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Risk Management in Construction Sites in Libya

Walid E. Al-Shaari[1], Eman M. Al-Shaibani[2]

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Authors affiliation
1. Higher Institute of Science and Technology, Tokra
2., Higher Institute of Science and Technology, Suluq
email-elshibanieman@mail.com

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ABSTRACT

The aim of the study is to investigate how the Libyan construction industry uses risk management practices and how experts manage risks in everyday situations. Compare risk management comparisons with standard practices to assess similarities and differences. In other words, the most important idea is to find out whether the construction industry works with risk management, as described in the literature on methods and techniques. Research shows that the risk is considered negative even if it is two-dimensional in science. The professional construction industry uses the method described in the RM document, but it is not known. Risk management in the industry is published once a day, but not as described in the literature. As other researchers have shown, RM and RMP are not yet clear, although the concept of risk management is becoming increasingly popular in the construction sector. Respondents want to use RMP, but the organization should be helpful.

إدارة المخاطر في مواقع البناء في ليبيا

وليد الشاعري[1] – ايمان الشيباني[2]

تهدف هذه الدراسة إلى بحث كيفية استخدام قطاع البناء الليبي لممارسات إدارة المخاطر، وكيفية تعامل الخبراء مع المخاطر في المواقف اليومية. وتقارن الدراسة بين ممارسات إدارة المخاطر المتبعة والممارسات المعيارية لتقييم أوجه التشابه والاختلاف. وبعبارة أخرى، تتمثل الفكرة الأساسية في معرفة ما إذا كان قطاع البناء يطبق إدارة المخاطر وفقًا لما هو موضح في الأدبيات المتعلقة بالأساليب والتقنيات. وتشير الأبحاث إلى أن المخاطر تُعتبر سلبية حتى وإن كانت ثنائية الأبعاد في العلوم. ويستخدم قطاع البناء المحترف المنهجية الموصوفة في وثيقة إدارة المخاطر، ولكنها غير معروفة على نطاق واسع. وتُنشر معلومات حول إدارة المخاطر في هذا القطاع بشكل يومي، ولكن ليس بالطريقة الموصوفة في الأدبيات. وكما أوضح باحثون آخرون، فإن إدارة المخاطر وخطط إدارة المخاطر لا تزال غير واضحة المعالم، على الرغم من تزايد شعبية مفهوم إدارة المخاطر في قطاع البناء. ويرغب المشاركون في الدراسة في استخدام خطط إدارة المخاطر، ولكن ينبغي على المنظمة تقديم الدعم اللازم.

INTRODUCTION

Risk management (RM) has become an indispensable discipline across various knowledge-intensive sectors, ranging from information technology and pharmaceuticals to the construction industry. According to the Project Management Institute (PMI) (2004), risk management stands as one of the core knowledge areas critical to successful project execution. While theoretically recognized as a highly effective field within construction management (Winch, 2002; Potts, 2008), its practical integration remains relatively limited, particularly within the construction sectors of developing economies (Klemetti, 2006).

The operational core of this discipline is the Risk Management Process (RMP), which systematically encompasses four fundamental phases: risk identification, assessment, response planning, and continuous monitoring (Cooper *et al*., 2005). Within the context of construction engineering, this process must extend beyond traditional financial and scheduling constraints to actively integrate environmental risk management and Occupational Health and Safety (OHS) protocols. Construction sites inherently generate significant environmental footprints—including waste, ecological disruptions, and resource depletion—while exposing workers to high-risk operational hazards. Therefore, modern construction RM requires a balanced framework that treats environmental sustainability and workplace safety as critical parameters for overall project success.

PURPOSE OF THE STUDY

The primary objective of this study is to investigate the contemporary application of risk management practices within the Libyan construction industry, contrasting theoretical frameworks with practical, real-world execution by local experts. Given the acute economic, political, and environmental challenges facing Libya, this research seeks to identify the alignment—or misalignment—between established literature and active field practices.

To achieve this objective, the study addresses the following research questions:

RQ1: How are project risks, particularly environmental hazards and OHS compliance issues, identified and defined within Libyan construction firms?

RQ2: What specific risk management tools and techniques are utilized by practitioners in everyday site operations?

RQ3: How do risk profiles dynamically evolve across the different stages of the construction project life cycle?

By answering these questions, this study aims to provide actionable insights to enhance safety standards, mitigate environmental impacts, and improve the resilience of infrastructure delivery in Libya.

THEORETICAL FRAMEWORK

The theoretical foundation of this research is structured into three integrated components to provide a holistic view of the engineering and managerial environment:

Construction Project Organization: An analysis of organizational structures and how communication channels influence risk distribution.

The Risk Management Process (RMP):

A comprehensive review of the strategic steps used to identify, evaluate, and mitigate uncertainties.

Construction-Specific Risk Vectors: A detailed examination of standard industrial hazards. In the construction sector, risks are highly diversified, spanning adverse weather conditions, logistical bottlenecks, materials scarcity, and labor disputes. Crucially, this framework prioritizes environmental risks (such as pollution, soil erosion, and improper waste management) alongside occupational hazards (such as site accidents and inadequate safety compliance), both of which heavily influence the project's socio-environmental viability.

PROJECT LIFE CYCLE (PLC)

Every engineering project possesses a definitive lifecycle, progressing through sequential phases from inception to closure. Project management utilizes the "Project Life Cycle" (PLC) framework to systematically organize activities, control budgets, and allocate resources over time. The exact configuration, terminology, and number of phases within a PLC vary significantly depending on the industry, organizational maturity, and specific corporate strategies (Smith *et al*., 2006). Consequently, establishing a single, universally standardized definition for a project's lifecycle remains challenging.

Within the construction sector, aligning risk management with the PLC is vital, as the nature of risks shifts dramatically from the conceptual stage through to procurement, execution, and final commissioning. Table 1 outlines the standard structural breakdown of these phases as conceptualized by Chapman and Ward (2003).

Table 1: Phases, stages, and steps in the Project Life Cycle (PLC) (Chapman and Ward, 2003).

Phases	Stages	Steps
Conceptualization	Conceive The product	Trigger event
		Concept capture
		Clarification of purpose
		Concept elaboration
		Concept evaluation
Planning	Design The product strategically	Basic design
		Development of performance criteria
		Design development
		Design evaluation
	Plan The execution strategically	Basic activities and resources basic plan
		Development of targets and milestones
		Plan development
		Plan evaluation
	Allocate Resources tactically	Basic design and activity-based plan detail
		Development of resource allocation criteria
		Allocation development
		Allocation evaluation
Execution	Execute Production	Co-ordinate and control
		Monitor progress
		Modification of targets and milestones
		Allocation modification

PROJECT RISK MANAGEMENT IN THE LIBYAN CONSTRUCTION INDUSTRY

Despite the implementation of major infrastructure projects in Libya over the past decades, localized empirical research on construction management remains limited. Notable exceptions include Greenwood *et al*. (2001), who examined the pivotal role of clients in overcoming project bottlenecks. Over the years, various construction planning and scheduling tools have been introduced to the Libyan sector, transitioning from foundational models like the Cyclone system (Halpin and Woodhead, 1976) to more complex methodologies based on the Critical Path Method (CPM), currently integrated into modern project management software packages (Scott *et al*., 2004).

The Libyan construction environment is uniquely shaped by a complex matrix of geographical, socio-economic, and geopolitical factors. Following the geopolitical instability and conflict that began in 2011, the country has faced severe infrastructure deficits, logistical disruptions, and heavy damage across almost all public and private construction sectors. In a developing economy like Libya, where the public sector finances more than half of the total capital expenditure, these challenges drastically amplify project vulnerabilities.

Crucially, environmental and situational risks play a determining role in the success of Libyan construction projects. Severe weather conditions, rapid desertification, and water scarcity interact dynamically with political instabilities, fluctuating material supply chains, and inflation. Moreover, the lack of stringent Occupational Health and Safety (OHS) regulations on local sites further complicates the risk landscape, making the institutionalization of robust risk management frameworks an absolute necessity for economic recovery and sustainable infrastructure development.

THE CONCEPT OF RISK MANAGEMENT

In recent literature, risk management (RM) has been conceptualized through various lenses depending on the industrial sector, whether focusing on operations, services, or broader business strategies (Samsonas, 2009). Because risk management is an inherently multidisciplinary topic, establishing a singular, universally accepted definition remains a challenge for industry practitioners. For the scope of this study, the operational frameworks selected are those that directly align with the strategic and tactical demands of the construction sector, ensuring that theoretical principles can be translated into practical risk mitigation strategies on site.

DEFINING RISK AND UNCERTAINTY

The terms "risk" and "uncertainty" are frequently used interchangeably in construction literature, yet academic consensus distinguishes between the two concepts (Samsonas, 2009). Generally, risk refers to a situation where the potential outcomes and their probabilities can be calculated or estimated through historical data and analytical models. In contrast, uncertainty represents a state where the future outcomes are completely unknown or unpredictable due to a lack of definitive data.

In the construction industry, both dimensions co-exist. Engineers and project managers must continuously navigate both quantifiable risks (such as predictable material price fluctuations or seasonal weather changes) and deep uncertainties (such as sudden geopolitical shifts or unexpected sub-surface ecological conditions). Identifying and differentiating these variables during the design and initial planning phases is vital to developing resilient risk response mechanisms.

Table 2 summarizes this and describes it

Author:	Risk definition	Uncertainty definition
Winch (2002)	A scenario at which there is an absence of information, but by viewing at previous events, it is simpler to forecast the Later outcome. Situations where the results are familiar and anticipated.	Uncertainty is part of the information required to provide the best outcome. The requested information consists of available information and uncertainties. Uncertainty will decrease if the project continues throughout its life cycle.
Cleden (2009)	Risk is a statement of what this lack of knowledge can cause. Risk is a lack of knowledge that we believe threatens a project.	Uncertainty is an intangible measure of what we don't know. Uncertainty remains after all risks have been identified. Uncertainty is a knowledge gap that we don't even know about.

Smith *et al*. (2006)	Risks happens in situations where there is some understanding about the circumstance.	There may be insufficient information about the event, but we know what can happen.
Webb (2003)	Risk is a situation in which you have objective information about a possible outcome. The exposure risk can be positive or negative.	Uncertainty is a situation in which a person knows nothing about outcomes.
Darnall and Preston (2010)	Risk is a likelihood of losing or injury.	
Cooper *et al*. (2005)	Risk is the effect of uncertainty results.	

THE CONCEPTUAL FRAMEWORK OF RISK MANAGEMENT

Smith *et al*. (2006) provide a comprehensive analysis of risk management frameworks and their practical application in industrial environments. They argue that risk management should never be misconstrued as a predictive tool designed to foresee an unpredictable future. Instead, it must be utilized as a dynamic decision-making instrument that enables project managers to make informed, data-driven investments and strategic choices. By systematically improving the quality of available information, organizations can minimize erroneous decisions and enhance overall project productivity.

While the exact operational scope and structural nomenclature of risk management vary across contemporary literature, the fundamental principles remain consistent. Cooper *et al*. (2005) explicitly detail the operational anatomy of this discipline, stating that risk management theory translates corporate governance, managerial processes, and systemic applications into well-defined, actionable workflows. These structured workflows systematically encompass the primary functions of risk identification, qualitative and quantitative analysis, assessment, mitigation, continuous monitoring, and reporting (Cooper *et al*., 2005). Within engineering construction management, this structured systemic approach ensures that unforeseen disruptions are controlled before they compromise project constraints.

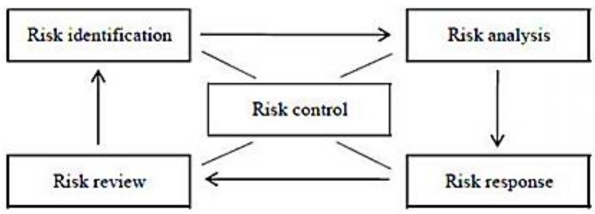

Figure 2 The Process of managing risks (Smith *et al*. 2006)

Risk Identification

Vinci (2002) argued that the first step in an RMP is general information and can be done in different ways depending on the organization and project team. This means that the risk identification is structured on the basis of previous experiences that are to be used in future projects. Distribution is important to identify potential threats. It can be defined and organized by the organization. In this case, the method is probably no better than the other because the sole purpose is to identify the potential risks of the project Table 3 summarizes the main risk-identification techniques used for this purpose.

Table 3: Risk identification techniques:

Information gathering methods	Workshops Brainstorming Interviews Questionnaires Benchmarking Consulting experts Past experience Delphi technique Risk breakdown structure
Documentation	Visit locations Databases, historical data from similar projects Templates Checklists Study project documentation (plan, files etc.) Study specialist literature
Research	Stakeholder analysis Research assumptions Research interfaces

Table 4: Risk categories divided into groups

Risk categories	
Groups:	**Risks:**
Monetary	Financial
	Economical
	Investment
Political	Legal
	Political
Environment	Environmental
	Natural, physical
Technical	Technical
Project	Contractual, client

ASSESSMENT/ANALYSIS

The purpose of identifying risks is to get a list of risks that can be managed by the project (PMI, 2004). You can use several methods to identify any risks that may affect the project. It is important to use the methods that the project team knows best and the benefits of the project. The aim is to identify potential problems that the project team is aware of. The author describes many alternative genetic methods. To facilitate this process, Table 3 lists all methods found in the course (Smith *et al*., 2006; Lester, 2007; PMI, 2004). The list of possible problems has been compiled for various reasons and tailored to specific projects. Textbooks provide examples of the risks with which these collections can be created. Table 4 lists the possible risks in the text. (Smith *et al*., 2006; Potts, 2008; Leicester, 2007; Bing *et al*., 2005; Webb, 2003; Darnall and Preston, 2003). 2010; Edwards) 1995; to Najiao; 2002) Risk analysis is the second step in RMP. It analyzes data on potential risks. The risk assessment can be seen as a brief overview of the risks that have the greatest impact on the project: all risks mentioned in the analysis phase (Cooper *et al*., 2005). Although some researchers differentiate between the terms "risk assessment" and "risk analysis" and have two separate procedures, this part of the RMP is the same as Smith *et al*. (2006) and is described as an independent process. There are two methods that can be used to analyze known hazards: intensity and size.

Quantitative Risk Analysis

Quantitative methods entail intensive analytical efforts, requiring a careful balance between the expected benefits of the analysis and its associated resource costs. While small-scale projects may suffice with qualitative risk identification and immediate mitigation actions, large-scale engineering and infrastructure projects demand rigorous quantitative evaluation due to their massive resource consumption and systemic complexity (Heldman, 2005). This analytical approach is crucial for assessing potential deviations and their cascading economic and environmental impacts on the project lifecycle (PMI, 2017).

A prominent tool in this domain is the Monte Carlo Simulation, a statistical technique that models historical project data to simulate thousands of probabilistic scenarios (optimistic, most likely, and pessimistic). This enables project managers to forecast performance trajectories and anticipate potential crises (Mun, 2006). In contemporary project management, these simulation models are increasingly integrated with Environmental Impact Assessments (EIA) to predict pollution risks and optimize construction waste management strategies on-site (Udawatta *et al*., 2022).

1. Sensitivity Analysis

Sensitivity analysis aims to identify specific risk events that possess the highest potential impact on achieving core project objectives—namely time, cost, and environmental quality. Inherently, the greater the uncertainty surrounding a particular variable, the more sensitive the project's target outcomes are to that variable (Heldman, 2005).

The outcomes of this analysis are typically visualized through graphical representations, such as Spider Diagrams or Tornado Diagrams, which explicitly highlight the most critical project sensitivities (see Figure 3). However, a key limitation of traditional sensitivity analysis is that it evaluates variables in isolation, assuming independence and failing to capture the complex, interdependent correlations among overlapping risk factors in dynamic construction environments (Smith *et al*., 2006; Sarker *et al*., 2023).

(Position for Figure 3: Illustrative example of a sensitivity analysis framework)

2. Diagramming Techniques

When critical risk factors significantly influence strategic decision-making, diagramming techniques are widely deployed to map out potential pathways:

Decision Tree Analysis: Used to evaluate alternative strategic choices by calculating their expected monetary values based on risk probabilities and cost consequences (Heldman, 2005).

Fault Tree Analysis (FTA): A deductive, top-down approach that originates from an undesired core event (e.g., a severe environmental contamination incident or a fatal occupational injury on-site) and branches downward to systematically isolate the underlying root causes (Cooper *et al*., 2005). Table 4 presents the risk categories referenced in this study.

Event Tree Analysis (ETA): An inductive, bottom-up technique that begins with a specific initiating event and traces its chronological consequences, evaluating its ultimate impact on site safety and the surrounding ecosystem (Cooper *et al*., 2005; Mohammadfam *et al*., 2023).

These diagramming tools provide a comprehensive visual mapping where the "trunk" represents the primary failure event, and the "branches" delineate interconnected causal factors and resultant outcomes. This enables project managers to implement proactive, defensive measures to safeguard both the workforce and the local environment (Heldman, **2005).**

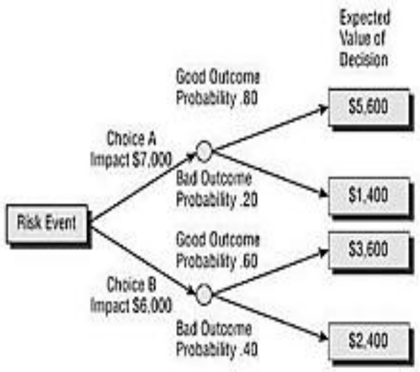

Figure 4 An example of a decision tree (Heldman, 2005)

Probability/Impact Risk Rating Matrix The probabilities and effects assessed in the previous phase are used as the basis for the quantitative analysis and risk analysis described later in this study. Therefore, the screening results are useful when using various statistical methods found in the course (PMI, 2004). Westland (2006) calculated importance as the importance of measuring probability and consequence. Select the distribution, contrast, and color of the primary color to clarify its meaning (Westland, 2006). To set the priority, multiply the effect by the probability. Our results are shown in the matrix in Figure 3.4 (PMI, 2004). Comprehensive factors indicate whether the risk is low, medium or high. Regardless of the accounting method chosen, this data combination underlines the importance of identified risks, for example by using suitable colors or numerical.

Probability and Impact Matrix

Probability	Threats					Opportunities				
0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05
0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04
0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03
0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02
0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01
	0.05	0.10	0.20	0.40	0.80	0.80	0.40	0.20	0.10	0.05

Impact (ratio scale) on an objective (e.g., cost, time, scope or quality)

Each risk is rated on its probability of occurring and impact on an objective if it does occur. The organization's thresholds for low, moderate or high risks are shown in the matrix and determine whether the risk is scored as high, moderate or low for that objective.

Figure 5: Probability and Impact Matrix (PMI, 2004)

Case Study and Semi-Structured Interviews

To evaluate how theoretical Risk Management (RM) principles are applied in practical settings, this study adopts a qualitative case study approach centered on an active construction project. To capture a comprehensive, multi-stakeholder perspective on the RM techniques utilized by professionals, an invitation was extended via email to all primary project participants ($N = 27$).Out of the 27 invited professionals, 7 responded and agreed to participate, yielding a final panel of seven informants. This purposive sample comprised key project stakeholders, including engineers, designers, clients, end-users, and project managers. Semi-structured interviews were conducted with these participants, with each session lasting approximately 40 minutes.To ensure data richness and allow participants to express complex technical and contextual insights without linguistic constraints, the interviews were conducted in Arabic. This approach eliminated potential translation distortion during the data collection phase. All participants consented to audio recording, ensuring data verifiability and facilitating rigorous thematic analysis. The interview protocol focused on the practical deployment of RM, stakeholder interactions, and the specific roles of participants across the Project Life Cycle (PLC). Furthermore, informants were tasked with identifying the critical risks native to each project phase and outlining their respective risk response strategies.3.4. Research LimitationsA primary limitation of this study is that the selected case project was in its early execution stages during the data collection period. Consequently, while the selected informants provided highly valuable strategic insights, the empirical data lacks a comprehensive ex-post description of risks that typically manifest during the later operations, maintenance, and facility service phases.4. Case Study and Project Description4.1. Project OverviewThe empirical focus of this study is a school construction project located in the Benghazi region, Libya. Characterized as a vital infrastructure investment, significant resources were allocated during the early initiation phases for the development of tailored project programs, templates, and contractual documentation.The project, which commenced in 2017, has an estimated average baseline duration of 2.5 years. To foster knowledge transfer and align execution with local standards, specialist professional associations and construction industry representatives participated in brief site visits during the early phases. The structural hierarchy and operational framework of the project are delineated in Figure 5.(Position for Figure 5: Organizational and structural framework of the Benghazi school project)4.2. Results and Analysis FrameworkThe qualitative findings derived from this case study and the subsequent stakeholder interviews are systematically detailed in the following sections, correlating the field observations with the established theoretical baseline 4.2).

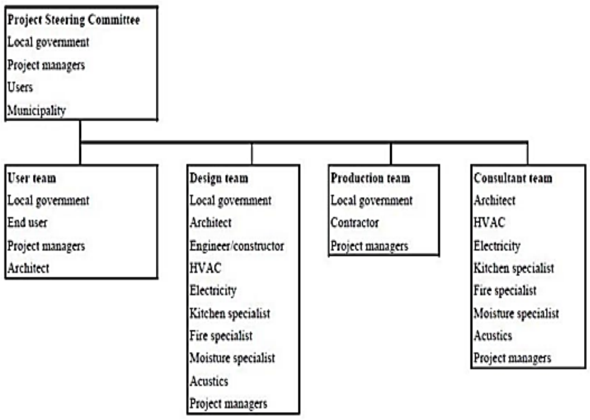

Figure 6: Organization chart over the case study

The PLC The PLC used in this project is suitable for the model proposed by Bennett, which divides the PLS into six parts. The approved PLC is a typical model of a construction project. The school's work schedule was adjusted in real time based on PLC knowledge to reflect the time scale of the project (see Figure 3.6). This combination is also important to ensure that people in different phases of the PLC are interviewed during the case. The fact that the exact form of the system is compatible is very similar to that of Smith and Al. (2006) Understand where the PLC average depends on the type of project.

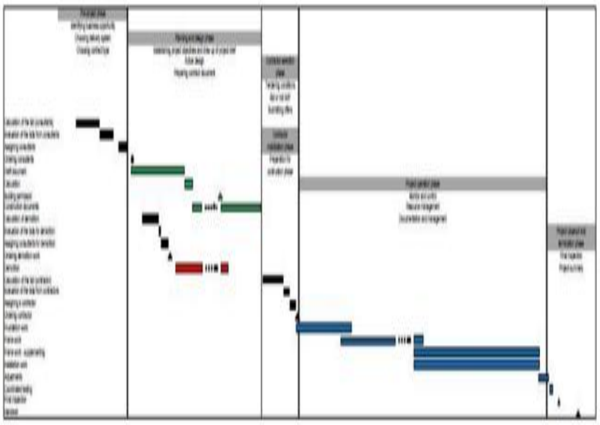

Figure 7: PLC in the top vs the actual project time schedule, where the colours represent different activities in the project

The interview shows how RM is used in automation and how project partners are familiar with the idea. This section presents the research results and risk assessment methods used by engineers, architects, customers, users and project managers in the project area. Respondents described each element of the application and its impact varied depending on the project phase. Many of the experts we spoke to only worked in the first two phases (the initial project phase and the design and construction phase) and were even more passive than the project. In this case, passive detection means support or monitoring to monitor and control the progress of the project. Figure 10 shows how the architect shows how these effects change in the PLC.

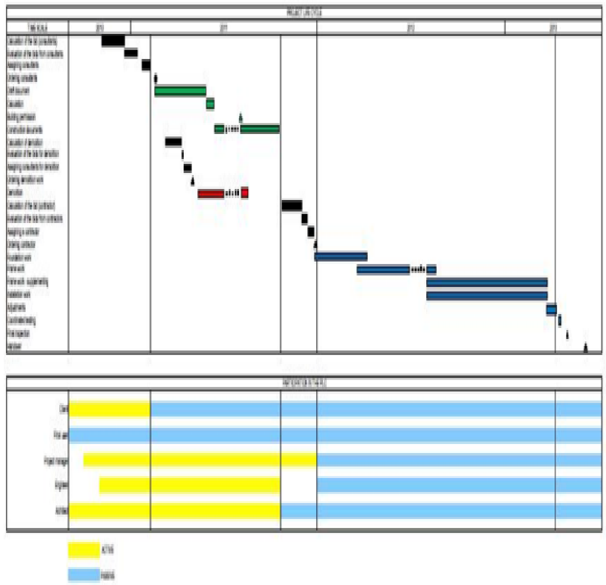

Figure 8: The PLC of the case study combined with the roles of the interviewees. The yellow bars represent an active role and the blue bars, a passive role

Risk Definition

The interview showed how raw materials were used in practice and how the project participants were familiar with the proposal. This section presents the research results and risk assessment methods used by engineers, architects, customers, users and project managers in the project area. Respondents described each element of the application and its impact vary depending on the project phase. Many of the experts we spoke to only worked in the first two phases - the first sample phase and the concept and design phase - and had more languages than the project. In this case, passive detection means support or monitoring to monitor and control the progress of the project. Figure 7. Show how these influences change in the PLC.

The RMP Figure 8 provides an overview of the literature that facilitates the use of RMP. All four steps are on the left. Here are some of the most effective risk management techniques. The following arrows list all valid PM measurements. This process must be carried out regularly throughout the project to identify potential threats.

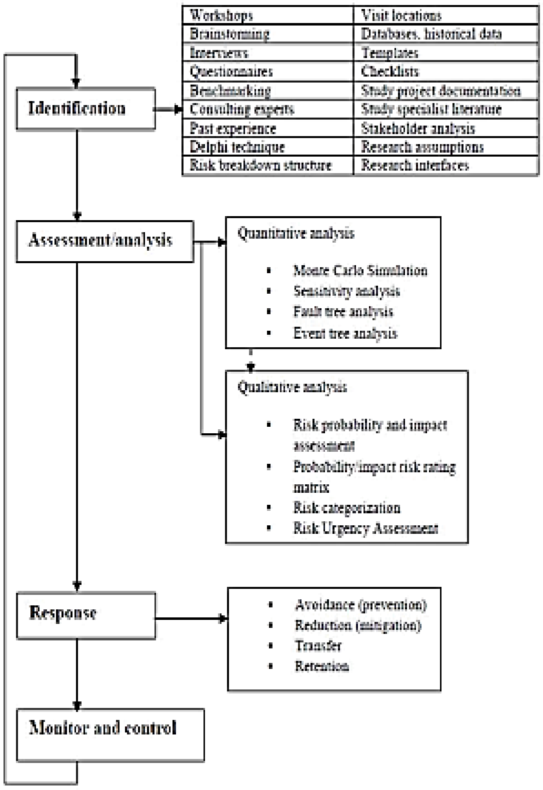

Figure 9: A coherent picture of how to manage risks

Risk Response The interview shows that a risk-free method has been developed. Some organizations have policies or guidelines for risk reduction, others are more familiar with experts in the field. The discussion was also mentioned as another way of reducing problems. In addition, respondents had to take measures to deal with the risks identified in the study. The results are summarized in Table 5:

Table 5 Risk identification and response from the interviews

PLC	PHASE NO	TYPE OF RISK	TYPE OF RESPONSE	DESCRIPTION
Pre-project phase	Identifying business opportunity	misunderstand the client	mitigate	Frequent discussions with the client.
		Miscalculation [1]	mitigate	Detailed discussions with the client
	Choosing delivery system	Miscalculation [2]	mitigate	checklists
	Choosing contract type	choosing not the right consultants [1]	mitigate	check up on the companies
		choosing not the right consultants [2]	retain	bidding process is regulated by law and they have no impact on it
Planning and design phase	Establishing project objectives and draw up of project brief	lack of cooperation between actors in the project	mitigate	facilitate cooperation by organizing project team meetings
		Shortage in resources	mitigate	making adjustments in a number of resources used in order to fit in the schedule
	Actual design	cheap, not efficient solutions which can be more expensive over time	mitigate	By being active in the project and questioning unclear issues
		problems with design	transfer	Transferring risk by involving experts in the process
		users do not take decisions necessary for work progress	mitigate	make a pressure for decisions being make on time
	Preparing contract documents	not achieve a good final result	mitigate	highlight all potential risks or problems on the workshop or a meeting
		gap of knowledge	mitigate	Being active in the process and take an action when any problem occurs

Use of the Probability and Impact Method

As mentioned in the "Methods" section, an online questionnaire was sent after the interview.

The first step is to deal with known risks, create probability and impact matrices and use the RMP method as an example. Respondents were asked to assess the possibility and the impact of the risk on time, costs and quality. We provide assessment tools from the PMI document (2004) and take into account the effects of Tables 6 and7.

Table 6: Probability Scale for Risk

PROBABILITY	Very low	Low	Moderate	High	Very high
RISK A	0.1	0.3	0.5	0.7	0.9

IDENTIFIED RISK	PROJECT OBJECTIVE	Very low (0.05)	Low (0.10)	Moderate (0.20)	High (0.40)	Very high (0.80)

RISK A	**COST**	Insignificant cost increase	<10% cost increase	10-20% cost increase	20-40% cost increase	>40 % cost increase
	TIME	Insignificant time increase	<5% time increase	5-10% time increase	10-20% time increase	>20 % time increase
	QUALITY	Quality degradation barely noticeable	Only very demanding applications are affected	Quality reduction requires sponsor approval	Quality reduction unacceptable to sponsor	Project end item is effectively useless

Table 7: Probability–Impact Matrix Used to Calculate Risk Scores

0,80	0,080	0,240	0,400	0,560	0,720
0,40	0,040	0,120	0,200	0,280	0,360
0,20	0,020	0,060	0,100	0,140	0,180
0,10	0,010	0,030	0,050	0,070	0,090
0,05	0,005	0,015	0,025	0,035	0,045
IMPACT↑ PROBABILITY→	0,1	0,3	0,5	0,7	0,9

Depending on the type of probability, risk factors from 0 to 1 are assigned. Multiply this number by the exposure value to get the result. This is done in Table 3.4, which also shows the level of risk. In the upper right corner there is a risk that the effectiveness of the project will be affected the most. On the other hand, the risk in the lower left corner belongs to the category of low impact projects. If the measurement relates to the risk assessment, the residual risk is modeled in the middle of the matrix, but not as strongly as the negative assessment. With this matrix, you can easily decide which steps to take based on the risk analysis. The classification of all risks should avoid the most important reasons.

Finally, the results according to the previous literature are summarized in Table 6. See the pain indicated by the red dot. Table 7 (upper right corner of the table) is the maximum negative limit of the result. In order to plan the most important time, cost and quality risks, the results are shown in a separate diagram. Figures 13 and 14 show similar accuracy and quality results. In the upper right corner of each system, risk is the most important, and in the lower left corner, risk is considered low. If many respondents give the same answer, the numbers in brackets are used

Discussion

Taken together, these findings suggest that Libyan construction professionals do engage with several core components of the RMP — informal risk identification, team-based mitigation, and probability/impact scoring — but rarely within a codified, literature-consistent structure. This is broadly consistent with international evidence that RM implementation in developing-economy construction sectors tends to be experience-driven rather than process-driven (Klemetti, 2006). Relative to financial and scheduling risk, environmental risk and OHS compliance were mentioned less frequently and with less procedural specificity by interviewees, despite their prominence in the study's theoretical framework; this gap points to a concrete opportunity to strengthen environmental and OHS risk management within Libyan project practice, for instance by incorporating structured EIA-linked tools (Udawatta *et al.*, 2022) or OHS-focused Fault Tree Analysis (Mohammadfam *et al.*, 2023) into routine site procedures.

Conclusion and Recommendations

This study examined how risk management is understood and practiced within the Libyan construction industry through a case study of a school construction project in Benghazi. Findings indicate that, while risk is generally perceived as a negative and unavoidable factor, professionals in the sector apply several RM elements — informal identification methods, discussion-based mitigation, and probability/impact assessment — without necessarily codifying them within a structured RMP as described in the international literature. Consistent with prior research, this study confirms that RM and RMP remain conceptually unclear to many practitioners, even as awareness of their importance grows across the Libyan construction sector (RQ1, RQ2).

Risk profiles were also found to shift across the project life cycle: stakeholder involvement in risk management was most active during the initiation and design/construction phases and became largely passive thereafter, limited to monitoring rather than active response (RQ3). Simple, accessible identification techniques — checklists, team discussions, and probability/impact matrices — proved effective for surfacing the risks with the greatest potential effect on time, cost, and quality, and respondents were generally willing to adopt more structured RM approaches provided their organizations offered adequate institutional support.

Environmental risks (such as waste management and resource depletion) and occupational health and safety hazards were consistently under-addressed relative to financial and scheduling risks, underscoring the need to integrate environmental and OHS considerations more explicitly into Libyan construction risk frameworks.

The study's principal limitation is that the case project was still in its early execution stages during data collection, which limited the ability to capture risks typically arising during later operational and maintenance phases. Future research should extend data collection across the full project life cycle, include a larger and more diverse sample of projects, and explore the development of a simplified, practice-oriented RM guide tailored to the constraints and priorities of the Libyan construction sector.

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