add that the unexpected events with unpredictable effects can cause risks and crises and demand planning, coordination, communication, and the ability to make quick decisions.

The literature indicates that construction risks can be either internal or external. Internal risks are poor planning, weak management, absence of specialized personnel, design errors, contractual disagreements, safety violations, and poor communication. Salem (2020) revealed that the major construction risks are inadequate design, delays in the delivery of equipment and material, inadequate safety compliance, fluctuation of prices, and poor project management. On the other hand, the external risks facing construction are economic instability, inflation, government regulation, geography, weather, floods, epidemics, and political conditions (Kolmakova et al., 2025). According to Karamoozian (2019), financial risks, including a change in currency and inflation, can have a significant impact on the implementation of the project. Moreover, Arar and Halicioglu (2025) highlighted that one of the primary threats in the context of a crisis is flooding due to its impact on security, stability, the environment, and financial performance. Kolmakova et al. (2025) have also found that construction projects are characterized by internal and external environmental risks and often have a deficit of professional managers.

Environmental crises, such as the pandemic, have acquired specific significance in planning construction projects. Simonovic et al. (2021) consider the floods and COVID-19 to be a two-hazard issue since it shows how diverse crises may occur at the same time and impose additional strain on institutions. Tang (2024) states that preparedness, documentation, research, and planning should be prepared to manage the risk of floods and reduce the economic losses. The results of Iqbal (2021) revealed that COVID-19 disrupted work patterns, reduced the capacity of the workforce, postponed work on the construction projects, and influenced productivity. A similar assertion was identified by Ogunnusi et al. (2020), who claimed that the pandemic led to the influence of the architectural and civil engineering works and emphasized the need for contingency plans and new business strategies. Rapaccini et al. (2020) proposed the model of crisis management, which is grounded on the disaster, speed, restart, and adaptation. Ritter and Pedersen (2020) noted that there was a need to invest in crisis preparedness.

Risk identification, evaluation, and priority of risk reduction are critical in reducing losses and improving the performance of the project. To substantiate this argument, PMI (2017) indicates that risk management begins with the

planning and identification of the risk, then proceeds to analysis, response, implementation, and monitoring. Moreover, Acebes et al. (2024) focus on the use of probability-impact matrices to evaluate the risks in terms of probability and impact. On the same note, Karamoozian (2019) maintains that in construction projects, the priority of financial risks was the highest. Similarly, Zhang (2020) demonstrated that the safety risks are dependent on project management teams, contractors, underground site conditions, public safety, and the allocation of resources. In addition, Alsharari (2022) has also found that the formal documentation is not as strong in small or less formal organizations.

In crisis management, both organizational and communication responses are required. According to Combs (2014), crisis communication is an activity that involves planning, management, and response to a crisis to limit organizational continuity and reputation. Vondruška (2020) states that communication between managers is a necessity since a crisis can influence the quality of the project, its budget, and timeframes. According to Islam and Islam (2019), the management of a crisis should monitor warning signs, evaluate crisis indicators, reduce damage, and avoid financial loss due to early warning. Vondruška (2020) adds that crises in construction projects are usually driven by schedule problems, budget issues, conflicts, or supplier withdrawal.

In sum, the literature shows that risk and crisis management enhances the performance of construction projects. According to Jarrah et al. (2022), project risk management can have a positive impact on the project performance when it is properly implemented. However, Meyer and Reniers (2025) believe that the proper risk assessment can help organizations avoid the crisis before it appears. Nevertheless, there has been little research specifically on the Jordanian free zones, given that they have unique investment, regulatory, geographical, and operational settings. Thus, the current study fills this gap by exploring the nature of risks and crises, identifying both internal and external causes, measuring the level of risks, addressing how they affect success in projects, and providing a real-life case study within the construction projects of a free zone in Jordan.

3. Methodology

3.1 Research Design

Dharavath (2025) defines methodology as the systematic procedures that are necessary to carry out research in an organized and consistent manner. The study followed a descriptive analytical research design to investigate the risk and crisis management in construction projects within the Jordanian Free and Development Zones Group. The descriptive method was adequate since it enabled the researcher to define the nature of the risks and crises, their internal and external causes, the level of the risk, and the relationship between the risk and the project's success. The analytical element was also appropriate since the study used statistical methods to explore the effects of practices of risk and crisis management on the success of projects in terms of cost, quality, and time.

3.2 Research Philosophy

The research philosophy was largely based on a positivist research philosophy since it was largely based on measuring data collected using a structured questionnaire and statistically analyzed using SPSS and AMOS. This philosophy is appropriate since the study aims to test the relationships among variables and also to examine the impact of risk and crisis management on project success. However, the study also incorporated supporting qualitative components with case studies, which assisted in giving further insight into the risks and crises that the construction projects in the free zones face.

3.3 Sample of the Study

The population included owners, contractors, project managers, project engineers, consultants, and other professionals involved in construction projects within the Jordanian Free and Development Zones Group. The purposive sampling technique was used due to the limited size of the population and the fact that the researcher was interested in sampling respondents who had a direct experience with the construction projects in the free zones. The study administered (160) questionnaire and (120) valid responses were received, giving a response rate of (27%). The

sample was comprised of consultants, owners or owner representatives, contractors, project managers, and project engineers.

3.4 Instruments of the Study

The major study instrument was a structured questionnaire. It was developed from the literature. The questionnaire included 4 main sections, namely, demographic information, risks and crises facing construction projects, risk and crisis management practices, and project success. It was measured on a five-point Likert scale that ranged from strongly disagree to strongly agree. The Likert scale is one of the scales that are often used to measure attitudes and perceptions in survey research (Rokeman, 2024). Moreover, case studies were employed to present practical evidence regarding the risks and crises undertaken by actual construction projects in Zarqa FZC and Airport FZC.

3.5 Validity of the Instrument

Validity is a process that indicates the capability of a research instrument to measure what it is supposed to measure. The validity of the questionnaire was maintained through an association of the items with the study objectives, research questions, and the literature. Three academic and engineering professionals reviewed the questionnaire to evaluate the clarity, coherence, and relevance of the questionnaire to the study variables. They were revised based on their comments to make the questionnaire more suitable. After that, the researcher distributed the questionnaire to the study sample.

3.6 Reliability of the Instrument

To test reliability, Cronbach's Alpha was used to test the internal consistency of the items in the questionnaire. The total value of Cronbach's Alpha of all dimensions was 0.901, which means that there is excellent reliability. The risk and crisis management dimension has a score of 0.972, and the project success dimension has a score of 0.861. Amirrudin et al. (2021) state that a value of between 0.8 and 0.9 is considered very good, and a value of over 0.9 is considered excellent. Thus, the instrument proved to be valid to measure the study variables.

3.7 Data Collection

The study used both primary and secondary sources. The primary data were gathered using questionnaires that were administered to the participants. The use of questionnaires was suitable since they are practical, efficient, and applicable in collecting data from relatively large samples within time constraints (Taherdoost, 2022). Secondary data was gathered through the use of journal articles, previous studies, project files, and case studies on risk and crisis management in construction projects.

3.8 Data Analysis

The data obtained were interpreted using SPSS and AMOS. The sample characteristics and the most influential risks were described using descriptive statistics (including frequencies, percentages, means, and standard deviations). To verify whether the items in the questionnaires were duly linked to their constructs, the Confirmatory Factor Analysis was conducted using AMOS (Koç & Yavuz, 2022). Figure 2: indicates that the questionnaire adopted will have 12 constructs and 74 items as follows:

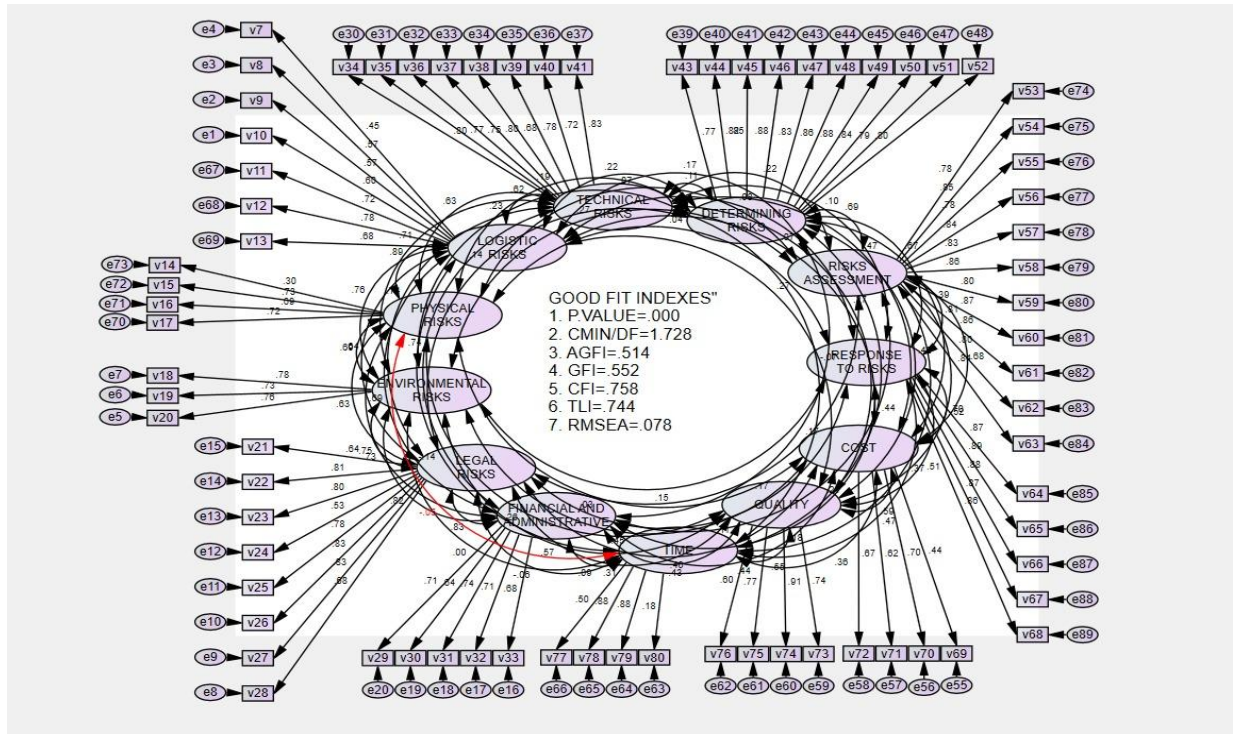


Figure 2: Questionnaire constructs and items

To investigate the effects of risk and crisis management on project success, the methodology adopted included stepwise multiple regression to analyze the differences in accordance with the demographic variables. Scheffe's test was also used for post-hoc comparisons.

3.8.1 Confirmatory Factor Analysis

To test the research hypothesis, a confirmatory factor analysis (CFA) of the questionnaire was conducted to determine the extent to which measures of constructs are consistent with the understanding of a researcher in the nature of that construct (or factor) (Koç & Yavuz, 2022). To this end, the researcher used CFA using the AMOS software.

- Physical risks, logistical risks, environmental risks, legal risks, administrative and financial risks, and technical risks are the latent variables for internal and external risk and crises.
- Identifying risks and crises, evaluating risks and crises, and responding to risks and crises are the latent variables for risks and crises in construction projects.
- Cost, quality, and time are the latent variables for the success of construction projects.
- V7 to V13 represent the statements related to logistical risks.
- V14 to V17 represent statements related to the physical risks.
- V18 to v20 represent statements related to environmental risks.
- V21 to V28 represent statements related to legal risks.
- V29 to V33 represent statements related to administrative and financial risks.
- V34 to V41 represent statements related to technical risks.
- V43 to V52 represent statements related to identifying risks and crises.

- V53 to V63 represent statements related to evaluating risks and crises.
- V64 to V68 represent statements related to responding to risk and crises.
- V69 to V72 represent statements related to project cost.
- V73 to V76 represent statements related to project quality.
- V77 to V80 represent statements related to project time.
- E1 to E73 represent errors that might affect the answers of the latent variables.
- The double-headed arrows between latent variables represent the correlation between them. In confirmatory factor analysis, latent variables are required to be correlated to calculate model fit.

Model Fit Summary

Table 1: below shows the model fit measures of the questionnaire.

Table 1: The Model Fit Measures of the Questionnaire CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	212	4301.831	2489	.000	1.728
Saturated model	2701	0.000	0		
Independence model	73	10111.900	2628	.000	3.848

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.112	.552	.514	.509
Saturated model	.000	1.000		
Independence model	.387	.115	.090	.111

RMR, CFI

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.575	.551	.762	.744	.758
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	FMIN	F0	LO 90	HI 90
Default model	35.552	14.982	13.511	16.518
Saturated model	.000	.000	.000	.000
Independence model	83.569	61.850	59.329	64.429

GFI: goodness of fit indices. RMR: root mean square. RMSEA: root mean square error associated. CMIN/DF: relative chi-square test. CFI: comparative fit index. IFI: incremental fit index. TLI: Tucker-Lewis index.

The result of the Goodness of Fitness Index (GFI) value was 0.552, showing that the data does not match the model, and the result of CFI was 0.758; where the result of GFI and CFI should be very close with a value of 1.00.

To evaluate the previously mentioned values, the researcher has compared these values with the accepted values that are shown in Table 3.3.

Table 2: Fit Measures Acceptance Value

Fit Measures	Acceptance Value
CMIN / DF= 1.728	< 2 (Carmines and McIver, 1981)
PMR = 0.112	Close to 0 (Arbuckle, 2014)
GFI= 0.552	> 0.9 or close to 0.9 (Arbuckle, 2014)
IFI= 0.762	> 0.9 or close to 0.9 (Arbuckle, 2014)
TLI= 0.744	> 0.9 or close to 0.9 (Arbuckle, 2014)
CFI= 0.758	> 0.9 or close to 0.9 (Arbuckle, 2014)
RMSEA= 0.078	< 0.1(Browne & Cudeck, 1993)

By comparing the model fit measures with the accepted values, some values were found a little bit far from the acceptance range. Thus, the researcher calculated a load of each item in the questionnaire. All constructs and items of the questionnaire were incorporated into the model to check the loading of each item in the construct. The loading of each item in the construct must be greater than 0.5; otherwise, it should be deleted in order not to affect the model's correctness. Table 3.4 represents the standardized regression weights.

3.9 Other Methodological Procedures

Case studies were also utilized in the study to justify and confirm the questionnaire results. Eight case studies were examined, including infrastructure and construction projects in Zarqa FZC and Airport FZC. These case studies provided practical evidence on the type of project, the area of the project, project cost, duration of the project, and risks or crises that arose during the implementation of the project. This contributed to the strength of the study as it linked statistical results with actual experiences of construction projects.

4. Findings

4.1 Findings Related to the First Research Hypothesis

This section reveals the findings of the main hypothesis, which investigated whether the risk management dimensions, determine, evaluate, and respond to risk, significantly impact the project success among construction projects in the Jordanian free zones.

Table 3: Model Summary for Multiple Regression Test to Show the Impact of Risk Management on Project Success in FZC

Model	R	R ²	Adjusted R ²	Std. Error	F Value	Sig.
1	.658	.433	.418	.50012	30.023	0.00*

These findings indicate that risk management contributes 43.3% of the variance in project success, as shown by R² =.433. The model was found to be significant, F = 30.023, Sig. = 0.00. Thus, it was established that the null hypothesis was rejected and that risk management statistically significantly impacts the project success.

Table 4: Multiple Regression Test for the Impact of Risk Management Dimensions on Project Success

Risk Management	B	Std. Error	Beta	T Calculated	Sig.
Determine Risk	.013	.064	.019	.202	.840
Evaluation Risk	.220	.083	.304	2.665	.009*
Response Risk	.239	.069	.382	3.460	.001*

As indicated in Table 4 above, evaluation risk and response risk were significant contributors to project success with a significance value of .009 and .001. The more powerful predictor was response risk, with Beta = .382. However, determine risk was not significant, as its Sig. The value was .840.

4.2 Findings Related to the First Sub-Hypothesis of the First Research Hypothesis

This section addresses the results that refer to the effects of the risk management dimensions on project cost.

Table 5: Model Summary for Multiple Regression Test to Show the Impact of Risk Management on Project Cost in FZC

Model	R	R ²	Adjusted R ²	Std. Error	F Value	Sig.
1	.596	.356	.339	.66679	21.719	0.00*

The findings indicate that risk management is used to explain 35.6% of variance in project cost as indicated by $R^2 = .356$. The statistical significance of the model was statistically significant, $F = 21.719$, $Sig. = 0.00$. Thus, the null hypothesis was rejected.

Table 6: Multiple Regression Test for the Impact of Risk Management Dimensions on Project Cost

Risk Management	B	Std. Error	Beta	T Calculated	Sig.
Determine Risk	-.179	.086	-.214	-2.086	.039
Evaluation Risk	.345	.110	.382	3.134	.002
Response Risk	.305	.092	.390	3.312	.001

The findings show that determining risk, evaluating risk, and responding to risk all had significant impacts on project cost. Response risk was the most significant with Beta = .390, then the evaluation risk with Beta = .382. Determine risk negatively affected Beta = -.214, that is, the weaknesses of determining risk could have a negative impact on project cost control.

4.3 Findings Related to the Second Sub-Hypothesis of the First Research Hypothesis

In this section, the results pertaining to the implication of risk management dimensions on the quality of a project are presented.

Table 7: Model Summary for Multiple Regression Test to Show the Impact of Risk Management on Project Quality in FZC

Model	R	R ²	Adjusted R ²	Std. Error	F Value	Sig.
1	.542	.294	.276	.66563	16.364	0.00*

The findings indicate that risk management provides an explanation of 29.4% of the difference in the quality of the project. The model had a statistically significant value $F = 16.364$, $Sig. = 0.00$. Thus, null hypothesis was rejected.

Table 8: Multiple Regression Test for the Impact of Risk Management Dimensions on Project Quality

Risk Management	B	Std. Error	Beta	T Calculated	Sig.
Determine Risk	.046	.086	.057	.534	.594
Evaluation Risk	.312	.110	.361	2.834	.005*
Response Risk	.125	.092	.168	1.364	.175

The results show that the only meaningful predictor of the quality of the project was evaluation risk with Sig. = -.005. Determination and response risk were not found to be significant predictors, as their significance values were .594 and .175. This implies that the quality of projects is primarily affected by the risk assessment, particularly the financial, probability, and potential impacts on the project objective.

4.4 Findings Related to the Third Sub-Hypothesis of the First Research Hypothesis

This section shows the results pertaining to how dimensions of risk management influence project time.

Table 9: Model Summary for Multiple Regression Test to Show the Impact of Risk Management on Project Time in FZC

Model	R	R ²	Adjusted R ²	Std. Error	F Value	Sig.
1	.495	.245	.225	.76559	12.737	0.00*

The findings indicate that 24.5% of the variation in project time is explained by the risk management. This model was found to be statistically significant, F = 12.737, Sig. = 0.00. Consequently, null hypothesis was rejected.

Table 10: Multiple Regression Test for the Impact of Risk Management Dimensions on Project Time

Risk Management	B	Std. Error	Beta	T Calculated	Sig.
Determine Risk	.173	.099	.194	1.749	.083
Evaluation Risk	.004	.126	.004	.028	.977
Response Risk	.286	.106	.345	2.710	.008*

The results indicate that the only predictor that significantly predicted project time is the response risk with Sig. = .008. The determination of risk and the assessment of risk did not mean much. This implies that the capacity of the organization to react to risks, revise action plans, prioritize serious risks, and implement appropriate control procedures is the main factors that influence project time.

4.5 Findings Related to the Second Research Hypothesis

The section shows the results of the variations in project success based on the job description, experience, and the level of education.

Table 11: One-Way ANOVA Test for Project Success According to Job Description

Dimension	F	Sig.
Cost	.978	.422
Quality	1.142	.340
Time	.233	.920
Project Success	.630	.642

The results show that there were no statistically significant differences in project success according to job description. The significance levels were all greater than .05.

Table 12: One-Way ANOVA Test for Project Success According to Experience

Dimension	F	Sig.
Cost	.759	.470
Quality	2.497	.087
Time	.120	.887
Project Success	.666	.515

The findings also indicate that statistically significant differences in the success of projects as a result of experience were non-existent. Though quality had the nearest value, Sig. =.087, it was still higher than .05.

Table 13: Independent Sample T-Test for Project Success According to Educational Background

Dimension	t value	Sig.
Cost	-0.554	0.580
Quality	-0.364	0.716
Time	-0.762	0.447
Project Success	-0.713	0.477

The results suggest that the level of education did not produce statistically significant differences in the success of the projects. In such a way, the null hypothesis was accepted.

4.6 Findings Related to the Third Research Hypothesis

The findings in this section are concerned with variations in risk management based on job description, experience and educational background.

Table 14: One-Way ANOVA Test for Risk Management According to Job Description

Dimension	F	Sig.
Determine	2.526	.044*
Evaluation	1.295	.276
Response	.767	.549
Risk Management	1.452	.221

The results show that there were statistically significant differences only in the determining dimension according to job description, Sig. = .044. Nonetheless, no significant differences in assessment, reaction or overall risk management were observed.

Table 15: One-Way ANOVA Test for Risk Management According to Experience

Dimension	F	Sig.
Determine	1.342	.265
Evaluation	1.148	.321
Response	.454	.636
Risk Management	.943	.392

The results indicate that experience did not produce statistically significant differences in risk management. All the significance values were greater than .05.

Table 16: Independent Sample T-Test for Risk Management According to Educational Background

Dimension	t value	Sig.
Determine	-0.827	0.410
Evaluation	-0.883	0.379
Response	-0.883	0.379
Risk Management	-0.973	0.332

The findings indicate that the level of education did not produce statistically significant variations in risk management. As such, the null hypothesis was widely accepted except in the determination of the dimension based on the job description.

4.7 Findings Related to the Case Studies

The quantitative findings were supported by the case-study analysis that revealed that construction projects in the Jordanian Free Development Zones were exposed to several recurring risks and crises that influenced the cost, time, quality, and workflow. The risk analysis of the eight projects conducted showed that most of the risks were not one-off events; they were manifested in various forms in more than one project. This affirms that risk and crisis management in these projects should be more planned, coordinated, and monitored in a more systematic way throughout the project life cycle.

The initial significant result is that environmental and geographical risks were some of the highest risks influencing the implementation of the project. The challenging geographical conditions, floods, weather conditions, and the COVID-19 pandemic influenced several projects. For example, the Zarqa infrastructural project was influenced by geographical changes and challenges due to the nature of the area, and the second and third projects by floods and harsh weather. The quantitative findings of the study align with the case study's findings, where environmental risks and crises are ranked first with a high mean value of 3.80.

The second observation is that issues related to design were a recurring reason for delay and other costs. The analysis of the case studies highlights some challenges facing the construction projects, such as a lack of clarity of plans, the incompatibility of design and reality, the incorrect estimation of the required quantities, and the absence of as-built drawings and design errors. These challenges resulted in variation orders, redesigns, conflicts, and delays during the implementation. For instance, the initial project involved a significant design change since the initial designs were not suitable for the actual site conditions. Likewise, there were errors in the plan and quantity in the seventh project, causing technical disagreements and increased expenses.

The third observation is that administrative and coordination vices were directly related to the disruption of the project. The case studies revealed that the lack of clear communication between the project parties, slow decision-making, alteration of the owner's vision, and the absence of specialized risk-management staff had a negative impact on the implementation. In some instances, the delay in work was due to centralization of decisions at the senior management level or due to a lack of clear coordination between the owner, contractor, consultant, investors, and external service providers.

The fourth finding is that physical and logistical restrictions were important risk factors within the free zones. These restrictions include limited working hours, inability to obtain entry and exit permits, security, airport free zone, and barriers due to fully occupied work areas. These limitations slowed the movement of equipment, reduced the flexibility of working, and imposed other procedural burdens. This was especially evident in the projects of free zones in the airports, where the workers, vehicles, and equipment were subject to security approval and access restrictions.

The fifth finding is that the risks directly impacted the cost and time of the project. Variation orders and additional work occurred in many of the projects, which resulted in increased costs through variation orders and additional work. To illustrate, the first project was raised to JD 9 million as compared to JD 7 million, whereas the time frame was also extended to 36 months as opposed to 26 months. The sixth project was subjected to variation

orders and JD 232,133, and had an extra 333 days. These observations agree with the quantitative results, which indicated that risk management had a significant impact on project success, cost, quality, and time.

In general, the case studies prove that the significant risks were the difficulty of the geographical area, weather conditions, permit restrictions, fully occupied work areas, specified working hours, and a lack of specialized personnel to study and monitor risks. Thus, the recommendations are that construction projects in Jordanian Free Development Zones should have more robust pre-project studies, correct design, up-to-date as-built drawings, more transparent coordination mechanisms, more lenient approval procedures, and a dedicated risk-management unit.

5. Discussion

Risk management has become one of the key predictors of project success in construction projects in the Jordanian Free Development Zones, which explains 43.3% of the variance in project outcomes. This observation supports the existing perspective that risk management does not necessarily serve a supportive role but becomes a fundamental managerial process that has a direct influence on the performance of the project. According to Foroutan Mirhosseini et al. (2022), risk is an unpredictable occurrence that can affect major project goals, including cost, time, and quality. Along similar lines, Hillson (2024) goes on to discuss the fact that structured processes, i.e., risk identification, analysis, and response, are vital to improve outcomes. The statistical significance of the model in the present study confirms that when properly implemented in a systematic manner, these processes significantly increase the probability of project success, especially in complex operational settings, like free zones.

This finding aligns with the argument of Pomaza-Ponomarenko et al. (2023), who point out that risk management minimizes uncertainty and potential failure, therefore, is more likely to increase project success rates. Likewise, Hillson (2024) illustrates how proper risk management enhances the attainment of project objectives and also better management of the budgets. The relationship is further enhanced in the case of Jordanian free zones, as the regulatory complexity, sensitivity of investment, and restriction of operations further increase exposure to various risks. As a result, risk management is an inevitable instrument for providing continuity and stability in the implementation of the project.

Although the entire importance of risk management is significant, the results showed that it differs in its aspects. Risk evaluation and risk response had a significant impact on the success of a project, unlike risk determination. This implies that it is not sufficient to just pinpoint the risks without having appropriate assessment and response plans. Such interpretation agrees within the framework of the Project Management Institute (2017), which conceives risk management as a process that is both sequential and integrated. The significance of the risk assessment is proven by Acebes et al. (2024), who insist on assessing the risks depending on the probability and impact to prioritize actions. Similarly, the potent impact of risk response justifies Meyer and Reniers (2025), who claim that risk management should involve proactive responses to the risks to minimize the undesirable impacts. The non-significance of risk determination can reflect feasible constraints like the lack of expertise, inadequate tools, or poor data systems (Alsharari, 2022).

Risk management also exhibited a significant effect on the project cost, with the percentage 35.6% of its variance. This observation underscores the sensitivity of cost performance to risk practices, especially in construction projects where financial uncertainties are prevalent. According to Karamoozian Ahmad (2019), inflation, currency fluctuations, and unexpected costs are the critical financial risks. Proper response strategies will help in the provision of timely interventions that will avoid cost overruns. Nevertheless, the drawback of risk determination is that inefficiencies could occur due to inaccurate risk identification. This supports Salem Omer (2020), who states that poor planning and design flaws may result in inefficiencies. What is more, Alves Tiago et al. (2021) claim that design errors and poor planning might constitute challenges to construction projects.

As for the quality of projects, the risk management was described by 29.4% of variance, whereas risk evaluation was the sole significant predictor. This highlights the significance of analytical evaluation in ensuring quality standards. According to Pinto et al. (2022), the project success criterion is the fulfillment of quality expectations, cost,

and time goals related to the project. The significance of evaluation is associated with Zhang Lei (2020), who links the quality outcomes to the risk of safety and the allocation of resources. The fact that other dimensions have no significant correlation with quality implies that quality is more analytically than anticipatively or reactive measures.

Risk management contributed 24.5% of the variance in terms of the project time, with risk response as the only significant predictor. This manifests the dynamic character of construction projects, with timely responses being highly significant in ensuring compliance with schedules. Vondruška (2020) attributes the delays to disruptions that need a quick response and recovery in the management of a crisis. Both recovery and response are highly significant in crisis management (Ebekozen et al., 2024).

Lastly, the fact that there were no significant differences in the success of projects when demographic variables were used further indicates that project success results from organizational systems rather than individual characteristics (Pomaza-Ponomarenko et al., 2023). The minimal differences in the risk management practices also imply a structured and standardized approach in the organization (Islam Mohammad and Islam Mohammad, 2019). The fact that environmental, administrative, and logistical risks interplay to affect the costs, time, and quality of a complex project is reinforced by the findings of the case studies. It can be inferred from these outcomes that logistical, administrative, and environmental risks overlap to influence the quality, time, and costs of the complex project management.

6. Conclusion

This research intended to explore risk and crisis dynamics in construction projects in the Jordanian Free Zones by determining the type, causes, and extent of risks and by investigating how they affect the success of projects in terms of cost, quality, and time. The research also aimed at substantiating the statistical results with real-life case studies of construction projects applied in the free-zone environment. To this end, the questionnaire was administered to 122 owners, contractors, project managers, project engineers, consultants, and other professionals working in construction projects in the Jordanian Free and Development Zones Group. The research followed the descriptive analytical methodology involving a structured questionnaire and eight case studies. Descriptive statistics, confirmatory factor analysis, multiple regression, t-tests, and ANOVA were used to analyze quantitative data using SPSS and AMOS.

The results indicated that risk management had statistically significant effects on project success, contributing to 43.3% of the variance. To be more specific, it was risk evaluation and risk response that contributed significantly to the overall project success, but not risk determination. Besides, risk management was highly influenced by project cost, quality, and time. Regarding cost, all three of the risk determination, assessments, and response to risks were very significant predictors, with the response risk being the strongest predictor. To predict quality, risk evaluation was the only important predictor. Similarly, risk response has been the only important predictor, but over the period of time. These results imply that identification of risks is not sufficient and that in construction projects, appropriate risk evaluation with effective response mechanisms is required to control the costs, quality, and prevent delays.

The demographic results revealed no significant differences in project success based on job description, experience, or educational background. Likewise, the findings revealed no significant differences in the risk management practices, except for the risk determination dimension based on job description. It implies that it is not only individual traits that influence the effectiveness of projects, but also the organizational systems, procedures, and coordination. The case studies supported the quantitative findings, proving that the environmental conditions, floods, COVID-19, design errors, permit restrictions, limited working hours, geographical difficulties, and poor coordination were significant sources of delay, cost rise, and quality-related issues.

The study contributes to the literature by concentrating on the relatively under-researched situation: construction projects in Jordanian Free Zones. It is unique in that it provides both the theoretical understanding of risk management and the actual practical challenges in investment-based construction settings. Nonetheless, the research was confined to the projects in the Jordanian Free Zones, and it was mostly based on the perceptions of the respondents

and the project case studies available. Future research can expand the sample size, draw parallels between free-zone projects and other types of construction, and utilize longitudinal data.

The research recommends that a special risk-management unit be set up, the pre-project feasibility and site studies should be enhanced, and the as-built drawings updated. Moreover, the development of the process of coordination of the stakeholders is essential. Moreover, it is also proposed to simplify the permit processes, emergency response planning, and to provide the project team with training in risk assessment and crisis management. Additionally, streamlining of permit processes, emergency response planning, and training the project team in risk assessment and emergency response is also recommended.

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