

**T.C.
ISTANBUL GEDİK UNIVERSITY
INSTITUTE OF GRADUATE STUDIES**



**DETERMINING THE RISK LEVELS AND CAUSES OF BRIDGE
PROJECTS**

MASTER THESIS

Safwat Jawhar Bark BARK

Engineering Management Department

Engineering Management Master in English Program

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T.C.
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DECLARATION

I, Safwat Jawhar Bark BARK, do hereby declare that this thesis titled “Determining the Risk Levels and Causes of Bridge Projects” is original work done by me for the award of the Master's degree in the Faculty of Engineering Management. I also declare that this thesis or any part of it has not been submitted and presented for any other degree in any other university or institution. (19.09.2023)

Safwat Jawhar Bark BARK



DEDICATION

To those of you who have showered me with support and inspiration, on this path full of knowledge and challenges, I stand with pride and gratitude to thank you from the bottom of my heart.

To my wonderful family, who spare no effort in supporting and motivating me, and to my loyal friends who always encouraged me to achieve my goals. I can only express my deep gratitude for every moment you spent by my side.

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PREFACE

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ABBREVIATIONS

BIM	: Building Information Modeling
IRM	: Integrated Risk Management
PPP	: Public Private Partnership
RW	: Researcher Work
SWOT	: Strengths Weaknesses Opportunities Threats
SPSS	: Statistical Package for the Social Sciences



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DETERMINING THE RISK LEVELS AND CAUSES OF BRIDGE PROJECTS

ABSTRACT

This study is dedicated to improving engineering project management, with a particular focus on bridge construction. The primary objectives encompass the identification of potential risk levels faced by bridge projects, a comprehensive analysis of the underlying causes of these risks, and the enhancement of safety and sustainability in bridge engineering structures. One of the pivotal challenges addressed in the study pertains to the often observed misalignment between project plans and bills of quantities, emphasizing the necessity for more efficient coordination and verification processes. The current study advocates for the adoption of modern load inspection methods to bolster structural performance and emphasizes the importance of quality control and continuous concrete processing to ensure the structural integrity of bridges. Additionally, the current study investigates and proposes measures to mitigate delays caused by issues such as beam manufacturing and transportation. Effective project management, involving the provision of heavy equipment like cranes and conveyors, is highlighted as a crucial factor for the successful execution of projects.

Furthermore, the current study delves into the significance of addressing challenges related to contractors' reluctance and suboptimal routines, underlining the need for improved management practices. Outdated techniques are recognized as potential obstacles to project quality, prompting the study to stress the importance of updating and optimizing these methods. It also underscores the need for robust decision-making in cases of test failures to ensure bridge safety. The current study emphasizes that addressing financial difficulties and bad decision making among contractors is vital, necessitating contractors to strengthen their financial planning capabilities and make proactive decisions while avoiding inappropriate schedules and non-compliance.

In conclusion, this study provides valuable insights into addressing challenges and enhancing project management and safety in the context of bridge construction projects. The recommendations offered include the development of a comprehensive risk management plan, vocational training programs, environmental impact assessments, the establishment of a robust reporting system, and the promotion of knowledge sharing and collaboration among experts in bridge design and construction. These recommendations offer a strategic framework for improving project execution and reducing risks.

Keywords: Determining Risk Levels, Bridge Projects, Causes of Risk, Project Risk Analysis, Engineering Challenges.

KÖPRÜ PROJELERİNİN RİSK SEVİYELERİNİ VE NEDENLERİNİ BELİRLEME

ÖZET

Bu çalışma, özellikle köprü inşaatı bağlamında, mühendislik proje yönetimini iyileştirmeye odaklanmıştır. Temel hedefler, köprü projeleriyle karşılaşabilecek potansiyel risk seviyelerinin belirlenmesi, bu risklerin kökenlerinin kapsamlı bir analizi ve köprü mühendislik yapılarının güvenliği ve sürdürülebilirliğinin artırılmasıdır. Çalışmada ele alınan önemli zorluklardan biri, sıkça gözlenen proje planları ile miktar cetvelleri arasındaki uyumsuzluktur ve daha etkili koordinasyon ve doğrulama süreçlerine ihtiyaç olduğunu vurgular. Çalışma, yapısal performansı artırmak için modern yük denetimi yöntemlerinin benimsenmesini önermekte ve yapıların bütünlüğünü sağlamak için kalite kontrol ve sürekli beton işleme önemli bulunmaktadır. Ayrıca, kiriş imalatı ve taşıma gibi sorunlardan kaynaklanan gecikmeleri ele almak ve bu gecikmeleri hafifletmek için önleyici önlemler önerilmektedir. Etkili proje yönetimi, ağır ekipmanın sağlanması dahil olmak üzere projelerin başarılı bir şekilde uygulanabilmesi için kritik bir faktör olarak vurgulanmaktadır.

Ayrıca, yüklenici isteksizliği ve yetersiz rutinler gibi yüklenici ile ilgili zorlukları ele almanın önemini vurgulamaktadır ve bu nedenle yönetim uygulamalarının iyileştirilmesi gerektiğine işaret etmektedir. Eskimiş tekniklerin proje kalitesine potansiyel bir engel olarak tanıdığı ve bu yöntemlerin güncellenmesi ve optimize edilmesinin önemini vurguladığı da dikkate alınmaktadır. Ayrıca, test başarısızlıkları durumunda köprü güvenliğini sağlamak için bilinçli kararların alınmasının önemini vurgulamaktadır. Çalışma, yüklenici kararlarının ve mali zorlukların ele alınmasının hayati önem taşıdığını vurgulayarak, yüklenicilerin mali planlama yeteneklerini güçlendirmeleri, yanlış zamanlamaları ve uyumsuzluğu önlemeleri gerektiğini vurgulamaktadır.

Sonuç olarak, bu çalışma, köprü inşaat projelerindeki zorluklarla başa çıkmak ve proje yönetimini ve güvenliği artırmak için değerli görüşler sunmaktadır. Önerilenler arasında kapsamlı bir risk yönetimi planının geliştirilmesi, mesleki eğitim programlarının geliştirilmesi, çevresel etki değerlendirmelerinin yapılması, sağlam bir raporlama sisteminin kurulması ve köprü tasarımı ve inşaatı uzmanları arasında bilgi paylaşımı ve işbirliğinin teşvik edilmesi yer almaktadır. Bu öneriler, projenin uygulanmasını iyileştirmek ve riskleri azaltmak için stratejik bir çerçeve sunmaktadır.

Anahtar Kelimeler: Risk Seviyelerini Belirleme, Köprü Projeleri, Risk Sebepleri, Proje Risk Analizi, Mühendislik Zorlukları.

1. STUDY INTRODUCTION

1.1 General

Bridges are one of the most important structural components in the infrastructure of any community, as they play a vital role in facilitating traffic, supporting economic development and enabling communication between different regions. However, they remain vulnerable to various risks and challenges that engineers and decision-makers have to face and overcome. Studies show that there has been a clear increase in the number of bridges returning to an unsafe state in recent years. Many bridges have made headlines in news for their sudden collapse or exceeding the threshold of structural sustainability. In many cases, the reason is that the actual risk levels of bridges cannot be determined and the main causes of structural deterioration cannot be differentiated.

In many cases, the reason is that the actual risk grades of bridges cannot be determined and the main causes of structural deterioration cannot be differentiated. It is hoped that this study will analyze the potential risk factors that may lead to the deterioration of bridges and identify the main causes behind these structural problems. Advanced analytical methods and tools will be used to assess the current performance of bridges and discover potential risks to their long-term sustainability.

It is hoped that this study will provide valuable insights to architects and decision-makers working in the field of bridge design and maintenance. This study will enable professionals to make informed decisions on improving existing structures and developing new, safer and more sustainable projects.

1.2 Justifications of the Study

Bridges are exposed to various risks that must be faced and addressed to maintain the integrity and sustainability of these bridges. Therefore, some of the main justifications for this study have been identified as follows:

1. Improve the bridge safety: This study focuses on improving the safety of bridges and reducing sudden collapse and structural breakdowns. By identifying risks and potential causes, preventive measures and engineering design can be taken to enhance the integrity of structures.
2. Reduce maintenance costs: Considering the regular maintenance of bridges as an expensive process, this study seeks to identify the area's most prone to breakdowns and damage and to identify the causes of deterioration. Thus, the points that need the most attention in maintenance and resource provisioning can be identified more effectively.
3. Improve the design and construction: It is hoped that the results of this study will enhance the ability of architects to improve the design and construction processes for future bridges. The engineers will be able to develop designs that take into account potential risks and safer and more effective construction technology.
4. Improve the management and decision-making: It is hoped that the results of this study will be used to help decision-makers and administrators in setting priorities and allocating resources effectively.

These justifications will provide data and evidence that enable decisions based on accurate scientific foundations and achieve optimal performance of bridges. By identifying risk levels and causes and studying their impacts, a valuable contribution will be made to the field of bridge engineering. It will also contribute to the development of knowledge and a better understanding of bridge design and maintenance and may inspire additional research in the future.

In short, this study is essential to improve the safety and sustainability of bridges and provide a reliable and scientifically validated analysis to identify associated risks.

1.3 Methodology of the Study

1. Determine the aims of the study that the researcher seeks to achieve
2. Develop hypotheses that show the expected relationships between the different variables associated with the study, which help to determine whether the study supports or denies these relationships.

3. Review the literature, previous studies and published researches related to the topic of risk for bridge projects to help in understanding the current developments in this field and extract useful ideas and concepts for current study.
4. Design the study by describing the method of data collection, determining the variables to be measured, determining the sample, and identifying the appropriate measurement tools. This step depends on the study methodology, whether quantitative or qualitative.
5. Collect the required data according to the specified study design. Many methods can be used to collect data such as field visits, interviews, questionnaires, document review and secondary data
6. Collect and analyze data using appropriate statistical tools to obtain results and conclusions that are an answer to study questions and hypothesis examination
7. Interpret the results obtained from the analysis and analyze them in the context of study aims and problem. This is to draw useful conclusions.
8. Statement of conclusions and recommendations to improve the safety and sustainability of bridge projects

In short, the scientific methodology of the study follows structured and logical steps to reach reliable and useful conclusions on “Determining the Risk Levels and Causes of Bridge Projects”.

1.4 Aims of the study

The current study aims at:

1. Identify the potential risk levels facing bridge projects. The study will provide an accurate classification of risk levels based on specific factors to help focus on the most impactful structural problems.
2. Analyze and identify potential risk causes for bridge projects, including environmental, technical and societal factors. This is to gain a deeper view of the main causes that lead to the deterioration of structures and enables appropriate action to mitigate these causes.
3. Improve the safety of bridge engineering structures and reduce the chance of traumatic accidents and structural sustainability. This is to develop engineering

practices and enhance the stability of bridges and thus ensure the safety of users.

1.5 The Importance of the Study

The importance of the current study can be summarized as follows:

1. Improve the overall safety of bridges as a top priority for any community. This contributes to the protection of people's lives and property and reduces the potential risks associated with engineering structures
2. Provide and develop stricter engineering standards for the design and construction of bridges, which contributing to better and more sustainable structural performance in the long term.
3. Reduce economic costs by identifying areas that need maintenance and repair.
4. Benefit from modern technology by relying on advanced analytical tools and techniques to evaluate the performance of bridges and identify potential risks. Which contributes to the development of the analytical and technical ability of engineers and specialists in the field of bridge engineering
5. Enhance the sustainability of bridges and improve their long-term performance, which contributes to reducing the need for frequent maintenance and general utilization of projects

In short, this study has important objectives that leave a positive impact on the safety and sustainability of bridges, benefiting society in general through improving life and achieving economic and social progress.

1.6 Hypotheses of the Study

Based on the aforementioned justifications, the hypothesis of the study will be as follows:

1. Effective managerial decisions and decision-making processes play a crucial role in mitigating risk levels in bridge projects
2. There is a relationship between project costs and risk levels, where inaccurate cost estimates can lead to increased risks
3. Provide the training and qualification for technical teams involved in bridge projects can reduce errors and, consequently, lower risk levels

4. Safety and occupational health of personnel working on bridge projects play a vital role in determining risk levels.

Based on this hypothesis, a comprehensive scientific methodology and advanced analytical tools will be used to achieve the study objectives, and the current study will provide stakeholders with valuable information to develop procedures and policies that enhance the sustainability and safety of bridge projects and reduce the potential challenges and risks associated with them.

1.7 Study Limitations

The current study limits can be explained as follows:

1. Determining risk levels, analyzing and explaining the cause of the risks that occur through the implementation of bridge projects.
2. Choosing the North Tikrit Bridge and the Dallah Bridge in Tikrit as a case study.
3. Selection of public and private sector engineers as a study sample to distribute the questionnaire.
4. The duration of the implementation of the projects covered by the study was limited to the period 1/1/2013, and it is possible that their final receipt will take place during the end of the year 2023.
5. Time constraint: The current study period was limited to the period 2022-2

1.8 Structure of Study

The structure of the current study consists of five chapters as shown in the figure (1.1).

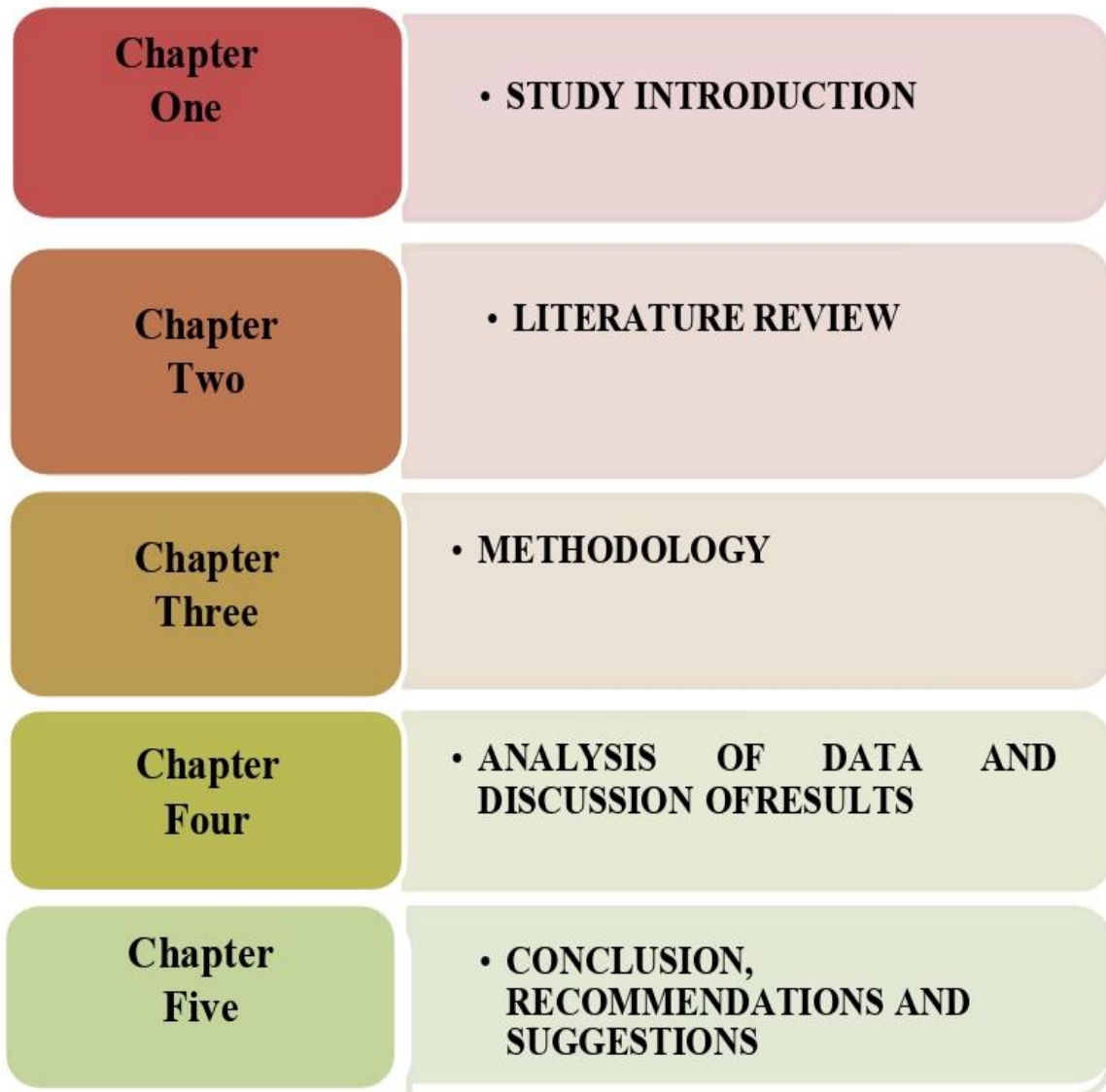


Figure 1.1: Structure of Study (RW)

1.9 Previous Studies

There are many previous studies related to risk management. Some of these studies were studied to find out the most important steps and procedures that were adopted and the results they reached. As shown in Table (1.1)

Table 1.1: Previous Studies

Title	Author, Year & Country	Study work &Results
<p>“Risk Management in Small and Medium Enterprises from a Strategic Perspective”</p>	<p>Al-Douri, Et Al. (2007) Jordan</p>	<p>The primary objective of this research was to develop an approach for assessing the operational context of an organization and pinpointing the key determinants that significantly influence its operational efficiency. Furthermore, the research aimed to establish a systematic method for ongoing risk evaluation within the organization's operational landscape.</p> <p>The outcome of this investigation culminated in the creation of a risk and anticipated returns matrix. This matrix serves as a valuable tool for guiding decision-making processes, facilitating the identification of potential risks, and comprehending the factors that hold the potential to mitigate said risks. The study strongly advocates for the integration of strategic management principles into smaller-scale projects, as a means to enhance their overall performance.</p>
<p>"Risk Management and Crisis Management in the Tourism Organization-Applications, Proposals and Suggestions at the Arab Level"</p>	<p>Shaber(2007) Iraq, Egypt</p>	<p>The research had the objective of delineating the concepts of risk management and crisis management, delving into their various classifications, with a particular emphasis on their ramifications within the domain of tourism organizations. The study's scope encompassed an investigation into tourism establishments within Egypt and Iraq, given the precarious political circumstances prevailing in these regions. Notably, the study examined the aftermath of the Iraq war and its reverberations across neighboring Arab nations.</p> <p>In its culmination, the study ascertained that there exists a gradual dissemination of awareness and familiarity pertaining to the principles and techniques of risk management and crisis management across multiple Arab countries. Furthermore, it highlighted the absence of comprehensive crisis management strategies and the scarcity of requisite resources to implement such strategies effectively.</p>

<p>“Assessment of Risk in Light of SWOT Analysis in Industrial Establishments -an Analytical Study”</p>	<p>Youssef (2007) Jordan</p>	<p>The primary objective of this research was to assess the significance of employing SWOT analysis within the context of industrial enterprises operating within a dynamic and evolving environment. The study aimed to not only identify the most imminent risks faced by these industrial entities but also to gauge the influence of SWOT analysis in mitigating these risks. The research findings underscored that the incidence of project failures among new ventures remains within an acceptable threshold, further emphasizing the indispensability of SWOT analysis as an essential instrument within the repertoire of business organizations.</p> <p>As a consequence of its exploration, this study advocates for the heightened attention towards enhancing management information systems, ensuring their development, and equipping them with proficient and adept personnel. Furthermore, it strongly suggests the activation of comprehensive mechanisms for evaluating the performance of diverse systems within the organization, as a means to consistently gauge their efficiency and effectiveness.</p>
<p>“Developing the Risk Management System in Construction Projects Using the Simulation Method”</p>	<p>Al-Sheikhly, EtAl. (2008) Iraq</p>	<p>"The primary aim of this study was to identify predominant risks within the construction sector contributing to significant project cost escalation. Additionally, the study sought to pinpoint and extract optimal applications for risk management, employing qualitative and quantitative risk assessment models as decision-making tools pertaining to project cost risks.</p> <p>The study's findings revealed that employing a database for risk assessment stands out as one of the most prevalent methods, effectively mitigating uncertainties and aiding in distinguishing varying hypotheses. Furthermore, the research highlighted the local construction industry's challenges in executing effective risk management planning processes, along with limited recognition and adoption of risk management methodologies."</p>

<p>“A Study of the Design and Implementation Factors That Lead to an Increase in Cost Risks during the Implementation Phase of Construction Projects”</p>	<p>Akab (2009) Iraq</p>	<p>"The primary objective of this study was to comprehend the underlying factors contributing to the emergence of risk within cost management, and to explore potential remedies to mitigate these risks and alleviate their impact. The study concluded that design requirements stand as the foremost influential factor, accounting for an 80% increase in project costs. Market volatility in construction material prices ranked second at 77%. Furthermore, alterations in expenses associated with equipment procurement and rental exerted a 67% influence on cost-related risks. The research also emphasized the significance of project management, attributing a 74% effect to its role in assessing design models and bill of quantities prior to implementation."</p>
<p>“Risk Management, Procedures, Methods and Experiments”</p>	<p>Berg (2010) China</p>	<p>"The primary objective of this study is to elucidate and describe the procedural stages encompassed in the risk management process, along with the methodologies applied at each phase within this process, including instances of risk management and safety protocols. The study adopts a theoretical methodology, with the researcher engaging with the highlighted examples throughout the study, scrutinizing the risk management steps in addressing specific hazards encountered in each scenario provided. The study underscores the perpetual nature of the risk management process, where its culmination signifies the commencement of a new cycle."</p>
<p>“Applications of Risk Management in a Construction Project”</p>	<p>Ropel & Ewelina. (2011) Gothenburg</p>	<p>It was about a construction project to build a school in the Gothenburg region, where the study aimed to answer the following questions:</p> <p>What are the risks and expected risk management in projects construction?</p> <p>How is the risk management process carried out?</p> <p>The study's findings indicate that while most of the company's employees possess some knowledge of risk management, risks often yield negative consequences. Operating organizations tend to lack a proactive approach to risk management. The study primarily relies on ad-hoc risk treatment, and a substantial portion of the sample members do not possess sufficient knowledge of risk management. Furthermore, the study highlights that the likelihood and impact of risks can vary between projects.</p>

<p>“Managing the Risks of the Construction Phase of Construction Projects in Syria”</p>	<p>Hamada et al. (2012) Syria</p>	<p>"The primary goal of this study was to recognize the array of challenges confronting construction projects in Syria, and to assess the magnitude of their influence on attaining project objectives. Additionally, the study sought to formulate a framework for effectively managing these risks. The study outcomes underscored those risks like 'inflation and price fluctuations and discrepancies between actual and contracted quantities' are paramount. Among the objectives, project scheduling is notably more susceptible to the impact of the identified risks. Notably, the research indicated that the strategy most commonly employed is risk avoidance."</p>
<p>“The Role and Status of Risk Management In The Economic Institution, a Case Study of the Cement and Its Derivatives in Saida”</p>	<p>Taifa (2012) Algeria</p>	<p>"The objective of this study was twofold: theoretical and practical. On the theoretical front, the study delved into the prominent challenges and impediments confronting Algerian economic institutions. It entailed identifying the steps and strategies employed in risk management, while also examining the mechanisms utilized by Algerian economic institutions to navigate these challenges. On the practical side, the study aimed to highlight the institution's proactive approach to managing the risks inherent in its operations.</p> <p>The study's findings revealed a notable absence of a risk management philosophy among the company's workforce. Furthermore, the study underscored a lack of emphasis on cultivating a culture of preparedness to tackle risks and a deficiency in training and development initiatives."</p>
<p>“Risk Management Is the Next Source of Competitive Advantage</p>	<p>Elahi (2013) China</p>	<p>"The core aim of this study was to assess the correlation between a company's risk management capabilities and its ability to attain a competitive edge. Additionally, the study aimed to examine the potential of effective risk management in shaping a company's industry-specific competitive advantage. The study categorized five primary factors underlying this phenomenon. These encompass the escalating state of uncertainty, which subsequently heightens risks for businesses and enterprises. The study delved into the drivers that contribute to augmented uncertainty levels, thus elevating the susceptibility of establishments to various risks. As a recommendation, the study emphasizes the imperative of integrating a strategic dimension into the realm of risk management."</p>

<p>“Assessing the Impact of Risks on the Objectives and Safety of Construction Projects in Iraq”</p>	<p>Intisar (2015) Iraq</p>	<p>This study has two main objectives: firstly, to establish effective planning for analyzing and managing risks of varying levels of importance through a specialized strategy led by risk management experts. Secondly, the study aims to identify responsive measures for addressing risks to ensure effective risk management in construction projects. The study identified key construction risks in Iraq, including the absence of site service network plans (such as electrical, phone, water), and discrepancies between implementation and required specifications due to a misunderstanding of plans. The study's findings indicated that these risks predominantly impact project implementation timelines, with minimal influence on occupational safety.</p>
<p>“Developing a Methodology for Analyzing and Managing the Risks of Dam Projects in Syria”.</p>	<p>Jarad & Deps (2015) Syria</p>	<p>The primary goal of this study is to create a model for pinpointing the paramount risks inherent in dam projects during their implementation phase, followed by an assessment process and the formulation of suitable response strategies. The study's findings identified several significant risks, including inadequate geological investigations, substantial cost disparities, elevated permeability of the foundation soil, escalating injection work quantities, and challenges in securing specialized personnel. These risks were observed to be of notable importance based on the evaluation, with the primary reasons being attributed to insufficient preliminary studies and a lack of experience.</p>
<p>“Evaluation of Investment Projects in Light of Risk and Uncertainty”</p>	<p>Asia (2016) Algeria</p>	<p>The objectives of this study encompass recognizing the fundamental steps and stages crucial for making investment decisions, determining whether to proceed with a proposed project or to abandon it. The study's findings highlight that assessing investment projects under risk conditions necessitates a broader approach beyond expected returns. The expected value alone does not adequately capture the project's benefits, given its uncertainty of achievement. This value serves as a mere average reference and a projection of potential future outcomes.</p>

<p>"Risk Identification in Construction Companies: A Field Study on Construction Companies Working in Syria"</p>	<p>Dayoub & Zrika,2016) Syria</p>	<p>This study aimed to identify the risks in contracting companies in Syria. The study concluded that inflation risks (manual labor wages, transportation costs, cost of materials) represent the main risk factors facing Syrian construction companies. Also, the absence of a construction management culture is the biggest threat because it does not show the risks and their impacts.</p>
<p>"Managing the Risks Affecting the Implementation of School Building Projects"</p>	<p>Salam(2016) Iraq</p>	<p>The primary objective of this study was to devise a strategy for mitigating risks encountered during the implementation phase of school building projects. The study aimed to alleviate conflicts between contracting parties and enhance the capabilities of less experienced engineers in effectively managing risks inherent in construction projects. It sought to comprehend the risks underlying the emergence of challenges during project implementation.</p> <p>The study's findings revealed several significant risks, notably the absence of alignment in the quantities table, recurring 50 times with an average score of 6.47, design failures, occurring 60 times with an average score of 5.58, and additional works, which appeared 64 times with an average score of 5.75. Among these, the subcontractor's limited qualifications and inadequate soil investigations were identified as the most influential risks impacting the cost of school building projects.</p>
<p>"The Method of Controlling Construction Risks in All Stages of Building Construction"</p>	<p>Al-Mahboub (2016) Sudan</p>	<p>This study aims to pay attention to the construction risks in construction projects. It has been concluded that it is necessary to work risk management within contracting companies in order to avoid problems that appear during the implementation of the project and to educate workers in this field that the risk study may not need to manage risks to avoid them. The researcher has concluded that, it is necessary to work on designing a model to help to evaluate construction companies.</p>

<p>“Studying the Risks of Cost Overrun in Road Projects in Syria”</p>	<p>Mustafa (2017) Syria</p>	<p>The aim of this study was to identify the reasons for the high costs in projects of road construction in Syria, and the reasons for the relatively high costs were arranged according to their importance, the point of view of road workers, and a model was developed to predict the risks of high costs in the project using a type of network, which is doctrinal networks.</p> <p>It was concluded that the rise in material prices, inflation, exchange rate change, and the attribution of non-contractual works are among the most important reasons that had a clear impact on the project and exceeded the proposed cost.</p>
<p>“Risk Assessment in Construction Projects in Misurata”</p>	<p>Al-Susi, Et Al.(2017) Misurata</p>	<p>"The primary objective of this study was to assess the impact of potential risks on the fundamental project objectives encompassing time, cost, and quality during the execution phase of construction projects. The study focused on identifying risks pertinent to building and construction projects, drawing from existing literature and interviews conducted with experienced engineers engaged in construction endeavors.</p> <p>The findings indicated that 53% of the identified risks directly influence the project's implementation timeline. Additionally, 15% of the risks were observed to significantly impact project costs, whereas 7% were associated with substantial effects on project quality. Notably, the outcomes underscore a robust and direct correlation between the likelihood of most risks. This implies that the occurrence of certain risks may trigger the emergence of others."</p>

<p>“Risk Management in Residential Construction - An analysis of the risk management process of a Swedish construction company”</p>	<p>Bonander & Ulriksson, 2016) Sweden</p>	<p>"The objective of this study was to provide a comprehensive depiction and analysis of the risk management process within a project-oriented organization operating in the construction sector. The study aimed to enhance comprehension regarding the practical application of risk management, as well as the pivotal elements that influence this process. The study took into account the perspectives of both originators and developers.</p> <p>The findings revealed that the efficacy of the risk management process is contingent on the individual knowledge and experience of project team members. Furthermore, the study unveiled that time and resource limitations impede robust engagement with risk management, resulting in a sporadic rather than continuous application throughout the project's lifecycle. These challenges can be overcome through prioritizing risk management efforts and fostering a heightened awareness of its significance."</p>
<p>“Managing the Risks of Construction Projects in Iraq”</p>	<p>Bashir (2017) Iraq</p>	<p>The primary objective of this study was to explore the risks inherent in construction projects within Iraq. The study sought to delve into the significant risks, analyze their potential impact, propose preventive measures, and devise plans to mitigate their effects, ultimately safeguarding projects from potential dangers. The core focus was to gain insights into the risk elements that construction projects might confront in Iraq, with the goal of identifying prevalent risk types to either prevent their occurrence or lessen their impact in the future.</p> <p>The study's outcomes highlighted that opting for design agencies solely based on the lowest prices emerges as a critical factor adversely influencing the quality and comprehensiveness of designs. This drawback arises due to the limited qualifications of the contracting party responsible for design completion. Furthermore, the study underscored that the absence of well-defined plans and design documents ranks as the most pivotal factor, adversely impacting projects and rendering them susceptible to vulnerabilities.</p>

<p>“The Financial Evaluation of Micro-Investment Projects under Risky Conditions”</p>	<p>Kairy(2018) Algeria</p>	<p>The objective of this study is to emphasize the significance of incorporating the risk factor into the financial assessment of small-scale investment projects. This inclusion aims to ensure judicious investment choices made within Algeria's national agency for youth employment support. The study's outcomes revealed the project's heightened sensitivity to key factors such as cash flow, investment cost, discount rate, and implementation duration, each influencing the project to varying degrees. As a result, careful attention is essential to understand the thresholds at which these factors fluctuate, potentially rendering the project infeasible.</p>
<p>“Preface on Risk Management from an Economic Perspective (Illustrative Case)”</p>	<p>Qaddo and Mishaal (2019) Jordan</p>	<p>The goal of this study was to uncover various approaches to risk management and mitigation. This entailed the identification, evaluation, and diagnosis of risks, encompassing aspects such as risk tolerance, diversification, avoidance, reduction, and transfer. Furthermore, the study delved into the analysis of schemes and contingency planning, and it engaged with a simulated case focusing on optimization under the influence of risk. Additionally, the study established criteria and indicators for assessing the impact of alternative strategies for accepting and confronting risks.</p> <p>The study's recommendations underscored the imperative of conducting economic analyses within the context of enterprise operations while accounting for risk factors. Moreover, the study suggested a comparative exploration between organizations integrating risk into their strategies and those that do not, to glean insights into the potential benefits and drawbacks of risk adoption.</p>
<p>“Construction Project Risks Related to the Document Preparation Stage in Sudan”</p>	<p>Abbas & Salah-Din (2018) Sudan</p>	<p>This study seeks to enhance Sudan's construction industry by identifying project risks during document preparation, fostering a culture of risk management, and defining risk management in construction projects. It also aims to explore solutions for risk mitigation and reduction, and to establish industry-wide standards for reducing risks and their impact.</p> <p>The study emphasizes the importance of technical, financial, and administrative evaluations of contracting companies, highlighting instances of</p>

		cost changes during project implementation that were overlooked. It also underscores the limited attention given by companies and institutions to risk analysis and the unfamiliarity of construction industry organizations with the concept of risk management. As a recommendation, the study advises contracting companies to invest in risk studies and to assign dedicated teams for assessing and managing project-specific risks.
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2. LITERATURE REVIEW

2.1 Introduction

Bridges are structures built to overcome physical obstacles without blocking the road below it, such as a body of water, a valley, or a road, for the purpose of providing a passage over the obstacle. There are many different designs that each serve a specific purpose and are applicable to different situations. Bridge designs vary depending on the function of the bridge, the nature of the terrain where the bridge is constructed and installed, the materials used to make it, and the funds available for its construction. Bridge construction is a complex and systematic work and there are various kinds of risks all the time during the whole phase of bridge construction from preparation for construction to completion of construction. During the bridge construction phase, there is a lot of work above ground and as a result, bridge construction has higher risks as compared to other engineering construction (Reddy et.al.,2016).

This chapter seeks to identify Background information of bridge construction, Bridge types, Importance of bridges, Factors affecting the choice of bridge type and design, Concept of risk management, Causes of risks, Risk classification, Risk analysis and management, Risk management and analysis concept, Emergence of risks management, Importance of risks management, Risk management stages, Risk determination, Risk ranking, Objectives of Risks Management, Analysis and management of the risks, Advantages of risks management, How to manage the risks, Constituents of risks management, Elements of risks management, Evaluation and review, Control of risk management, Mitigation of risks, Monitoring and follow-up the risks, Bridge management system for risk management & The nature of risks management in bridge projects.

2.2 Background Information of Bridge Construction

A bridge is a structure that is built over a railway, river, or road so that people or vehicles can cross from one side of it to the other. In another definition, a bridge is a structure that is built to overcome physical obstacles without blocking the road below it, such as a body of water, a valley, or a road, for the purpose of providing a passage over the obstacle. The bridge is included in an important component of the road because it determines the maximum load of vehicles that can pass across the road (Dumpa, 2018).

Bridge building appeared for the first time in the Roman civilization, which developed a technology for building bridges using hydraulic cement, and most of their bridges still exist to this day. After that, no one was able to develop Roman technology until the Renaissance and the emergence of the aesthetic dimension of the Rialto Bridge in Venice, and then the revolution appeared. The real thing in building bridges using steel and concrete, and the first steel bridge in the world was the iron bridge in England in the eighteenth century (Zabalueva & Zakharov, 2020).

The bridges of Iraq especially the city of Mosul have evolved over time according to the development of the need for them between one bridge and two bridges or their absence at times, especially when the state was threatened by an enemy coming from the left side of this city, so it demolished the crossings and bridges or in the event of the weakness of the state or its lack of budget, when it was afflicted by flood disasters its bridges are demolished, so it cannot rebuild these bridges again as they were before those floods. These bridges have evolved until they are in their current state, and today there are five bridges crossing the Tigris River (Neish ,2007). Evidence within the photographs at the beginning of the appearance of photography of this city indicates the presence of two bridges that preceded the five bridges above, namely the old bridge (antique), figure (2-1) and the stone arch bridge, figure (2-2), (Al-Azdi, 1967) also indicates in the incidents of the year 212 AH / 827 AD that Harun bin Abi Khaled, the governor of Mosul, ((Digging barrages through which the water passes to the Tigris)) to protect the city from its eastern side and as a defensive plan for it, when it was threatened from the eastern side.



Figure 2.1: The Old Bridge (Antique)

Source: (Al-Azdi, 1967)



Figure 2.2: Stone Arch Bridge

Source: (Al-Azdi, 1967)

2.3 Bridge Types

The most striking factor in the design of bridges in the world is its long life spanning centuries. Bridges in the world have varied and differed according to their intended purpose, the length of the bridge's opening, the materials involved in its construction, and its structural shape. Below will mention the different types which are:

1. Beam bridges

It is the simplest type of bridge, as it consists of the surface of the bridge, which is often made of wooden planks or stone panels, and rests on peripheral pillars between the two ends of the bridge. To increase the reinforcement and stability of the bridge, here it is called a continuous girder bridge (Wei et.al.,2022).

Soliman et. al., (2000) state that most types of cantilever bridges are made of prefabricated concrete, and the loads they are subjected to are transferred from the roof to the beams, which in turn are transferred through the supports to the pillars and then to the foundations. This can be avoided by constructing relatively long girder bridges by building them in a box shape, which are hollow boxes made of steel beams and reinforced concrete. An example of girder bridges is the Iowa river bridge.



Figure 2.3: Beam Bridges

Source: (Wei et.al.,2022)

2. Truss bridges

The truss bridge has been found for centuries, especially in rivers and narrow mountain valleys. It is characterized by the ability to build it over relatively long distances. It is in the form of interconnected structures called trusses in the form of triangular units, since these triangles absorb pressure and tension in a way that is able to bear the various dynamic loads that the bridge is exposed to the loads in it, as in a truss bridge, are mostly steel rods and sometimes may be wooden, most commonly

straight chains of steel rods. An example of a truss bridge is the Francis Scott Key Bridge in Baltimore (Li, 2022).



Figure 2.4: Truss bridges

Source: (Li, 2022)

3. Cantilever Bridges

This bridge is constructed of cantilevers (simple beams or abutments), and shall be made of pre-stressed concrete or steel if designed to handle traffic or rail, and the cantilever arm shall be fixed only on one side to carry the necessary weight on the same upright side, if The bridge is wide so that it is not sufficiently cantilevered on each side, so it must be supported by a cantilever or truss bridge between the two cantilever arms and linked to one bridge known as the suspended span bridge, and the most important example of the cantilever bridge is the Forth Bridge in Scotland (Heggade et. al.,2021).



Figure 2.5: Cantilever Bridges

Source: (Heggade et. al.,2021)

4. Arch Bridges

There are different types of arch bridges, and they all share the central elements, as each bridge contains two peripheral pillars that support the arch structure at the bottom of the bridge, and one of the most common types of arch bridges is the Viaduct bridge, which is a long bridge consisting of many arches, in this type of bridges the stress is transferred Lateral that results from the arches to the end pillars so these pillars must remain strong and solid, the arch bridge can be used for everything from a pedestrian bridge to a railway (zhang,2021).

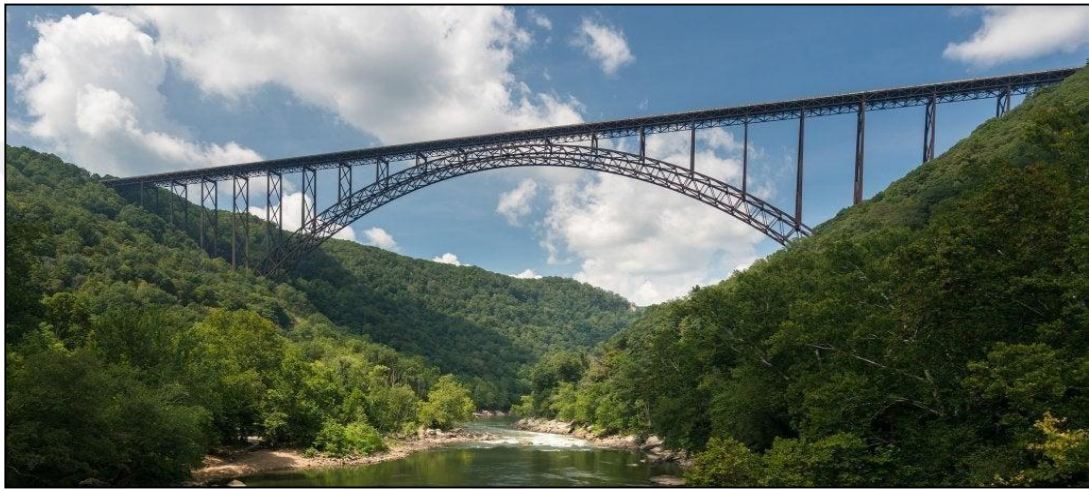


Figure 2.6: Arch Bridges

Source: (zhang, 2021)

5. Suspension Bridges

The structure of this type takes the simple, typical form, but its design is very effective, as the bridge surface is the carrying element of its structure and is fixed by vertical brackets that support the cables, called suspension cables, and extend beyond the sides of the bridge and are well fixed in the ground, and according to the size of the bridge, the number of towers varies in it to hold and assemble suspended cables, an example of suspension bridges is the Brooklyn bridge (suspension bridge of the great east river), (Zhi, 2018).



Figure 2.7: Suspension Bridge

Source: (Zhi, 2018)

6. Cable-Stayed Bridges

Cables suspended by towers in these types of bridges are the load-bearing element. These cables are connected from the towers to the surface of the bridge either from the top of the tower or different points from it. This type of bridge is used for large distances greater than the distances covered by the cantilever bridge but less than the distances of the suspension bridge, and one of the main problems with this type is the center connection of the cables which can create horizontal stress on the bridge deck which needs to reinforce the deck structure to be able to bear the stress (Zhi, 2018).

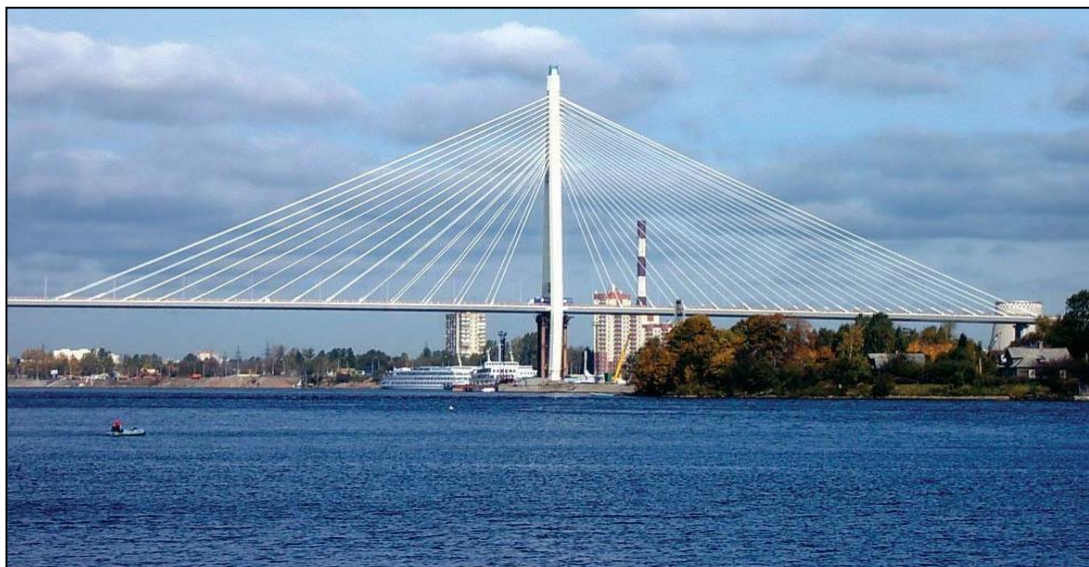


Figure 2.8: Cable-Stayed Bridges

Source: (Zhi, 2018)

2.4 Importance of Bridges

The bridges are one of the most important infrastructure structures that are related to the transport process. They facilitate and sustain the traffic of the means of transport and pedestrian movement. Construction of bridges and tunnels as basic structures reflects the level of growth and general urbanization and the urban level of the cities of that community. They provide a high degree of traffic flow for modes of transport and reduce the costs of delays and accidents. Bridges are more than just an element of transport; they create a sense of identity of the city or region (Vinh, et.al., 2023).

The natural environment affects the extent to which these infrastructures (bridges) are needed. Areas with rivers, valleys, rugged terrain or densely populated cities located around waterways require the construction of bridges and tunnels in order to facilitate movement and passage between the banks of the river or isolated islands. Bridges are also of particular importance in wars, as it is a strategic target that must be protected and sometimes requires blowing up bridges to hinder the advance of the invading forces (Ermakova, 2010).

2.5 Factors Affecting the Choice of Bridge Type and Design

The factors through which the type of bridge can be chosen and designed are mixed with each other, so that it is difficult to distinguish these factors. It can be determined by the following factors (Gürün, 2016) & (Debaraj & Pathak, 2023) & (Moda et. al., 2023):

1. The function of the bridge is it intended for pedestrians or cars or railways or pipe transport etc. Thus, determine the density of services that will pass on the bridge or tunnel, especially at rush hour and the design capacity of the streets.
2. The topography of the bridge site, where the topography of the area in which the bridge is to be constructed, is one of the most determining of the type and design of the bridge.
3. The materials used in its construction.

4. The funds available for the construction of the bridge, where the construction of these bridges is expensive according to the material used in its construction, its location and the design which suits with this site.
5. The number of branches and entrances required for the bridge or tunnel.
6. It is preferable to establish bridges around cities and in the outskirts and suburbs, especially highway bridges because, they need large areas, while tunnels are preferable to establish them within city centers due to the limited available spaces.

2.6 The risk Management

2.6.1 Concept of risk management

A clear definition of the concept of risk is very important because it represents the objective basis for understanding its role and tasks. Risk is considered one of the terms that are always mentioned in the business administration literature. There are industrial risks in the field of production and operations management, marketing risks in the field of marketing management (Bu and Zhang ,2013), and financial risks in the field of managing financial resources and in practical life. It is a term frequently used to denote a state of uncertainty.

In this regard, (Borkovskaya & Passmore 2020) defined risk as any activity or activity that does not add value to the commodity or the customer, or that it is any undesirable activity in the production process that leads to waste in the various resources of the organization such as defective, damaged, returned, returned, lost and wasted time.

Many organizations and researchers in the field of project management dealt with the definition and concepts of risk. These studies confirmed the link between risks and the nature of projects and the emergence of the industrial revolution and the resulting large size of projects. (Aven,2009) believes that risk is the possibility of an adverse deviation from the expected or desired result. The main objective of risk management is to measure risks in order to monitor and control them, (Ibadov, Nabi,2020) states that risk is an inevitable necessity that cannot be avoided in building and construction projects and define risk as the potential for profit or loss resulting from uncertainty or unpredictability.

(Magapu, 2022) stated that every project is exposed to risks, and if we neglect them, they impede its continuity. Risks are a major element in business. With every decision taken in the field of business, risks appear. It is indicated that risks occur when the comparison is between two or more alternatives.

2.6.2 Causes of risks

Dhungana, (2020) & Zidane & Andersen, (2018) & Gopal et. al., (2023) state that there are several reasons that may lead to problems and risks during the implementation of bridges, as follows:

1. **Badness of planning and design:** If the planning and design is not done correctly and thoroughly, problems may arise during the implementation of the bridge. This may include not calculating expected loads or an inaccurate estimate of terrain and weather conditions.
2. **Lack of resources:** There may be a lack of financial, human or material resources to properly implement the bridge. This may lead to quality deficiencies, delay in schedule, or even cancellation of the entire project.
3. **Infrastructure challenges:** There can be infrastructure challenges such as difficult terrain or rivers or swamps under the bridge. Excavation and construction operations can be difficult to carry out in these conditions.
4. **Weather and natural factors:** The influence of adverse weather conditions such as strong storms or floods can jeopardize the operational process. It may be difficult to work in unfavorable weather conditions and this may result in delays in implementation or depreciation of materials.
5. **Badness of coordination and management:** Problems may occur as a result of poor coordination between the different teams involved in implementation of the bridge. Lack of good coordination between civil engineers, contractors and suppliers can negatively affect the quality of work and schedule.
6. **Non-compliance with standards and regulations:** If local and international engineering standards and regulations are not followed, serious problems may arise during the implementation of the bridge. Standards and regulations must be complied with to ensure the safety of the bridge.

7. Changes in requirements: A change in project requirements may occur during implementation of the bridge, whether due to modifications in design, owner requirements or changes in laws and regulations. These changes can be challenging and affect the implementation schedule and project cost.
8. Soil problems: There may be soil problems during implementation of the bridge, such as the weak sandy soil or wet clay soil. These problems may require additional procedures such as the use of improved soil or deep foundations to ensure bridge stability
9. Occupational safety and health: Attention must be paid to aspects of occupational safety and health during implementation of bridges. Work accidents or injuries to workers may occur if proper safety procedures are not followed or appropriate protective equipment are not provided.
10. Weak of inspection and control: Continuous inspection and control should be carried out during implementation of bridges to ensure that the work is carried out in accordance with standards and specifications. If scrutiny and oversight are insufficient, undetected problems may appear early and cause problems in the future.
11. Environmental and social impacts: Environmental and social impacts must be taken in consideration during the implementation of bridges. Special requirements may need to be taken to protect wildlife, reduce pollution, and avoid negative impacts on local communities.

2.6.3 Risk classification

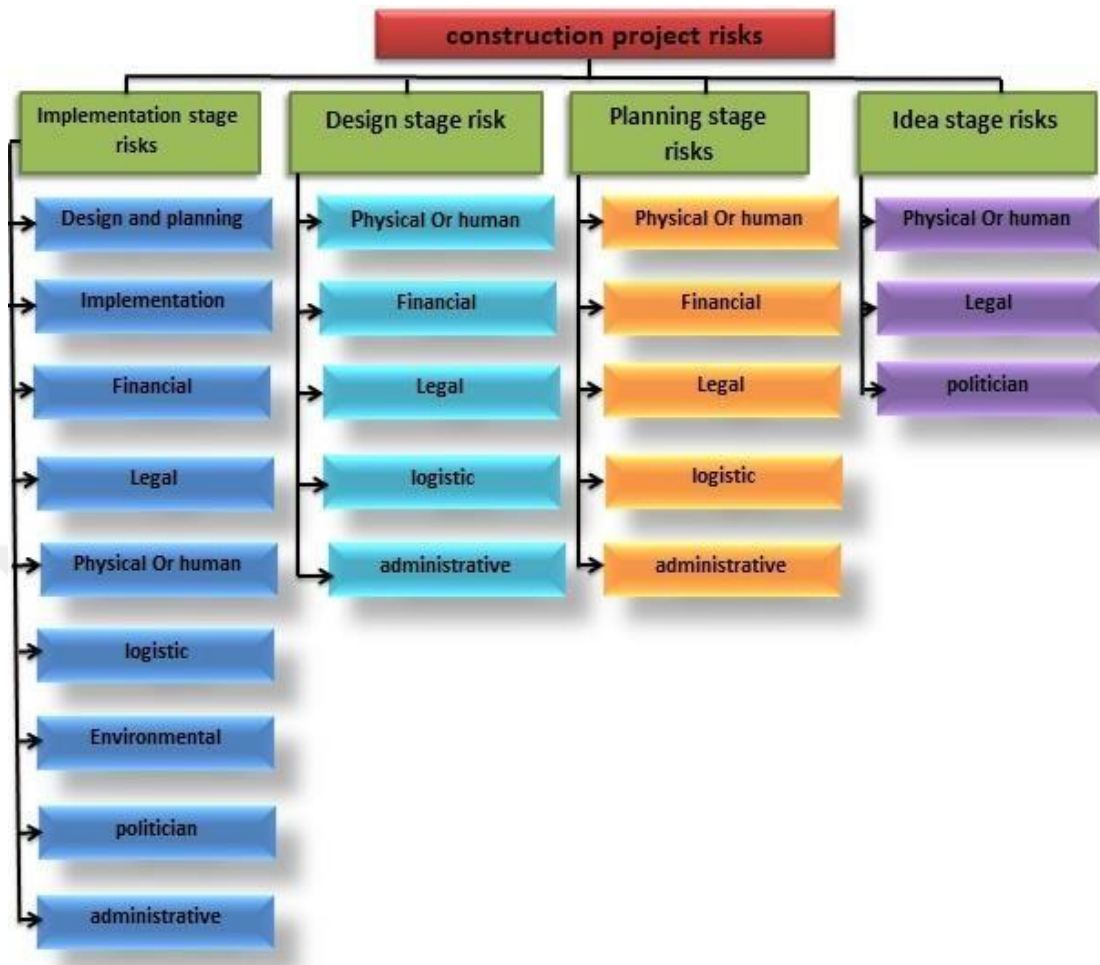


Figure 2.9: Classification of Risk

Source: (Ahmed et.al., 2017)

Risk classification contributes to facilitating understanding and identifying risks in the project and defining and choosing the appropriate strategy to mitigate their effects. Where (Lee and Lim, 2017) classified the risks according to their primary sources or nature, and classified the risks according to the type of impact and according to the stage of the project and according to the ability of the project team to control them. The risks were classified according to more than one standard.

In Figure (2-9), the following classification has been adopted, which adopts the concept of different levels, where each level follows a specific standard (Ahmed et. al., 2017).

Vidal & Marle (2014) classified the risks according to the stage in which they occur in the life of the project and according to the party causing them. It mentions:

A- Known risks:

These are expected risks such as minor changes in the productivity of workers or equipment, or differences in the prices of some materials.

B- Known – impersonality Risks:

These risks are expected to occur, but were not taken into account due to the greatness of their impact or the impact of their occurrence is not known, such as the emergence of large unexpected cavities or the collapse of part of the structure during construction.

C- Unknown - impersonality Risks:

They are risks that cannot be expected and the extent of their impact is not known. Such risks are defined in contracts as force majeure (Lutovska et.al.,2018):

1. Classification of risks according to the stage in which they occur:

- a. The risks of the idea identification stage
- b. Design phase risks
- c. Risks of the contracting stage.

2. Classification of risks according to the party participating in the project:

- a. Risks related to the work team: They are the responsibility of the project work team so that they can manage and deal with them and find appropriate solutions to avoid damage that may occur to the project, which are:
- b. Risks related to the consultant/designer office
- c. Risks related to the owner of the project
- d. Risks related to project management

2.6.4 Risk analysis and management

Risk analysis and management can be defined as the technique that helps to identify the elements that have the main negative impact on the project and that the risk management process is the system that enables management to assess the level of risk impact and then develop a contingency plan to avoid or reduce the impact of its occurrence (Waal & Versluis, 2017).

Hollá, (2007) states that the risks for which there is sufficient data can be estimated statistically, and in most cases, dealing with risks differs from one stage to another. There has been a significant development in the risk analysis process by using the computer in the analysis.

Analysts, specialists in the field of risks, and managers have developed good and varied perceptions of this process, and to simplify this process, (Hollá & Ristvej, 2013). risk management is divided into two basic steps after the risks are identified in the project, namely:

1. Risk Analysis (Risk Measurement)
2. Risk Management

2.6.5 Risk management and analysis concept

The term risk management includes two parts, the first is management and the second is risk. Management, according to the common concept, means planning, organization and control. As for risk, it is the discrepancy in what is expected. Risk management and analysis is defined as the process that enables knowing the risks and analyzing those risks in the appropriate way and then developing the appropriate solution that removes that risk or reduces its impact and thus increases the success of the project and achieves its objectives (Lande & Mohture, 2021).

Risk analysis and management is a continuous process and can begin at any stage of the project life cycle and can last and continue until the costs of using it become more than its potential benefit, and as the project progresses, the risks decrease, and thus the effectiveness of using risk management and analysis tends to diminish, so it is advisable Its use in the early stages of the project life cycle (Tóth & Sebestyen, 2016).

2.6.6 Emergence of risks management

Many organizations that are interested in and adopt the idea of risk management have been established. The most important of them is the Environmental Academy in Washington in 1980, which issued a quarterly magazine in the same year and more than 2200 members from different countries of the world joined it. Several conferences have been held which concerned with risk management (Amerigo et. al., 2018).

Malik et. al., (2021) state that the most important of which is the Basel Conference, and during which the first document in this field was issued, known as Basel III. With the end of the eighties and the beginning of the nineties, and the desire of companies to reduce costs in the implementation of projects, they saw that they could put additional preventive measures to reduce the burdensome costs of insurance premiums in their budget, which occupy a huge number in their expenditure schedule and their belief in their ability to bear risk responsibility.

From the above, the researcher believes that what leads to the establishment of risk management is not global trends, international legislation, or the administrative desire to add value to shareholders, but rather the change in policies and procedures that help identify risks.

2.6.7 Importance of risks management

The importance of risks management lies in the benefits achieved by the company, as follows (Benefits et. al., 2016) & (Arslan et. al., 2023):

1. Understand and cognition the business risks.
2. Analyze and assess risks related to new and existing activities, products and services.
3. Assist senior management in focusing on deviations and issues that need attention.
4. Increase the achievability of strategic objectives.
5. Improve decision-making, planning and prioritization.
6. Management of the company's business governance, i.e. the company's control to achieving its objectives towards the optimal use of its resources.
7. Enhances companies' ability to predict failure and reduce the likelihood of it occurring and thus helps develop their preventive capabilities to avoid disasters and financial losses.
8. Raising the efficiency of resource allocation and improving quality and business returns.
9. Improve the company's chances of success in implementing business plans according to these timelines.

10. Develop a policy and strategy for the risk management.
11. Discover the specific risks for each economic activity.
12. Providing information about the risks of the company for disclosure purposes to the citizens.
13. Cooperation at the strategic and operational level and building cultural awareness within the institution for the purpose of developing risks management
14. Reduce the risks that may lead to significant losses as a result of the large volume of investment in these projects.
15. Forecast the cash flows that projects and organizations can receive.
16. Evaluation and promotion of investment proposals related to the activities of the organizations.
17. Develop plans to protect and assist the company's employees in its organizational departments, administrative, productive and service.
18. Helping the project or company to fulfill social and economic responsibilities towards society.
19. Help to increase the profits of the project by reducing risk management costs and directing these amounts to investment.

Through the importance of risk management, the researcher concludes the need to find a channel to send reports to all team members working in risk management, prepare risk mitigation plans, review and evaluate the plan continuously, as well as update the results of the risk analysis process continuously.

2.6.8 Risk management stages

Hai & Thúy, (2022) state that risk management requires an effective management to develop a strategy through which to identify and diagnose the risks to which the project is exposed, then to assess the potential losses for each of these risks, and then to determine the appropriate method for each of them in coordination with the parties to the project.

The reference study showed three basic stages of risk management (determination - analysis

(Response). (Kumar, 2021) state that since the risk management process is a dynamic and continuous process, monitoring and follow-up are necessary. The following figure (2-10) shows the basic stages of risk management, which are:

1. Risk identification: in which the most likely and impactful risks on the project are determined, and the characteristics of these risks are documented.
2. Measurement of risks: in which the risks and their interaction with the project and its outputs are assessed.
3. Developing the response: reinforcement steps are identified to prepare the response to respond to these risks
4. Risk Responsive Control: Responding to changes in risks over the project period.

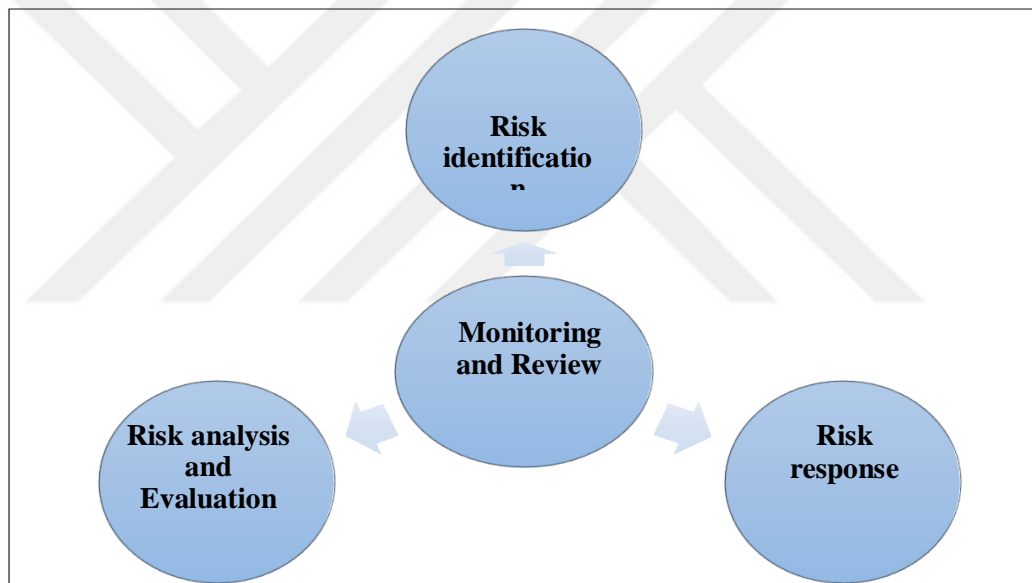


Figure 2.10: The Basic Stages of Risk Management

Source: (Kumar,2021)

2.6.9 Risk Determination

Ahn, (2015) states that the identification of risks is based on the objectives, i.e., event that causes the project objectives to not be achieved, whether partially or completely, is considered a risk. Risk identification is also by reviewing common risks. Many institutions have lists of common or potential risks that are reviewed to identify similar risks.

Sharma & Gupta, (2020) state that this stage aims to discover and identify all the risks to which the project is exposed that could threaten the objectives of the

project. This requires tools to identify risks such as questionnaires, personal interviews with project managers or the project team, checklists, and brainstorming.

2.6.10 Risk Ranking

Each project has different risks and, in fact, different levels of risks. These risks may be associated with operating processes or work functions, and therefore all of them affect the activities of the project, as it is mentioned (Sima,2022) that the arrangement of risks is derived from the intuitive idea that the risks that have the worst results it should have the lowest chance of occurrence, on the other hand, the arrangement of risks is based on the probability and severity of the impact, and describes the probability, possibility, or chance of the occurrence of risks, while the impact of these risks must be measured according to three factors: cost, time, and quality (the required specifications).) Oost et.al., 2021) state that there is a technique used in the arrangement of risks, which is the probability and impact matrix, as shown in the following table, it expresses the weight of each risk in numbers 1, 5, 10 or any other numbers such as 1, 2, 3 to indicate the order of risks as it expresses the importance of risks (low, medium, high) respectively.

These estimates do not represent the actual amount of risk, but rather express its importance (risk order = probability x impact).

Table 2.1: Qualitative Analysis in the Probability and Impact Matrix

Impact	Probability		
1	1	5	10
5	1	5	10
10	5	25	50

Source: (Ward, 1999)

On the other hand, (Ward, 1999) states that ranking of the risks is based on two main points, as follows:

1. Probability: through which the possibility or opportunity of risk can be described.
2. The severity of the impact: it helps to measure the impact of risks according to three factors: cost, time and quality (required specifications). There is a technique used in arranging risks, which is the probability and impact matrix.

2.6.11 Objectives of risks management

The basic objectives of risks management can be explained as follows:

1. Develop policies and practical procedures to confront any risk in order to reduce the material and human losses that may occur as a result of the occurrence of such risk.
2. Develop the competitive attribute by controlling costs, and this is done by reducing the following costs:
 - a. Moral costs.
 - b. Material costs associated with risk.
 - c. Actual losses incurred as a result of risk.
3. Contribute to finding the necessary means to reduce risks.
4. Ensure that policies and procedures help the safety of the institution.
5. Preventing destruction in one way or another. This requires all the required actions to avoid destruction, protection, providing alternatives, and setting protection, safety and insurance instructions.
6. Risk management should provide judgment on comparing the cost of risk with the cost of reconstruction and compensating for the loss of income.
7. Making written policies for risks management that must align with the project strategy.
8. Trying to prevent severe financial losses leading to the collapse of the project.
9. Choose inexpensive means to facing the risk.
10. Reduce accident rates.
11. Development of the analysis methods of risks cost.
12. Maximizing long-term profit in addition to periodic evaluation of the results of the riskmanagement programme.
13. Discover the risk for each activity separately, whether this activity is for an individual or for the project.

14. Choose the most appropriate way to manage each of the risks that exist in the individual or the project according to the necessary degrees of safety and cost.

It is clear from the above that the general objectives of risk management are to protect the project from negative effects, to ensure that decisions related to risks are made by the senior management of the project. In addition, contact with the project team and maintain a clear and accurate record of risks during the project stages.

2.6.12 Analysis and management of the risks according to scientists

Dey et.al., (2007) state that risk analysis and management is the process through which risks can be identified and analyzed using the appropriate method and then develop the appropriate solution that helps avoid this risk or reduce its effects. In other words, it is the process that increases the success and termination of the project from the perspective of cost, time and specifications, with the least possible problems. Many scientists have devised and developed methods for analyzing and managing risks, as follows:

1. According to Perry and Hayes (1985)

(Perry and Hayes) in 1985 identified a risk management method by defining and analyzing the type of risk and then the possibility of facing this risk. Figure (2.11) shows the risk management method according to Perry and Hayes:



Figure 2.11: The Risk Management Method According to Perry and Hayes

2. According to Grammer & Trollope (1993)

(Grammer & Trollope) in 1993 developed a new method for confrontation risks, by defining the type of risk confrontation the project, analyzing it, then reducing it, then planning for managing and confrontation the risk, and finally reviewing all the risks to which the project is exposed after the management process. Figure (2.12) shows the method of risk management according to Grammer & Trollope:

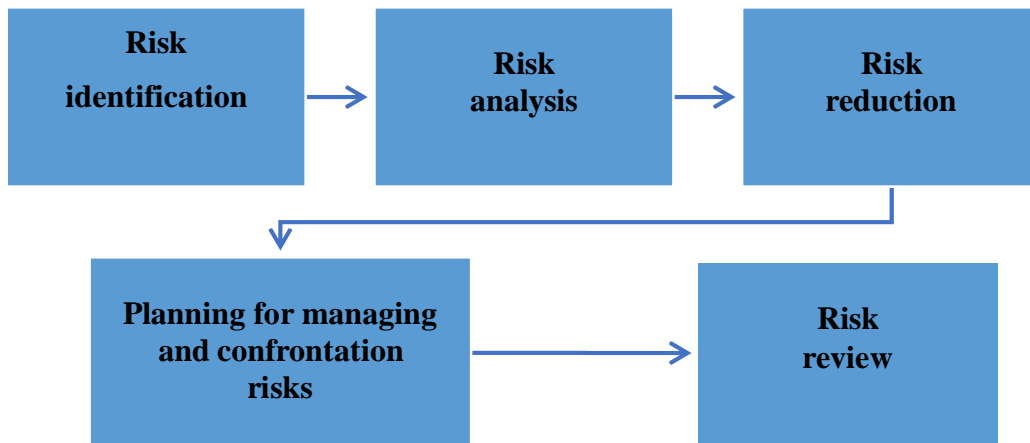


Figure 2.12: The Method of Risk Management According to Grammer & Trollope

3. According to Carter et. al. (1994)

According to (Carter et. al.) in 1994, he developed risk management, starting with identifying and documenting the risk, then classifying, analyzing, reporting on this risk, searching for the best strategy to mitigate and improve the risk, and finally monitoring and controlling the risk. Figure (2.13) illustrates the risk management method according to Carter et. al.

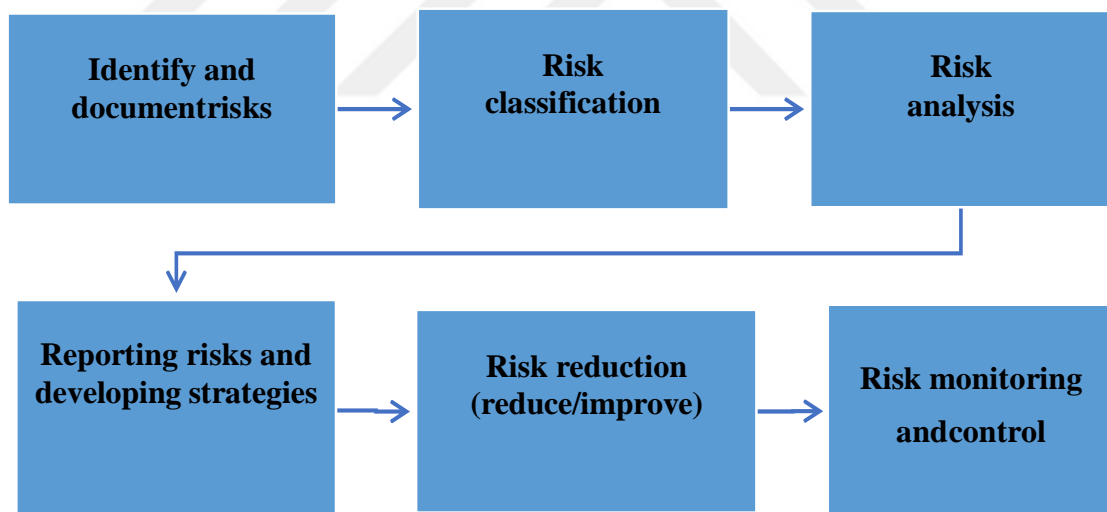


Figure 2.13: The Risk Management Method According to Carter et. al.

4. According to Kliem & Ludin (1997)

According to (Kliem & Ludin), he added to the risk definition and analysis the reporting of the risks faced by the project to control these risks. Figure (2.14) shows the risk management method according to Kliem & Ludin:



Figure 2.14: The Risk Management Method According to Kliem & Ludin

5. According to Chapman (1997)

According to (Chapman) in 1997, he defined a more accurate method for risk management by defining the risk and focusing on it and defining the type of risk and then creating an organizational structure to confront the risk and then distributing the responsibilities of this structure to estimate the risk and assess its size, and then develop a plan for risk management. Figure (2.15) shows the method of risk management according to Chapman.



Figure 2.15: The Method of risk Management According to Chapman

6. According to Baker et.al (1998)

According to (Baker et al.) in 1998, he identified a risk method by identifying the risk, estimating the size of the risk, evaluating its type, and then monitoring the risk to deal with it. Figure (2-16) illustrates the risk management method according to Baker et.al.

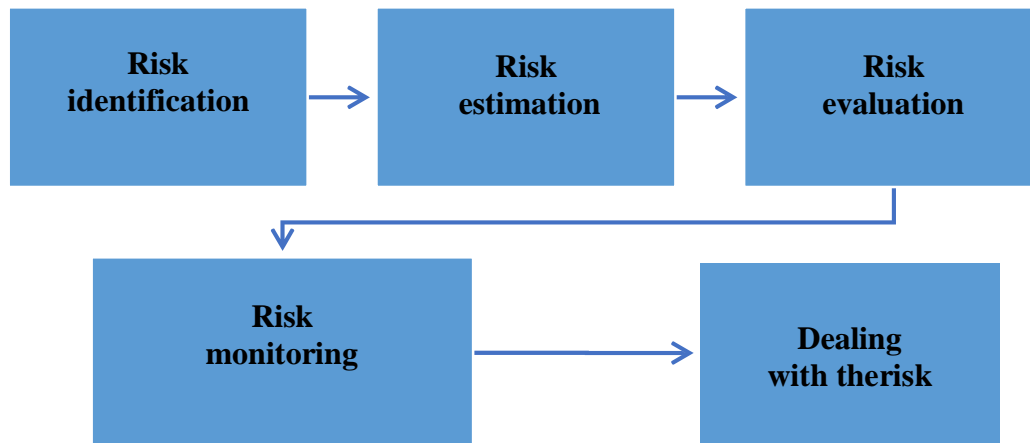


Figure 2.16: The Risk Management Method According to Baker et.al.

The scholars unanimously agreed that there are two stages of analysis: A- Qualitative analysis stage (qualitative techniques)

They are easy-to-applying techniques and their needs are usually less effortful. It allows the project manager or experts in the field of risk management to prioritize risks depending on their importance and impact on the project.

B- Quantitative analysis stage (quantitative techniques):

This type of analysis requires more techniques and more effort, as risk response depends on quantitative calculations, it allows the project manager to arrange the risks according to their severity from most important to least important. This type of analysis prepares information for the project team that enables him to estimate the overall project risks and estimate the project agenda and reserve budget for risky projects.

Risks analysis gives many benefits, including (Benefits et. al., 2016):

1. Helps reduce risks due to the availability of management measures and understanding project risks.
2. Helps to predict project completion quantitatively based on cost and time estimates.
3. Knowledge of the risks surrounding the project allows for contingency assessment, leads to a better decision, and gives greater confidence to investors or shareholders to reject or accept projects that are not financially reliable.

2.6.13 Advantages of risks management

Risks management enable systematic and coordinated work in its field as it protects the company and adds value to it. The advantages of risks management can be summarized, as follows (Podarilova, 2023) & (Tembo et. al., 2015):

1. Make risks management an integral part of achieving the company's objectives, thereby helping to ensure that those objectives are achieved.
2. Improve management's ability to understand, identify and manage risks.
3. Reduce the inefficiencies associated with the traditional piecemeal approach to risk management through comprehensive and integrated risks management.
4. Identify common and overlapping risks and improve communication and discussion between the managements.
5. Create a more realistic layout of the project and associated work.
6. Timely implementation of activities to be more effective.
7. Creating and quickly exploiting all opportunities.
8. Increase flexibility by being aware of all the tests or associated risks.
9. Achieve lower cost by planning more transparently and effectively.
10. From foregoing, it can be said that it identifies common risks to improve management's ability to understand risks.

2.6.14 How to manage the risks

In order to implementing the risk management process correctly and effectively, it is necessary to determine the scientific and practical steps. These steps are called the general framework for risk management. There are many opinions of researchers about determining these steps, as follows:

1. Identifying the objective (Mbajiorgu, 2014):

The first step in the risk management process is to determine the objectives and needs of the corporation from the risk management program, so the primary objective of risk management must be to protect the efficiency of the corporation's activities and ensure that there are no additional risks or expected losses that hinder its objectives. This includes two things:

- a. Avoid huge losses that can hinder the work of the corporation
- b. Protecting the corporation's employees from dangers that may cause them death

2. Identifying or detecting risks (Karmakar, 2023):

This is done through the presence of experts in asking questions that identify the risks that may exist, with the aim of discovering the risks which the project is exposed and selecting and training workers

3. Assessment of risks (Arwine, 2004):

Risks management must assess and identify detected risks. Risk assessment is the measurement of the probability of a particular loss and this requires giving priority to risks with a significant impact where the risks are classified into groups, such as:

- a. High risks: Includes risks that lead to the bankruptcy of the enterprise.
 - b. Medium risks: Which leads to large financial losses, but can be borrowed for the purpose of continuing production.
 - c. Low risks: Include risks whose losses can be easily treated.
- 4- Making decisions (Charkhakan, 2023):

The risk manager chooses the appropriate means to face each risk and chooses the best and least expensive methods through the following steps:

1. Risk retention or risk bearing: If the probability of achieving the risk is small or the resulting losses are small, the corporation may bear the risk itself, without collateral, but the project must not bear the risks that lead to a loss that more than its financial capacity, with taking into account irregular cases.
2. Reducing the risk: This is done by using means of prevention and safety and refraining from certain actions, and this method is called prevention.
3. Transfer of risk: In this case, the risk manager decides that the collateral will be directly with the collateral company.

2.6.15 Constituents of risks management

Risks management process requires the availability of a set of constituents, which are considered as essential elements as follows (Elborombaly, 2010):

1. **Human Constituents:** Related to individuals and are considered the basis for the success of any work, especially if they have scientific qualifications.
2. **Physical Constituents:** Risk management process needs to provide a set of physical elements such as money.
3. **Information Constituents:** To achieve the risk management process, an advanced and integrated system of information must be available to help provide senior management with information that enables them to face the risks.
4. **Communication Constituents:** It is very necessary to have effective lines of communication between those responsible for risk management and all other administrative levels in the corporation.

2.6.16 Elements of risks management

Risks management of each corporation (financial, non-financial) should include the following main elements (Ishak & Mohamad, 2017) & (Gonidakis et. al., 2021):

1. **Control of management effectiveness:** Risk management requires effective supervision by the Board of Directors and senior management. Board of Directors must adopt objectives, strategies, policies and procedures commensurate with the financial situation of the corporation, and the nature of the risks it faces, as well as the Board of Directors must ensure the quality of an effective risk management structure to practice the activities of the corporation.
2. **Adequacy of policies:** The Board of Directors and senior management should work on the need for the risk management policy to be commensurate with the risks that arise in the corporation, as well as the need to follow accurate procedures to change all elements of risk management, including identifying and measuring risks.

3. Adequacy of risk monitor and information systems: Effective monitor of the risks of the corporation requires the knowledge and measurement of all risks with a significant physical impact. Therefore, risks require the need for an information system capable of providing senior management and the board of directors with the necessary reports in a timely manner.
4. Adequacy of control systems: These systems have a crucial role in ensuring their proper observance in general and in risk management in particular.

2.6.17 Evaluation and review

The evaluation and review process are very necessary because there are some risks that change and decrease and other risks arise. Evaluation and review process is necessary to detect risks before they become costly. One of the researchers also pointed out that risk management is carried out according to the following steps (Md.Sum, 2016) & (Karpushenko & Filatova, 2021):

1. **Risk measurement:** After identifying the risks with each activity, the next step is to measure these risks. Each type of risks must be seen in its three dimensions, namely: size, duration, and probability of occurrence. The correct measurement is the one that is done in a timely manner and is of great importance for risk management.
2. **Risk control:** After identifying and measuring risks, the third step comes to control these risks. There are three basic ways to control the risks of utmost importance, which are to avoid, minimize, or cancel their impact.
3. **Risk Monitoring:** Corporation must work to create an information system capable of identifying and measuring risks accurately. At the same time capable of monitoring important changes in risks status.

From the previous presentation, the researcher concludes, that individuals with sufficient knowledge must participate in identifying risks. Identifying risks requires sufficient knowledge of the institution, its customers and its legal framework.

2.6.18 Control of risk management

Follow-up and control process is necessary in keeping things under control on the path drawn by the plan that results from the previous stage. Plans are modified according to the data that result during the implementation of the project. This stage may require looking at the risks in other ways as it interacts with time to change the shape of the project and its data. Risk control ways include (Alsahar, 2019):

1. Avoidance: means that the chance of losing is reduced to zero.
2. Loss control: It has two directions:
 - a. Prevent loss: refers to the scale at which the frequency of loss decreases
 - b. Reduction of loss: means reducing the size of losses after they occur.

2.6.19 Mitigation of risks

Risks are minimized by minimizing their effects by taking the necessary procedures to make the risks acceptable. Risks can be mitigated by minimizing the impact of their occurrence whereby taking action in the early stages is more effective than trying to reduce the effects of these risks after they have occurred (Nehemiah et.al., 2019).

2.6.20 Monitoring and follow-up the risks

It is about monitoring and following up the effectiveness of the actions that have been taken. It should be noted that the risk management process must be built during the project definition phase, which is the beginning of the project - during the preliminary studies of the project, and must be continuous during its implementation. (Nehemiah et.al., 2019).

Risk management includes the following steps:

1. Identify preventive measures to avoid risks or mitigate their impact.
2. Create contingency plans to deal with risks as they occur.
3. Work as hard as in order to mitigate confusion by gathering good information.

2.7 Bridge Management System for Risk Management

Bridge management systems usually provide functionality to capture inventory and inspection data for each bridge, and then provide a set of mathematical models to analyze each bridge to predict future conditions, performance, and costs. Performance deficiencies and reduce future costs. The program predicts future performance and costs conditional on the project alternative and year of implementation. The nothing scenario is also analyzed using similar models (Akgul, Ferhat2007).

The basic requirements of the guidelines can be implemented with the help of bridge management systems. Therefore, they must be structured to fit within the analytical framework of these systems. Although statistics confirm hydraulic causes (such as flooding, siltation, and debris build-up), the bridge condition has identified collisions as the primary cause of bridge failure or service interruption. This difference is primarily due to the fact that in most failures, problems related to hydraulic events are referred first to hydraulic engineers and are therefore not necessarily the primary cause of all bridge failures (Qin, 2022).

2.8 The Nature of Risks Management in Bridge Projects

Risks in construction projects, especially bridges, are the most important vital problems that affect as an effective impact on the progress of the project, so we must know them scientifically because, the increase in risk within any project transforms into a problem and these risks can be legalized by studying the types of these risks and identifying them more accurately (Xie & Yang, 2021). Risk management is a tool or means that can be used to avoid losses as much as possible, due to the possibility of continuing work. It is also found within construction projects to address the results of the remaining risks within the project, and the importance of risk management lies in the fact that some risks are likely to occur during the various stages of project completion. It includes preventing the occurrence of potential problems, addressing actual problems if they occur, reducing them, and developing an action plan to avoid or reduce the impact of those risks(Rizk et.al., 2022).

3. METHODOLOGY

3.1 Introduction

To achieve the objectives of the current study, risks in bridge projects in Iraq must be identified to know their impact and how to control them. In this chapter, the field study will be discussed to identify these risks. This chapter includes two parts, the first one explains the selected case study and its details. As for the second part, it the questionnaire that has been adopted in the current study through the field survey, which includes collecting information about risks in construction projects Then, design and distribute the questionnaire, using statistical means for social sciences then analyze the questionnaire by the researcher using the appropriate statistical means for analysis data (SPSS version 25) and (Excel 2016).

3.2 The Field Study

This part of the study includes aspects related to the questionnaire by collecting and analyzing the results of the questionnaire. The questionnaire distributed among a group of experienced engineering cadres, project managers, university professors and experts in this field. It also dealt with aspects related to field questionnaires, preparing questionnaire questions derived from theoretical research and personal interviews, presenting methods of designing questionnaires, and then presenting the results of researchers.

In addition, this section includes a field survey and collection of information from previously implemented projects, to give project departments a clear vision on how to respond to risks, to determine why the resulting risk response failed and how to respond to them again.

3.3 Data Sources of the Field Study

3.3.1 The field questionnaire

In order to achieve the objective of the current study, it was necessary to conduct the field questionnaire through two types of questionnaires, namely the open and closed questionnaire, as follows:

1. The open questionnaire

It means to conduct direct personal interviews with experts and engineers who have sufficient experience in the subject of the current study to obtain answers for the questions prepared in advance or developed during the interview, in order to add more information and correct the ideas of the researcher before conducting the closed questionnaire. It considered as a brainstorming process. During this phase, a number of direct personal interviews were conducted with a number of experts and engineers with experience in the field of implementing construction bridge projects. The aim of these interviews was to develop ideas, preparation for the design of the closed questionnaire form by taking advantage of their opinions and suggestions and their evaluation of the questions proposed in the closed questionnaire.

2. Choosing of the bridge

In this part, it will be explained how the bridge was chosen as the study sample. This includes the criteria and methodology used in selection of the bridge, such as geographical location, current use of the bridge, and expected traffic. It will be focuses fully and accurately on the importance of choosing the appropriate bridge that represents the study sample, after the researcher's visit to a group of bridges in Iraq, and ask the staff of experienced engineers. The following pictures show the projects which visited and collect data from those engineers.



Figure 3.1: North Nasiriyah Bridge in Dhi Qar (RW)



Figure 3.2: Numaniyah Concrete Bridge in Wasit (RW)



Figure 3.3: Al-Kuraiyat Fixed Bridge in Baghdad (RW)



Figure 3.4: Fallujah's Fourth Bridge in Anbar (RW)



Figure 3.5: Daquq Bridge in Kirkuk (RW)

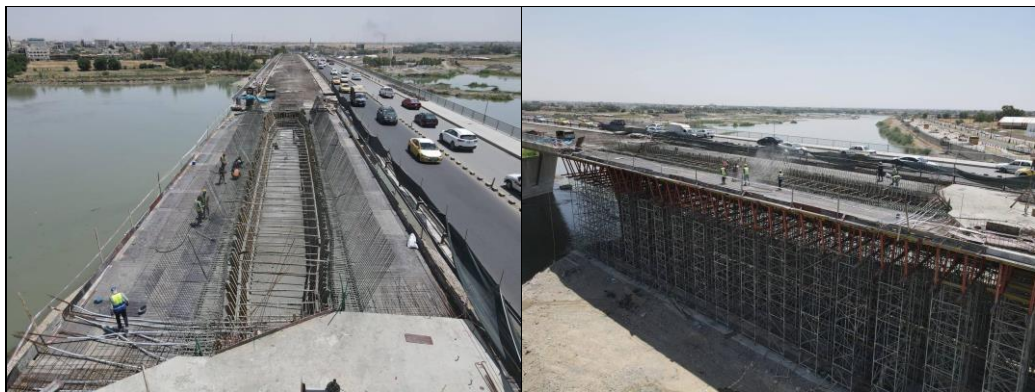


Figure 3.6: Mosul Fourth Bridge (RW)



Figure 3.7: Fifth Mosul Bridge (RW)



Figure 3.8: The Iron Ramili Bridge in Maysan (RW)





Figure 3.9: North Tikrit Bridge (Study Sample) (RW)

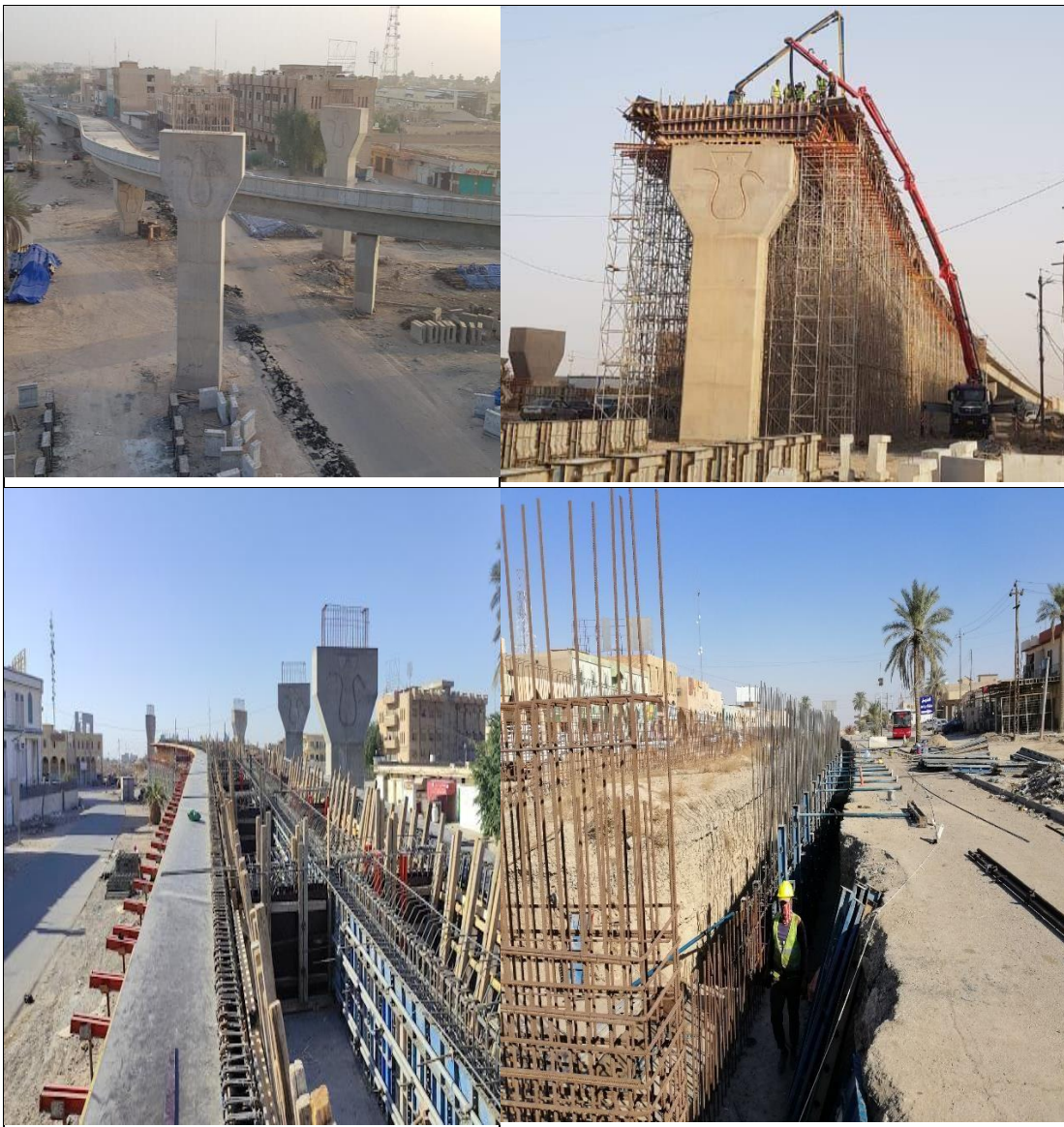


Figure 3.10: Al-Dallah Bridge Tikrit (Study Sample) (RW)

After visiting the bridges projects in Iraq that are under implementation by the researcher, the information was taken by the engineers and the problems that caused the risks faced by the engineers before and during the implementation, where this part included a set of questions that related to the problems and risks to which these engineers were faced through their experiences and expertise throughout the period of their supervision of bridge projects. Information about risks and problems was collected before and during implementation and adopted as an initial form of questionnaire form as shown in appendix (1).

3. Closed questionnaire

After the completion of the open questionnaire, the closed questionnaire form was prepared and designed, which represents the initial form. This form includes several areas related to the study topic and was in the form of questions prepared based on scientific sources and information collected by the researcher through interviews that took place during the open questionnaire. After that, the researcher presented the initial form of questionnaire to a group of experts and specialists as shown in table (3.1), and asks them about any required modifications, omissions, or additions by submitting a request by the researcher shown in appendix (2), then completing the final form of the questionnaire and the experts and specialists are divided into three groups:

- The first group includes experts from the field of construction to evaluate the survey questions and whether they are suitable for the field of the current study.
- The second group is made up of field statisticians to assess the validity of the questionnaire design to conduct statistical tests.
- The third group includes language specialists to evaluate the Arabic and English languages of the questionnaire.

Table 3.1: Shows the Academic Qualifications of Jury and Experts (RW)

Specialty	No.	Jury and Experts	Academic Qualifications	Years of Experience	Workplace	Accurate Specialty
Engineering	1	Abdulrahman Adnan Ibrahim	Ph.D	38	Tikrit University / College of Engineering	Projects Management
	2	Nizar Noman Ismail	Ph.D	25	Tikrit University / College of Engineering	Projects Management
	3	Adnan Ahmed Madhloum	M.A.	40	Department of Roads and Bridges	Roads and Bridges
	4	Anmar Mohammad Jassim	M.A.	25	Department of Roads and Bridges	Structure
	5	Maysoon Abdullah Mansour	Ph.D	23	Tikrit University / College of Engineering	Projects Management
	6	Sabbar Abdullah Saleh	Ph.D	30	Tikrit University / College of Sciences	Geology
English	1	Marwah Kareem Ali	Ph.D	15	Tikrit University / College of Arts	English Language
	2	Nahida Taha Majeed	Ph.D	35	Tikrit University / College of Arts	English Language
Statistic	1	Ahmed Farid Naji	M.A.	15	Tikrit University / College of Management and Economics	Business Administration
	2	Amer Mahdi Saleh	Ph.D	26	Tikrit University / College of Education	Statistic

After exposure the initial form, which contains 145 items, to the experts, they are unanimously agree to delete some items because they are not important compared to the rest of the items. The most important items have been chosen which are agreed that they have a clear impact on bridge projects which numbers become 97 items distributed among four different areas and was adopted to be the final form of the questionnaire, as follows:

- **The first area: the personal information of the sample members**

This area includes personal questions which aimed at collecting information and data about the sample members, and the questions about the workplace, the department or company in which the associates work, the scientific level through the certificate obtained, his engineering specialization, the number of years of

experience, the job position he occupies, and some other questions that clarify his qualification to participate in the questionnaire.

- **The second area: Determining the Risk levels**

After collecting information about the sample members and indicating their qualifications for the purpose of participating in the questionnaire. A set of questions were presented, which dealt with their opinions about the risks and problems faced by bridge projects and assessing the extent of the risk for each problem, as shown in appendix (3).

- **The third area: Identification of the main cause of the risk**

After collecting questions about determining the risk levels faced by the implementers in the bridge projects, the main cause of each risk was presented and its risk level was determined and the reasons are divided into two groups:

1. The main reason for the employer, as shown in the appendix (4).
2. The main reason for the executing company, as shown in the appendix (5).

4. ANALYSIS OF DATA AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter involves the analysis and interpretation of data collected from the sample questionnaire through interviews. As well as how to employ analytical skills to extract patterns and provide useful guidance based on the results achieved.

4.2 Analysis of the Results of Questionnaire

After collecting the data from the questionnaire, it will be analyzed in accurate way to determine the risk levels in the project. This is done by analyzing the quantitative and qualitative data collected. Quantitative data is analyzed using statistics and graphs, while qualitative data is analyzed by sorting and classifying them to determine the risk levels in the project.

4.3 Statistics of Personal Information of Respondents

The academic qualifications of the study sample members have been determined. Occupation, the department in which they were working, the number of years of professional experience, the specialty of the academic degree, the types of projects that contributed to the implementation, and the place of work (city). It was divided as follows:

1. Academic certificates for engineering specialties

Figure (4.1) shows the percentages of scientific degrees where they are classified into (Doctorate, Master, Bachelor). The relative results according to the degree classification were 12% Doctorate's certificate holders, 40% Master's certificate holders, and 48% Bachelor's certificate holders.

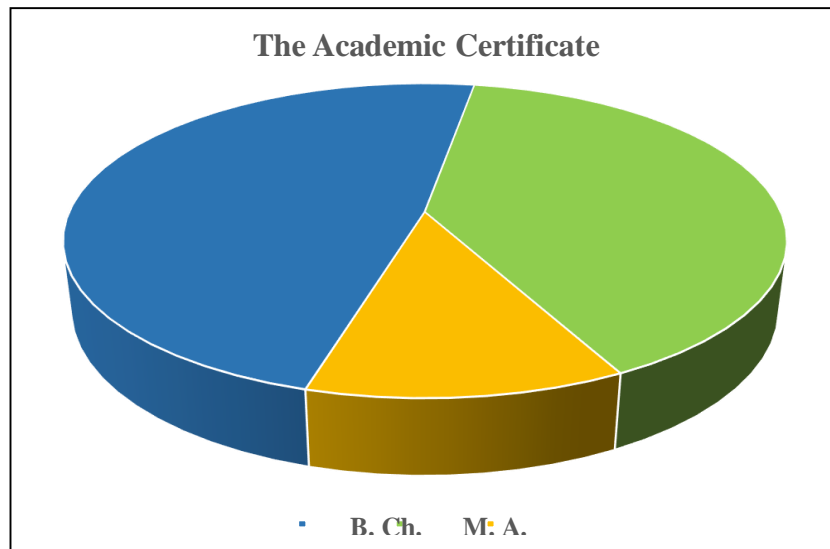


Figure 4.1: The Academic Certificate (RW)

2. The Precise engineering specialization

The engineers and experts who participated in the questionnaire amounted to (83) engineers. There were (38) engineers majoring in civil engineering, and (26) engineers majoring in construction engineering, the number of each of the Highway and building and construction specializations was (6) engineers, the number of mechanical engineers was (4) engineers, as for the area specialization, they were two, and one materials engineer.

The following figure shows the engineering specialization of the engineers and experts who participated in the survey.

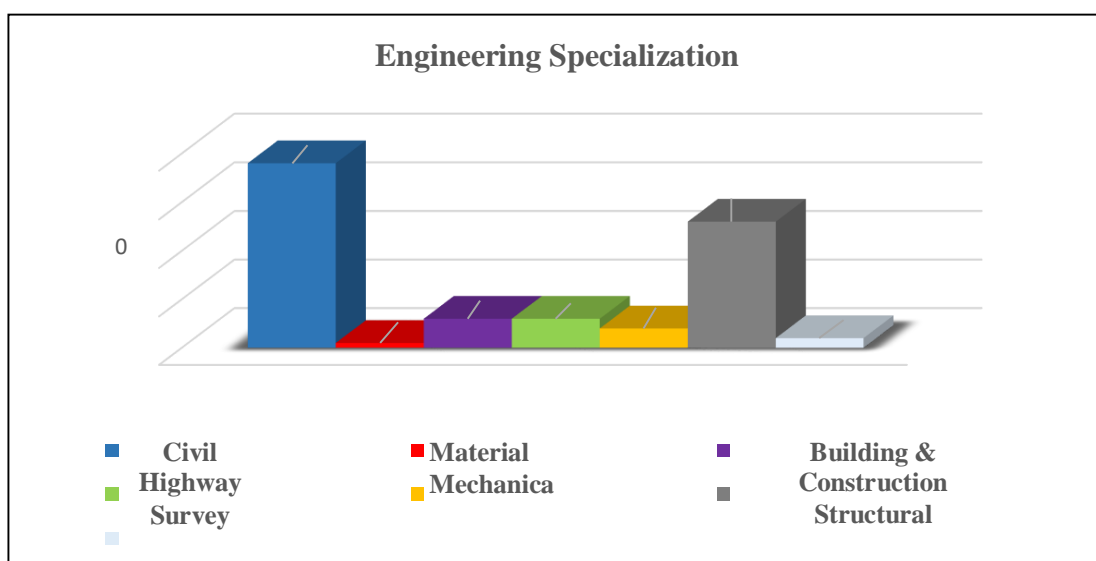


Figure 4.2: Engineering Specialization for Participates (RW)

3. Years of Experience for Expert Engineers

Figure (3.4) shows the years of experience of the participants in the questionnaire, as it turns out that the highest group of respondents in the questionnaire had years of experience ranging between (10-15) years, and their number was 27 engineers, and those who have experience between (3-9) years, and between (16-25) years, their number reached 25, and 6 of them have more than 25 years of experience, as shown:

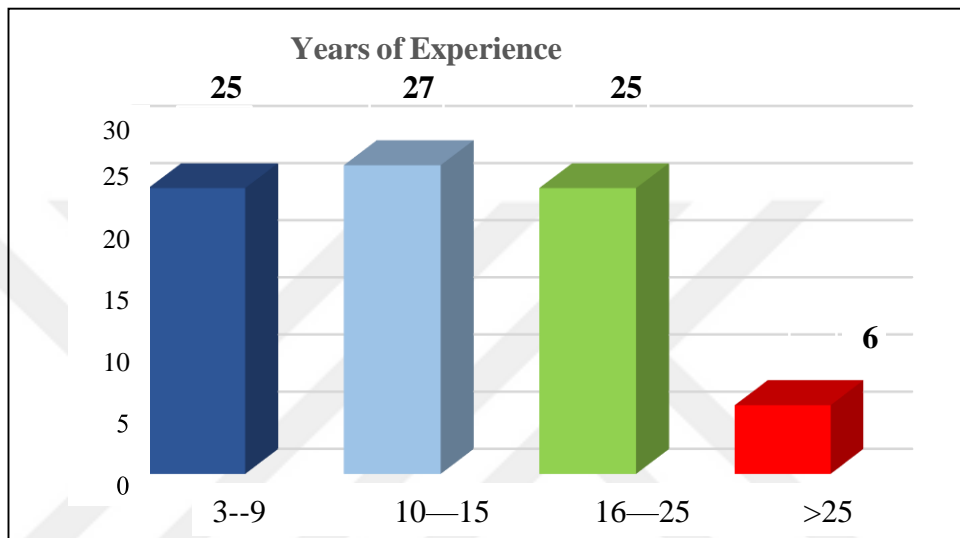


Figure 4.3: Number of Years of Experience (RW)

4.4 Study Methodology

This study adopted the descriptive analytical approach as the most appropriate approach. This approach depends on studying the phenomenon as it is in reality, describing it accurately and analyzing the data resulting from this description without the intervention of value judgments.

4.5 Statistical Methods

Internal consistency test: In order to determine the internal consistency of the questionnaire items and the extent to which variables are expressed under them, Cronbach's alpha test was used.

The stability of the questionnaire aims to give the questionnaire the same results if it is re- applying several times in succession within specified time periods and to redistribute the questionnaire to the same subjects after 15 days, it also means

to what degree the scale gives close readings each time it is used, or what is the degree of consistency, consistency and continuity when it is used repeatedly at different times. The stability of the study decision was verified by Cronbach's alpha coefficient method (Najjar, 2017).

Table 4.1: Cronbach's Alpha Coefficient Method (RW)

Reliability Statistics		
Cronbach'sAlpha	Cronbach's Alpha Based on Standardized Items	N of Items
.801	.814	3

It is clear from the results shown in Table (4-1). That the value of Cronbach's alpha coefficient was high two question and its equal to 0.801.

Table 4.2: Inter-Item Correlation Matrix (RW)

Inter-Item Correlation Matrix			
	Eng.Item.No.	Answers	After15days
Eng.Item.No.	1.000	.488	.450
Answers	.488	1.000	.843
After15days	.450	.843	1.000

	EngItemNo	Answers	After15days
1	1	275	280
2	2	268	279
3	3	270	280
4	4	277	282
5	5	270	279
6	6	272	280
7	7	273	281
8	8	275	289
9	9	278	293
10	10	277	289
11	11	279	288
12	12	281	294
13	13	278	286
14	14	280	290
15	15	287	293
16	16	280	287
17	17	274	286
18	18	281	289
19	19	278	290
20	20	270	276
21			
22			
23			
24			

Figure 4.4: SPSS Stability Testing (RW)

After collecting the required data from the questionnaire, the weighted mean and percentage weight were adopted in processing the data and analyzing the results in relation to the risk levels.

$$WA = \frac{\sum_i F_i W_i}{F_i} \dots \quad (1)$$

Where:

WA: Weighted averages for weights of answers (weighted mean).

Fi: Number of answers for each weight.

Wi: Weight for each answer (Mansor & Mahomad, 2015).

The questionnaire was corrected according to the weights set to grade the answers: Yes, Sometimes, and No in order to identify the level of risk (Al-Hadayris,2019), as shown in the following table:

Table 4.3: Shows Correcting the Questionnaire According to A Three-Point Likert scale

Answer	Yes	Sometime	No
Answer Weight	3	2	1

Source: (Al-Hadayris,2019)

In the current study, weighted mean has been used to determine the risk levels. If the value of the weighted mean is equal to or greater than (2.34), this indicates that the risk levels is high; if the value of the weighted mean is between (1.67-2.33), this indicates the existence of the risk to a medium level, but if the value of the weighted mean is equal to or less than (1.66), this indicates that the risk level is low, as shown in Table (4.4), (Al-Hadayris,2019). As for the calculation of the percentage weight, it shows the weight of each levels in relation to the other scores. It is clear that the risk is arranged according to its risk levels.

Table 4.4: Shows Likert Scale Levels

Risk levels	High	Medium	Low
Weighted mean	2.34-3	1.67-2.33	1-1.66

Source: (Al-Hadayris,2019)

4.6 Analyzing and Discussing the Data Collected According To the Results of the Data

The performance of the samples in the checklist areas is shown as follows:

4.6.1 Determine the risk levels

After analyzing the results of the questionnaire, and completing the statistical requirements, the risk levels was determined, after calculating the weighted mean and the weight percentile for each item. And because the items are many and close to a hundred items in the appendix (3), the researcher relied on the interpretation of a random set of results for the purpose of clarification, and the items that were randomly selected by the researcher are:

1. The samples with a high-risk level are (83, 12, 13, 27, 3, 84, 11, 26, 21, 31) with a weighted mean (2.90, 2.88, 2.88, 2.84, 2.81, 2.81, 2.80, 2.71, 2.70, 2.69). These samples deal with the following: "Do you think that the lack of advance plans for the lifting and installation work can cause project delays or errors in the implementation process", " Do you think that the mismatch of the plans with the prepared bills of quantities can cause problems in construction projects", " Has the speed of implementation of the project been slowed down due to the contractor's delay and bad administrative routine", " Was the mold erected well if the bridge was reinforced concrete", " Should everything that is in the schemes be transferred at the implementation stage and large loads of the substrates controlled", " Do you think that the lack of special heavy equipment such as cranes and long vehicles can affect the efficiency and quality of carrying out works in the bridge", " Do you think that not choosing the right construction system can lead to problems in construction bridge projects", " Do you think that not using modern methods in checking pile loading can cause potential structural problems in the bridge to go undetected", " During implementation, is the financing of the project delayed due to the country's budget", " Do you think that neglecting quality control and continuous processing of concrete can cause bad quality of the bridge and its deterioration in the long run".
2. Samples with medium risk are (45, 19, 20, 25, 37) with a weighted mean (2.16, 2.08, 2.07, 2.00, 1.94). The items for these samples include the

following: "Do you think that making inappropriate decisions when tests fail is the right action", "Has the installation of the joists in their location on the bridge pillars been delayed during implementation", "Has the manufacture, transportation and lifting of the beams been delayed during implementation", "Has the work stopped by the executing party due to the currency difference and the increase in its exchange rate", "Were the provided bills of quantities sufficiently accurate".

- The samples with low risk are (15, 1) with a weighted mean (1.55, 1.54). The items for these samples include the following: "Is there a possibility of devising wrong hypotheses when implementing bridges", "Is the cost of land acquisition calculated in the project cost".

Table 4.5: Risk Levels for 17 Items (RW)

Items No.	Problems Causing Risk	Weighted Mean	Percentage Weight	Risk levels
83	Do you think that the lack of advance plans for the lifting and installation work can cause project delays or errors in the implementation process?	2.90	96.79	High
12	Do you think that the mismatch of the plans with the prepared bills of quantities can cause problems in construction projects?	2.88	95.98	High
13	Has the speed of implementation of the project been slowed down due to the contractor's delay and bad administrative routine?	2.88	95.98	High
27	Was the mold erected well if the bridge was reinforced concrete?	2.84	94.78	High
3	Should everything that is in the schemes be transferred at the implementation stage and large loads of the substrates controlled?	2.81	93.57	High
84	Do you think that the lack of special heavy equipment such as cranes and long vehicles can affect the efficiency and quality of carrying outworks in the bridge?	2.81	93.57	High
11	Do you think that not choosing the right construction system can lead to problems in construction bridge projects?	2.80	93.17	High
26	Do you think that not using modern methods in checking pile loading can cause potential structural problems in the bridge to go undetected?	2.71	90.36	High

Table 4.5: (Cont.) Risk Levels for 17 Items (RW)

Items No.	Problems Causing Risk	Weighted Mean	Percentage Weight	Risk levels
21	During implementation, is the financing of the project delayed due to the country's budget?	2.70	89.96	High
31	Do you think that neglecting quality control and continuous processing of concrete can cause bad quality of the bridge and its deterioration in the long run?	2.69	89.56	High
45	Do you think that making inappropriate decisions when tests fail is the right action?	2.16	71.89	Medium
19	Has the installation of the joists in their location on the bridge pillars been delayed during implementation?	2.08	69.48	Medium
20	Has the manufacture, transportation and lifting of the beams been delayed during implementation?	2.07	69.08	Medium
25	Has the work stopped by the executing party due to the currency difference and the increase in its exchange rate?	2.00	66.67	Medium
37	Were the provided bills of quantities sufficiently accurate?	1.94	64.66	Medium
1	Is there a possibility of devising wrong hypotheses when implementing bridges?	1.55	51.81	Low
15	Is the cost of land acquisition calculated in the project cost?	1.53	57.03	Low

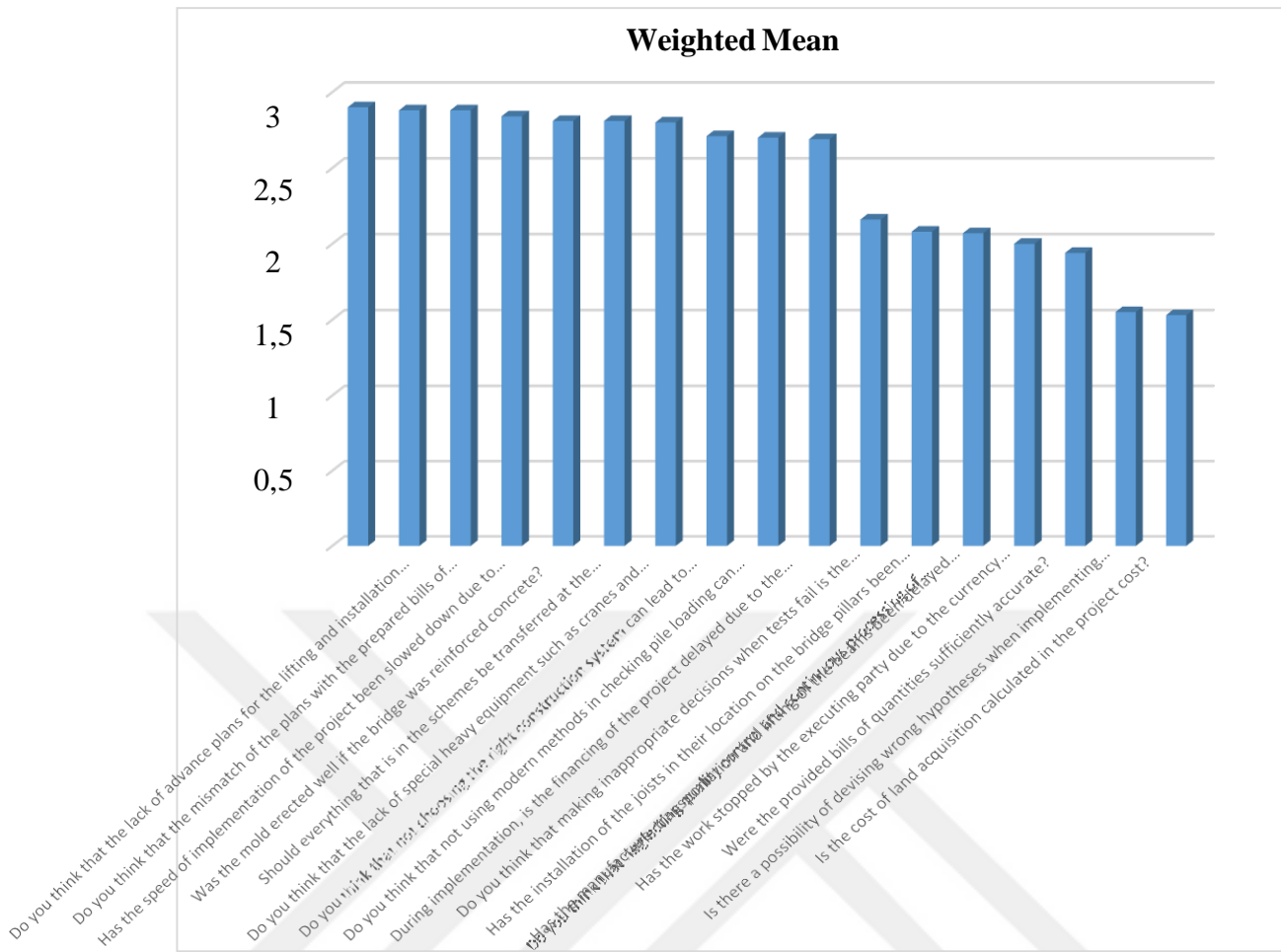


Figure 4.5: Risk levels (RW)

4.6.2 The main causative for the employer

Eight items were selected from appendix (4), because the results related to collecting the opinions of engineers are 38 items, so the researcher relied on some randomly selected samples for each category, in order to know the main cause of each item of questionnaire according to the opinion of the participants. Based on the analysis of results, the following points are concluded:

1. The ratio of 43% for the designer and 20% for the consultant are considered high as the causes of the item (12), which states: "Schemes do not match with the prepared bills of quantities", indicating the importance of enhancing communication between the intended teams.
2. In the item (11), which states: "for not choosing the appropriate structural system." The designer's choice as the main reason was 50%. This indicate that the need to improve the designer's understanding of project requirements

and surrounding circumstances. The consultant as a secondary cause by 21% so his role in providing accurate technical guidance can be enhanced.

3. Based on the results of the item (26), it appears that (49%) to consider the resident engineer as the main reason for not using modern methods in checking the loading of piles, and this percentage is high. It indicates the need to train engineers on the up-to-date technologies. Concerning to the consultant as a secondary cause, the percentage was 36%, so he can play a vital role in providing guidance for the optimal use of methods.
4. Based on the results of the item (21), it appears that the percentage (75%) to view the employer as the main reason for not financing the project due to the country's budget. This percentage considered high, so it is necessary to look for alternative sources of funding or negotiate to improve the budget. The feasibility study department is considered as a secondary cause by 20% and can play a crucial role in providing accurate feasibility studies to ensure the availability of appropriate financial resources.
5. Based on the results of the item (31), 71% of the respondents blamed the resident engineer as the main reason for the lack of emphasis on quality control and continuous treatment of concrete, which is a high percentage indicating the need to strengthen and review quality processes and standards. On the other hand, the consultant received 20% because he plays a main role in providing guidance to improve quality control. Finally, the 7% rating for the employer indicates the importance of continued support for quality control.
6. Based on the results of the questionnaire for the item (37), 50% of the participants considered that the designer was a major reason for the inaccuracy of the bills of quantities submitted, and this indicates the need to improve the process of preparing bills of quantities and clarifying the requirements. The feasibility study section indicated by 24% that it can contribute to providing guidance to ensure the accuracy of quantities. The consultant was 21%, as it can play an important role in ensuring that the quantities are compatible with the plans.

7. With regard to the results of the questionnaire for the item (15), the percentage (60%) of the respondents indicated that the employer was the main cause of the cost of land acquisition, so it is necessary to improve the management of the financial resources of the project. As for the feasibility study department, the percentage was 38% that it has a role in directing the feasibility study more accurately to estimate the cost of land acquisition.
8. Based on the results of the questionnaire for the item (1), 43% of respondents considered the designer to be the main reason for devising wrong hypotheses during the implementation of bridges. This indicates the need to improve and clarify the details of hypotheses. The resident engineer was 33%, so it is possible to contribute to the monitoring and audit of implementation. The consultant was 23% of the ability to play an important role in providing precise guidance for the implementation of bridges.

In conclusion, the researcher believes that each of the above items has a crucial role in enhancing the quality of the plans, providing accurate guidance to the designer, and enhancing the role of the consultant in reviewing and determining the details of the project to improve that in future. It is preferable to discuss these points with the teams and adopt collaborative strategies to ensure compatibility between plans and quantities and to achieve the selection of a suitable construction system for future projects. These findings should also be discussed with stakeholders to ensure better use of pile load inspection methods to enhance the safety of future projects. It is preferable to discuss these findings with all stakeholders to improve the management and channeling of financial resources to ensure the continuity of projects. The researcher recommends that these results be discussed with the relevant parties to enhance quality management and ensure the quality of concrete in projects and to improve the accuracy of bills of quantities and improve their preparation for a better future. As well as to improve the planning and management of land resources to achieve financial balance, to improve the implementation and monitoring of bridges and to ensure the accuracy of hypotheses in future projects.

Table 4.6: The Main Causative According To the Employer (RW)

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)				
			Designer	Advisor	Resident Engineer	Employer	Feasibility Study
12	Mismatch of charts with prepared bills of quantities	2.88	43%	20%	14%	13%	10%
11	Notchoosing the appropriate construction system	2.80	50%	21%	19%	10%	0%
26	Failure to use modern methods in checking the loading of piles	2.71	4%	36%	49%	9%	3%
21	Non-financing of the project due to the country's budget	2.70	%	1%	4%	75%	20%
31	Lack of emphasis on quality control and continuous processing of concrete	2.69	1%	20%	71%	7%	1%
37	Inaccuracies of bills of quantities	1.94	50%	21%	3%	2%	24%
15	Cost of land acquisition	1.71	0%	1%	1%	60%	38%
1	Devising wrong hypotheses when implementing bridges	1.55	43%	23%	33%	0%	1%

4.6.3 The main causative for the executing company

Nine samples were selected from appendix (5), because the results related to collecting the opinions of engineers are 59 items, so the researcher relied on some randomly selected samples for each category, so that the researcher can know the main cause of each item of the questionnaire according to the opinion of the participants. According to the analysis of results, the following points are concluded:

1. Based on the results of the questionnaire for item (83), it seems that the department of planning and occupational safety is the main reason for the lack of advance plans for lifting and installation work by 39%. This indicates that the need to strengthen and improve the planning processes and prepare the necessary plans before the start of the lifting and installation work. The supervising engineer can play a role in following up and monitoring the implementation of the work by 30%. Bad decision-making by contractor indicates that the need to improve decision-making processes to reduce inappropriate circulation by 18%. Structural management can contribute to

improving the overall coordination and organization of the project by 13%. It is preferable to discuss these results with stakeholders to improve planning and implementation processes in future projects.

2. Based on the results of the questionnaire related to the item (13), bad decision-making by the contractor is attributed as the main reason for the slow pace of project implementation as well as bad administrative routine by 40%. This suggests the need to improve the contractor's ability to make effective decisions and better manage routines. Construction management can contribute to the organization and facilitation of implementation processes by 33%. The supervising engineer can play a role in monitoring the progress of the project by 20%. It is preferable to discuss these results with stakeholders to improve workflow and accelerate the implementation of future projects.
3. Based on the results of the questionnaire in item (27), the supervising engineer is considered the main reason of the bad quality and accuracy of the erection of the mold in the case of concrete bridges by 49%. This suggests that moderator monitoring of template installations should be improved and accuracy and quality ensured. The presence of old mechanisms in the projects had an impact on quality by 15%, so more modern mechanisms should be used. Construction management contributes to improving organization and procedures by 14%. Bad decision-making by the contractor requires improving his ability to make effective decisions by 12%. It is essential to discuss these results with all relevant parties to ensure the quality and accuracy of the construction of concrete bridges.
4. Based on the results of the questionnaire for item (3), the supervising engineer is the main reason for not transferring information from the plans in the implementation phase and not controlling the large loads of the piles by 60%. This suggests the need to improve the role of the supervisor in ensuring accurate information transmission and monitoring of processes. Bad contractor decision-making by contractor by 25%, so their ability to make detailed decisions should be improved. Structural management can contribute to improving organization and procedures by 13%. It is important to discuss these results to achieve the best information transfer and control of large loads in future projects.

5. Based on the results of the questionnaire for the item (84), the contractor's financial difficulties are the main reason for the lack of heavy equipment such as cranes and long conveyors by 45%. This indicates the need to provide financial solutions to secure the necessary equipment. The presence of old mechanisms gets 30% which indicates the importance of modernizing the mechanisms to ensure good performance. Bad decision- making by contractor was 18%, requiring improving the contractor's ability to make strategic decisions. Therefore, it is necessary to discuss these results to ensure that the necessary equipment and machinery are in place and that future projects are improved.
6. Based on the results of the questionnaire for item (45), the supervising engineer being the main reason for making inappropriate decisions when there was a failure in the examinations was 70%. This indicates the need to improve the supervising engineer's ability to assess failure and then make appropriate decisions. Construction management was 16% where it can play a vital role in facilitating decision-making processes and supporting the supervisor. Bad decision-making by contractor was 10%, indicating the need to improve their ability to deal with failure and make strategic decisions. Therefore, it is necessary to discuss these results with the concerned parties to improve performance and not respond to failure by making appropriate decisions in future projects.
7. Based on the results of the questionnaire for the item (19), the supervising engineer was the main reason for the delay in installing the joists accurately in their position on the bridge pillars with 34%. This indicates that the role of the admin in directing and monitoring installations should be improved with precision. As for the old mechanisms section, it was 19%, and this requires updating it to achieve greater accuracy in installation. Concerning to bad decision-making by the contractor, it was 18%, which is evidence that he needs to improve his ability to achieve the installations successfully. As for the construction department, it was 17% because it contributes to organizing and facilitating the installation processes. It is essential to discuss these results to improve rigorous joist stabilization processes and ensure better implementation of future projects.

8. According to the results of the questionnaire for item (20), bad decision-making of the contractor is the main reason for the delay in manufacturing, transporting and lifting the beams by 43%. This indicates the need to improve the contractor's ability to make strategic and organizational decisions. As for the contractor's financial difficulties, they were 20%, as they require financial solutions to facilitate the manufacture, transportation and lifting operations. As for the old mechanisms section, it was 18%, so it must be updated to improve performance. It is preferable to discuss these results to enhance contractor capabilities, provide financial support and improve production and transportation processes in future projects.
9. According to the results of the questionnaire for item (25), the contractor's financial difficulties were the main reason by 54% due to the suspension of work by the executing party due to the currency difference in the sense of increasing its exchange rate. This suggests the need to provide financial solutions for the contractor to deal with fluctuations in exchange rates. Bad decision-making by contractor was 30%, this need improving their ability to make proactive decisions to deal with potential changes in the exchange rate. These results should be discussed to improve financial planning to avoid the risk of currency exchange rate changes in future projects.

Table 4.7: The Main Causative for the Executing Company (RW)

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)						
			Construction Management	Supervising Engineer	Bad Decision-Making by Contractor	The Contractor's Financial Difficulties	Difficulty in Preparing Materials	Department of Planning and Occupational	Old Machineries
83	Lack of prior plans for lifting and installation work	2.90	13%	30%	18%	1%	0%	39%	0%
13	The speed of project implementation was slowed down due to contractor delay and bad administrative routine	2.88	33%	20%	40%	3%	0%	4%	0%
27	Bad quality and accuracy of erecting the mold when the bridge is concrete	2.84	14%	49%	12%	6%	0%	4%	15%
3	Not to transfer what is in the plans in the implementation stage and control on large loads of substrates	2.81	13%	60%	25%	1%	0%	1%	0%
84	Lack of special heavy equipment such as cranes and long conveyors	2.81	3%	1%	18%	45%	1%	2%	30%
45	Making inappropriate decisions when tests fail	2.16	16%	70%	11%	0%	0%	3%	0%
19	Delayed installation of joists in their position on the bridge pillars accurately	2.08	17%	34%	18%	3%	1%	9%	19%
20	Delayed manufacturing transportation and lifting of Beams	2.07	10%	6%	43%	20%	0%	3%	18%
25	Stopped of work by the executing party because of the currency difference during the increase in its exchange rate	2.00	1%	0%	30%	54%	8%	7%	0%

4.7 Summary

Analyzing the results of a questionnaire to determine the levels and causes of risk in bridge projects is a vital step in ensuring safety and quality. This analysis enhances our understanding of potential challenges that could impact the project and compromise the safety of users and workers. When distributing the questionnaire to workers and beneficiaries, their observations and opinions regarding various aspects of the project are collected.

Based on the analysis of the data taken from the questionnaire, risk scores and their probability of occurrence are determined. This can help prioritize threats and better allocate resources to deal with them. The analysis also allows identifying the main causes of risk, and this can contribute to taking specific preventive measures to reduce these causes and prevent their recurrence in future projects.

Thus, analyzing the results of the questionnaire contributes to the involvement of all relevant parties and the improvement of administrative and technical decisions. This, in turn, enhances the effectiveness of safety and quality procedures, and ensures that bridge projects are implemented safely and reliably.

5. CONCLUSION, RECOMMENDATIONS AND SUGGESTIONS

5.1 Introduction

This chapter includes the most important conclusions, recommendations and Suggestions for future studies.

5.2 Conclusions

The results of the current study have revealed a series of critical issues that significantly impact the quality and successful implementation of construction projects. These challenges necessitate careful consideration and targeted actions for resolution.

- First, communication and coordination between project teams, particularly designers and consultants, significantly influence the alignment of project plans with corresponding quantities. The mismatch between these elements, as indicated by 43% attributing it to designers and 20% to consultants, underscores the urgency of enhancing inter-team communication.
- Second, the choice of the appropriate structural system is vital to project success. Designers are identified as the primary influencers in this regard, with 50% citing them as a cause. Consequently, there's a need to bolster designers' understanding of project requirements and contextual factors.
- Modern methods for pile load inspection exhibit clear benefits in enhancing structural performance and risk mitigation. These methods need wider adoption across construction projects. Further, securing stable financial backing is imperative to prevent costly project interruptions due to financial constraints.
- Quality control and continuous concrete processing play pivotal roles in ensuring structural integrity and resilience against various loads. It's evident that resident engineers play a significant part in not using modern methods for

pile load inspection (49%). Thus, there's a pressing need for training engineers in the latest technologies.

- The inability to secure project financing, primarily attributed to the employer (75%), underlines the necessity of exploring alternative funding sources or improving budget negotiations. The feasibility study department, considered a secondary cause by 20%, can assist in providing accurate feasibility studies.
- Additionally, there is a critical need for precise bills of quantities and comprehensive plans for lifting and installation work to avoid delays and complications during project execution.
- Finally, addressing poor decision-making and financial difficulties for contractors is vital to maintaining project progress, with contractors needing to strengthen their financial planning capabilities and make proactive decisions, while avoiding inappropriate schedules, inadequate planning, and non-compliance.

5.3 Recommendations

The recommendations that provide a comprehensive and clear overview can serve as a framework for improving project management and implementation in engineering projects. To address these findings, several recommendations are put forth.

- First and foremost, fostering collaboration and communication among project teams should be prioritized. Improved inter-team coordination and alignment of plans and quantities are essential for project success.
- Investing in continuous training and knowledge updates for engineers, particularly resident engineers, is vital to encourage the adoption of modern methods for load inspection and ensure project safety and quality.
- Establish a comprehensive Project Management system using dedicated software. This measure will help enhance project monitoring and management effectively, ensuring the successful achievement of its objectives while minimizing potential risks and issues.

- Establish a comprehensive approach that integrates monitoring, reporting, and proactive precautionary measures. This approach will contribute to the effective management of projects, ensuring they meet their objectives efficiently while minimizing risks and issues.
- Diversifying funding sources, such as exploring alternative financing options and improving budget negotiation strategies, can mitigate the impact of financial constraints on project progress.
- Strengthening quality control processes, ensuring continuous concrete treatment, and enhancing the accuracy of bills of quantities are fundamental steps to improve project quality and consistency.
- Effective project management practices and informed decision-making are essential to enhance project efficiency and timeliness. Contractors and engineers should be encouraged to make proactive decisions and provide precise guidance for project implementation. Furthermore, rigorous planning and monitoring of lifting and installation work can enhance accuracy and efficiency. Investing in modern equipment and machinery can address financial difficulties faced by contractors and ultimately improve project performance.
- Finally, supervising engineers should receive additional training to assess failures and make appropriate decisions, contributing to better project outcomes.

These recommendations should be acted upon by relevant stakeholders to improve project management and implementation in the future.

5.4 Suggestions for Future Studies

There are still many studies that have not been studied, and the researcher suggests some important studies that reduce the risks of bridge projects in the future, and these studies include:

1. Improving risk analysis techniques in bridge projects: an applied case study.
2. The use of artificial intelligence techniques in analyzing and estimating the risks of bridge projects.

3. Develop risk cost analysis models in bridge projects and assess potential returns.
4. Improving the sustainability and maintenance of railway bridges through risk analysis and assessment.
5. Building bridge resilience: an effective reporting system for safety and risk management



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APPENDICES

Appendix (1): Initial Model of the Problems Posed To the Researcher by Expert Engineers

No.	Problems that caused the risks faced by engineers before and during Implementation
1.	Devising wrong hypotheses when implementing bridges.
2.	Make frequent design changes during implementation.
3.	Referring projects to companies that do not have sufficient experience in the implementation of bridges.
4.	Errors in design and construction which lead that the bearing capacity is below the designed limit.
5.	High levels of water, especially in winter.
6.	Congestion, changing the lanes and moving to a higher ground level.
7.	Use old charts.
8.	Expropriations of land on which the bridge is construct.
9.	Damage to the structural elements of the bridges as a result of earthquake, separation or soil liquefaction.
10.	Insufficient considerations for plant wealth at the implementation site.
11.	Adopting previous designs of the classical type and not adopting modernity in the design of modern bridges that are with architectural designs and masterpieces.
12.	Most of the risks before the implementation of bridges are related to the security situation at the site.
13.	Ability of the owner.
14.	Ability of the contractor.
15.	Impetuosity of newly graduated engineers and the inexperienced and their presences in places where there is no need for their presence, especially with the lack of safety means.
16.	Collapse of bridge openings due to slipping from their bases.
17.	Collapse and tilt of the bases due to lack of shear or bending ability.
18.	The distance of the site from the construction materials.
19.	Delayed approval procedures by the government.
20.	Delayed installation of joists in their position on the bridge pillars accurately.
21.	Delayed manufacturing, transportation and lifting of beams.
22.	Delay in resolving correspondence in determining the location of bridges.
23.	Delay the approval permits for project.
24.	Establishing a nearby department for resident engineer with no overlap with the site's work.
25.	Conflict with other facilities (oil pipelines, communication lines, sewage and electricity).

26.	Exposure of bridges to fire risks resulting from the use of oxygen torch during metal cutting
27.	Exposure of workers or engineers to gases resulting from epoxy materials, paints and dyes
28.	Exposure of workers or engineers for drowning.
29.	Exposure of workers to electric shocks as a result of the use of welding machines, lighting and punching
30.	Exposure to running over by large machinery and equipment that carry out excavation, burial and lifting of materials
31.	Falling from the top of the bridge parts such as columns, main bridges and the bridge deck-
32.	Change the design of bridge before execution due to unexpected things
33.	Changes in the project such as deletion and creation (change orders).
34.	Cost of overtime for the project
35.	Cost of materials and equipment
36.	Cost of project design
37.	Damage of the bridges which designed with flexibility
38.	The contractor's delay for any reason such as: lack of engineering staff, surveyors and skilled workers, delay in advances, bad weather or any other emergency.
39.	Demolition or collapse of the bridge due to failure to take the necessary measures to dig the piles
40.	Stopped of financial funding
41.	Stopping the work by the executing party due to the currency difference during the increase in its exchange rate
42.	Stopping the project due to unforeseen accidents (war, coronavirus, weather conditions)
43.	The occurrence of decay or isolation with concrete
44.	The occurrence of problems during implementation caused delays and thus increases the cost of implementation
45.	Accidents caused by human error and construction equipment
46.	Pulling of joists due to overloading or unexpected loads on the bridge
47.	The bad choice of place in terms of its connection to the road system leading to it, so that it does not cause traffic momentum beyond it.
48.	The bad choice of type of the engineering contract.
49.	The bad choice of type of engineering contract.
50.	The bad preparation of project statements.
51.	The bad planning and mismatch of the plans with the reality of the situation.
52.	The bad design based on assumptions that may be realistic and may be far from reality.
53.	The bad administrative routine such as delayed examinations and some official correspondence related to implementation, which can only be decided by an official letter and inaccuracy of laboratories
54.	The bad processing of specialized installation equipment
55.	Mistreatment of citizens near the site with the project management.
56.	Miscalculation of schemes with reality
57.	The bad implementation of tablet substrates
58.	Inaccuracy in erecting the mold when the bridge is concrete

59.	The bad excavations of foundations and deep piles that may reach a depth of 50 meters.
60.	the bad quality of iron, the materials of concrete mix, type of felts strength and strength of joists according to the required specification
61.	Difficulty of understanding with the beneficiary
62.	The difficulty of implementation in the river basin (in the presence of water)
63.	Rising water levels while pouring column bases
64.	Weak reports of investigations about the ability of the soil to withstand the weight.
65.	The working pressure of officeholder to the speed of delivery so that gets crowded.
66.	Narrow and unrehabilitated roads
67.	Weather conditions and natural disasters during implementation
68.	Environmental conditions and determinants surrounding the project implementation area
69.	Not to conduct laboratory tests during the preparation of materials before the implementation of any part of project
70.	Failure to take into account the path of public services and the interference of the bridge with these paths when implementing
71.	Not choosing the right materials
72.	Failure to choose the appropriate site for the construction of bridge
73.	Not choosing the right structural system
74.	Not using modern methods in the implementation of river pillars and columns
75.	Not using modern methods in checking the loading of piles
76.	The lack of use of modern methods in pouring the surface of bridges and the lack of equipment and tools for them
77.	Not taking into account salt water
78.	Not taking into account the presence of groundwater
79.	Not taking into account (heights and electric shocks)
80.	Not taking into account the lengths of concrete joists
81.	Failure to take into account future landings in the area of approaches
82.	Not taking into account the depth of the river
83.	Not taking into account the large number of car accidents
84.	Non-compliance with schemes that cause executor staff errors
85.	Inattention to proper placement of joists
86.	Lack of attention to safety measures when working on Project
87.	Lack of emphasis on quality control and continuous processing of concrete
88.	Lack of good coordination of the transport of materials to the site when the part timeline approaches
89.	Lack of careful care of the expansion joints during the implementation of the pillow area under the joists
90.	Not installing rails and heights safely and providing protective barriers for workers
91.	Failure to prepare materials in the required time
92.	Failure to determine levels correctly
93.	Failure to determine the route of transporting materials and equipment from workshops and warehouses to the work site

94.	Not allocating a central mixer close to the site and preparing roads, so that the processing of concrete is not delayed.
95.	Not putting qualified engineers in sensitive parts
96.	Mismatch the scheduling with Bills of prepared quantities
97.	The lack of convergence of bridge designs with the location of the bridge and the verification of the soil and slope that determines the speed and shape of bridges of importance
98.	Not to assign a specialized surveying team to bridges because the work is usually done from both sides and must meet with integrity
99.	The project was not funded due to the country's budget
100.	Failure to carry out the work of pouring concrete parts correctly
101.	Not being careful about falling materials from above
102.	Lack of caution during bridge construction operations to avoid overloading them with axial loads that pose a risk to worker safety
103.	Lack of caution in earthen excavations.
104.	Lack of skilled manpower.
105.	Lack of expertise among the executing engineers.
106.	Lack of specialized cadres, experience of executors, and failure to adopt appropriate construction methods for the implementation of bridges
107.	Insufficient space in the bank to transport materials
108.	Not having enough time to prepare the requirements for starting the project
109.	Not having enough time to review detailed charts and drawings
110.	Lack of specialized construction and import materials for the implementation of bridges.
111.	Failure to provide safety programs for workers on the construction site to ensure their safety.
112.	Inaccuracy of surveying works.
113.	Inaccuracy of hydraulic information.
114.	Inaccurate cost estimate required.
115.	Inaccuracies of bills of quantities.
116.	Failure to conduct soil investigations at the specified location of bridge
117.	Lack of readiness of the land for the implementation of the project
118.	Not monitoring the deviation of the piles periodically and take the necessary measures in case of any unacceptable inclination.
119.	Not moving the schemas in the implementation phase.
120.	Lack of control of large loads starting from the piles and allowing subsidence.
121.	Lack of infrastructure connected to the implementation site.
122.	Lack of contracting with consulting bodies to solve problems and thus give wrong decisions.
123.	Lack of advance plans for lifting and installation work.
124.	Lack of plans for infrastructure such as water, electricity, communications and sewage.
125.	Lack of special heavy equipment such as cranes and long conveyor.
126.	Lack in engineers and supervisors of safety department in executive projects.
127.	The obvious impact of environmental factors that lead to corrosion of steel in the superstructure and infrastructure.
128.	Absences of workers and sudden breakdown of machinery.

129.	Surfaces' failure and deflection of the superstructure in both longitudinal and transverse directions.
130.	Failure of bridge bases that retaining the roof.
131.	Impact of flooding in the spring season, which leads to the washing away of all equipment despite precautionary measures.
132.	Lack of manpower in the city where project is implemented.
133.	Cost of land acquisition.
134.	Over-design by placing a high-risk factor than international standards.
135.	Exaggerating the quantities and diameters of iron used in concrete structures.
136.	Exaggerating the sizes of pillars, columns and joists.
137.	Problems in cash flow.
138.	The presence of mines or unexploded rockets and this happens when the destroyed bridges are built.
139.	The presence of waste at site of work.
140.	The presence of encroachments on both sides of the river, which hinders the survey work.
141.	The presence of environmental, social and technical conflicts.
142.	The presence of infrastructure beams.
143.	The presence of old beams that oppose the implementation of piles.
144.	The presence of hidden obstacles according to the reality of the site and not mentioned in design plans.
145.	The presence of opposition from the people who are near the site.

Appendix (2): The personal information of the sample members

Samples No.	The workplace (department) or company	Academic certificate	Engineering specialization	Years of Experience	The job position you are currently in
1	Free business	B. Ch	Civil	25	Project Manager
2	Free business	M.A.	Civil	20	Project Manager
3	Free business	M.A.	Civil	5	Engineer site
4	Free business	M.A.	Civil	25	Project Manager
5	Free business	M.A.	Civil	15	Project Manager
6	Free business	B. Ch	Civil	6	Engineer site
7	Ministry of transport	B. Ch	Civil	15	Engineer site
8	General Company for Design and Project Implementation	B. Ch	Civil	16	Project Manager
9	Free business	B. Ch	Civil	19	Project Manager
10	Roads and Bridges	B. Ch	Civil	22	Project Manager
11	University of Babylon	B. Ch	Material	18	Project Manager
12	Engineering Department at the Ministry of Finance	B. Ch	Building & Construction	30	Project Manager
13	Municipalities	B. Ch	Building & Construction	17	Project Manager
14	The Company of Modon for Estste Development	B. Ch	Civil	5	Project Manager
15	Tikrit University	B. Ch	Civil	25	Project Manager
16	Provincial Council	B. Ch	Civil	15	Project Manager
17	Salahaldeen Governorate Office	B. Ch	Civil	6	Project Manager
18	Anbar Governorate Office	B. Ch	Civil	15	Project Manager
19	Ministry of Oil	B. Ch	Civil	7	Engineer site
20	Trans Dejla Company	B. Ch	Civil	13	Project Manager

Samples No.	The workplace (department) or company	Academic certificate	Engineering specialization	Years of Experience	The job position you are currently in
21	Company for General Contracting	B. Ch	Civil	5	Engineer site
22	Company of Al-ezza	B. Ch	Civil	14	Project Manager
23	Ministry of Communications	B. Ch	Civil	22	Project Manager
24	Tikrit University	B. Ch	Civil	30	Project Manager
25	Project of Bdour Baghdad	B. Ch	Highway	12	Project Manager
26	Ministry of Construction & Housing	B. Ch	Civil	23	Project Manager
27	Ministry of Higher Education	B. Ch	Building & Construction	14	Project Manager
28	Ministry of Construction & Housing	B. Ch	Civil	19	Engineersite
29	Free business	B. Ch	Civil	5	Engineer site
30	Tikrit University	B. Ch	Civil	20	Project Manager
31	Projects and Engineering Services Section / Saladeen Health Department	B. Ch	Civil	9	Project Manager
32	Power china	B. Ch	Civil	7	Project Manager
33	China Power Gina Company	B. Ch	Civil	10	Project Manager
34	Tikrit University	B. Ch	Building & Construction	28	Project Manager
35	Al-Najaf Construction Laboratory	B. Ch	Civil	8	Project Manager
36	Ministry of Construction and Housing	B. Ch	Civil	22	Project Manager
37	Free business	B. Ch	Building & Construction	4	Engineer site
38	Al-Zumrrd Company	B. Ch	Civil	3	Project Manager
	Projects &	B. Ch			Engineer

Samples No.	The workplace (department) or company	Academic certificate	Engineering specialization	Years of Experience	The job position you are currently in
39	Engineering Services Section		Civil	7	site
40	Ministry of Construction and Housing	B. Ch	Civil	25	Project Manager
41	Ministry of Electricity	B. Ch	Civil	11	Project Manager
42	Ministry of Defense	B. Ch	Civil	5	Designer
43	Free business	B. Ch	Civil	10	Engineer site
44	Free business	B. Ch	Survey	7	Engineer site
45	Ministry of Agriculture	B. Ch	Highway	5	Engineer site
46	Tikrit University	B. Ch	Mechanical	24	Engineer site
47	Baghdad Company for General Contracting	B. Ch	Civil	9	Planning Engineer
48	Ministry of Industry	B. Ch	Mechanical	12	Engineer site
49	Baghdad Company for General Contracting	B. Ch	Civil	42	Planning Engineer
50	Petroleum Company	M.A.	Structural	20	Project Manager
51	Najaf Governorate Office / Reconstruction Authority	Ph.D.	Mechanical	15	Engineersite
52	Tikrit University	Ph.D.	Structural	36	Project Manager
53	Directorate of Education of Babylon / School Buildings	Ph.D.	Structural	8	Engineersite
54	Al-masar Company	M.A.	Structural	3	Engineer site
55	Directorate of Roads and Bridges of Wasit	M.A.	Highway	15	Engineersite
56	UNDP	M.A.	Structural	13	Project Manager
57	Free business	M.A.	Structural	18	Project

Samples No.	The workplace (department) or company	Academic certificate	Engineering specialization	Years of Experience	The job position you are currently in
					Manager
58	Tikrit University	M.A.	Highway	13	Project Manager
59	Free business	M.A.	Highway	5	Engineer site
60	Faculty of Engineering	M.A.	Structural	20	Project Manager
61	Tikrit University	M.A.	Structural	15	Project Manager
62	Department of Health / Engineering Projects Section	M.A.	Structural	15	Project Manager
63	Free business	M.A.	Structural	7	Project Manager
64	Free business	M.A.	Structural	18	Project Manager
65	Free business	M.A.	Structural	10	Project Manager
66	The Malaysian Company	M.A.	Structural	5	Planning Engineer
67	Ministry of Construction and Housing	M.A.	Structural	14	Project Manager
68	Ministry of Higher Education	M.A.	Highway	12	Project Manager
69	Consulting Office	M.A.	Structural	16	Project Manager
70	Company of Petrojaina/ China	M.A.	Mechanical	17	Project Manager
71	Karbala Governorate Local Administration	M.A.	Structural	15	Project Manager
72	Free business	M.A.	Structural	8	Designer
73	Tikrit University	M.A.	Structural	23	Planning Engineer
74	Baghdad Province	M.A.	Structural	20	Planning Engineer
75	Anbar Education Directorate	M.A.	Structural	10	Project Manager
76	Directorate of School Buildings	M.A.	Structural	11	Project Manager
77	Roads and Bridges	M.A.	Structural	25	Project Manager
78	Tikrit University	M.A.	Structural	15	Designer

Samples No.	The workplace (department) or company	Academic certificate	Engineering specialization	Years of Experience	The job position you are currently in
79	Free business	M.A.	Structural	11	Project Manager
80	Free business	M.A.	Structural	11	Engineer site
81	Ministry of Electricity/ Department Engineering Projects	M.A.	Building & Construction	4	Engineersite
82	Anbar Governorate Office	M.A.	Structural	5	Engineer site
83	Free business	B. Ch	Survey	9	Engineer site

Appendix (3) Risk Levels

No	Problems Causing Risk	Yes	Sometime	No	Weighted Mean	Weight Percent	Risk Levels
1.	Is there a possibility of devising false hypotheses when implementing bridges?	3	40	40	1.55	51.81	Low
2.	Should frequent design changes be made during implementation?	9	64	10	1.99	66.27	Medium
3.	Should everything in the plans in the implementation and control phase be transferred to the large loads of piles?	71	8	4	2.81	93.57	High
4.	Is there a possibility for the project owner to provide adequate resources and support in terms of design and construction?	52	28	3	2.59	86.35	High
5.	Can the executing entity (contractor) fully meet the requirements of the project?	47	30	6	2.49	83.13	High
6.	Does the project require additional work?	35	46	2	2.40	79.92	High
7.	Is the cost of materials and equipment reasonable relative to the size of the project? Does the lack of sufficient time to prepare the necessary supplies affect the start time of the project?	49	30	4	2.54	84.74	High
8.	Is the speed of project implementation affected by the distance of the site from construction materials?	41	36	6	2.42	80.72	High
9.	Is hydraulic information accurately available in bridge projects?	43	22	18	2.30	76.71	Medium

10.	Do you think that not choosing the right construction system can lead to problems in bridge projects?	22	40	21	2.01	67.07	Medium
11.	Do you think that the mismatch of the plans with the prepared bills of quantities can cause problems in construction projects?	72	5	6	2.80	93.17	High
12.	Has the speed of project implementation been slowed down due to contractor delays and bad administrative routine?	75	6	2	2.88	95.98	High
13.	Is the cost of designing the project reasonable relative to the size of the project you supervised?	74	8	1	2.88	95.98	High
14.	Is the cost to land acquisition calculated within the project cost?	38	33	12	2.31	77.11	Medium
15.	Are modern means used in pouring the surface of bridges and providing the necessary equipment and tools?	6	32	45	1.53	57.03	Low
16.	Are previous designs of the classic type adopted in the design of modern bridges?	46	28	9	2.45	81.53	High
17.	Are the old schemes used in the design of modern bridges?	37	39	7	2.36	78.71	High
18.	Is it well coordinated when transport the materials to the site when the paragraph timeline approaches?	39	37	7	2.39	79.52	High
19.	Is the installation of joists delayed in their location on the pillars of the bridge accurately during implementation?	18	54	11	2.08	69.48	Medium
20.	Is the manufacture, transportation and lifting of the beams delayed during implementation?	16	57	10	2.07	69.08	Medium

21.	Is the financing of the project delayed during implementation due to the country's budget?	60	21	2	2.70	89.96	High
22.	Is a central mixer close to the site allocated?	55	24	4	2.61	87.15	High
23.	Is the design changed before execution due to unexpected conflicts?	33	43	7	2.31	77.11	Medium
24.	Do you think that an inaccurate cost estimate can cause a project delay or exceed the budget allocated for the construction of the bridge?	57	20	6	2.61	87.15	High
25.	Is work stopped by the executing party due to the currency difference and the increase in its exchange rate?	20	43	20	2.00	66.67	Medium
26.	Do you think that not using modern methods in checking pile loading can cause potential structural problems in the bridge to go undetected?	63	16	4	2.71	90.36	High
27.	Is the mold well erected in case the bridge is reinforced concrete?	72	9	2	2.84	94.78	High
28.	Have implementation difficulties been encountered in the river basin due to the presence of water?	47	27	9	2.46	81.93	High
29.	Have there been changes in the project from deletion or creation?	58	22	3	2.66	88.76	High
30.	Have there been problems in the construction bridge projects due to non-compliance with the prepared plans?	40	26	17	2.28	75.90	Medium
31.	Do you think that a lack of emphasis on quality control and continuous processing of concrete can cause bad bridge quality and long-term deterioration?	61	18	4	2.69	89.56	High

32.	Was there a bad preparation of the architectural and structural design of the bridge?	23	46	14	2.11	70.28	Medium
33.	Was there a mis preparation of the project's statements?	29	44	10	2.23	74.30	Medium
34.	Was there bad planning and mismatch of the plans during the implementation of the bridge?	24	41	18	2.07	69.08	Medium
35.	Was there a mis design based on assumptions that may be realistic and may be far from reality during the implementation of the bridge?	23	37	23	2.00	66.67	Medium
36.	Was there pressure from the Administration to speed up the completion?	58	22	3	2.66	88.76	High
37.	Were the bills of quantities provided sufficiently accurate?	19	40	24	1.94	64.66	Medium
38.	Are there problems with the cash available for the project?	45	32	6	2.47	82.33	High
39.	Are large loads from piles controlled and allowed for landing in bridge projects?	53	24	6	2.57	85.54	High
40.	Are hidden obstacles at the site that are not mentioned in the design plans detected in the bridge projects?	43	33	7	2.43	81.12	High
41.	Is a high safety factor of the international standard placed in bridge projects?	47	22	14	2.40	79.92	High
42.	Is there enough time to review detailed plans and drawings in bridge projects?	48	25	10	2.46	81.93	High

43.	Do you think that having a contract with consultants to solve problems can contribute to making correct decisions and avoiding technical and engineering problems in the process of implementing bridges?	43	30	10	2.40	79.92	High
44.	Is there an exaggeration in the quantities and diameters of iron used in concrete structures as well as in the sizes of piles, columns and joists?	29	35	19	2.12	70.68	Medium
45.	Do you think that making inappropriate decisions when tests fail is the right procedure?	27	42	14	2.16	71.89	Medium
46.	Do you think that occupational safety problems can cause serious work accidents and a negative impact on the work team and bridge implementation?	51	25	7	2.53	84.34	High
47.	Do you agree that newly graduated and inexperienced engineers are reckless, in unnecessary places and without means of safety?	47	28	8	2.47	82.33	High
48.	Do you think that the breakdown of the bridge openings due to slipping from their bases can happen?	56	20	7	2.59	86.35	High
49.	Do you agree to establish a resident engineer department nearby without interfering with the site works?	41	30	12	2.35	78.31	High
50.	Do you feel that bridges are exposed to fire risks caused by the use of an oxygen torch while cutting metal?	61	15	7	2.65	88.35	High

51.	Do you think workers or engineers are exposed to gases from epoxy materials, paints and dyes?	58	20	5	2.64	87.95	High
52.	Do you think that workers or engineers are at risk of drowning?	46	25	12	2.41	80.32	High
53.	Do you think that workers are exposed to electric shocks as a result of the use of welding, lighting and punching machines?	51	25	7	2.53	84.34	High
54.	Are workers or engineers exposed to vehicular accidents by large machinery and equipment that carry out excavation, burial and lifting of materials?	43	28	12	2.37	79.12	High
55.	Do you think that providing the necessary safety measures, such as the presence of protective barriers and the availability of safety belts, can reduce the risk of falling from the top of the bridge such as columns, main bridges and the bridge deck?	66	15	2	2.77	92.37	High
56.	Do you think that it is possible for the bridge to collapse due to the lack of action to dig the piles?	51	28	4	2.57	85.54	High
57.	Do you think the bad administrative red tape such as delayed testing and laboratory inaccuracies affect bridge safety?	61	15	7	2.65	88.35	High
58.	Do you think that the bad equipment processing of specialized installation equipment can affect the quality of the bridge?	58	20	5	2.64	87.95	High
59.	Do you think that the bad implementation of panel piles can cause problems in the bridge?	46	30	7	2.47	82.33	High

60.	Do you think that bad accuracy of wiping works can affect the stability of the bridge?	54	21	8	2.55	85.14	High
61.	Do you think that the bad quality of iron, concrete mix materials, the type of strength of the panels and the strength of the joists are dangerous for the bridge?	53	24	6	2.57	85.54	High
62.	Do you think that the reports of soil tolerance can affect bridge stability?	55	20	8	2.57	85.54	High
63.	Do you think that not conducting laboratory tests during the preparation of materials before the implementation of any part can affect the quality of the bridge?	61	18	4	2.69	89.56	High
64.	Do you think that not counting the path of public services and the interference of the bridge with this path when implementing can cause problems with the bridge?	59	20	4	2.66	88.76	High
65.	Do you think that the choice of incorrect materials can affect the quality and durability of the bridge?	66	15	2	2.77	92.37	High
66.	Do you think that improper placement of joists can lead to problems with bridge stability?	46	25	12	2.41	80.32	High
67.	Do you think that not paying attention to safety measures while working on the project can put workers and the bridge at risk?	56	20	7	2.59	86.35	High

68.	Do you think that not taking careful care of the expansion joints during the implementation of the area of pillows under the joists can lead to problems with the stability of the bridge?	41	30	12	2.35	78.31	High
69.	Do you think that not installing rails and heights securely and not providing protective barriers for workers can put them at risk while working on the bridge?	45	28	10	2.42	80.72	High
70.	Do you think that the failure to prepare the material on time can affect the correct execution of the bridge and in the required quality?	49	24	10	2.47	82.33	High
71.	Do you think that not determining the route of transporting materials and equipment from workshops and warehouses to the site can cause delays and difficulties in the implementation of the bridge?	51	20	12	2.47	82.33	High
72.	Do you think that not training and hiring competent engineers in sensitive vertebrae can affect the quality of the implementation of the bridge?	55	20	8	2.57	85.54	High
73.	Do you think that not carrying out the work of pouring concrete parts correctly can affect the strength and stability of the bridge?	61	15	7	2.65	88.35	High

74.	Do you think that not paying attention to the fall of materials from above can cause injuries to workers and damage to equipment or other equipment?	66	12	5	2.73	91.16	High
75.	Do you think that not being careful during the execution processes on bridges can cause them to be overloaded with axial loads and thus pose a risk to the safety of the bridge?	63	11	9	2.65	88.35	High
76.	Do you think that the lack of skilled labor can negatively affect the quality of execution of works on bridges and cause problems in the future?	56	22	5	2.61	87.15	High
77.	Do you think that the lack of experience of the executing engineers can cause errors in the process of implementing bridges and not achieving the required standards?	71	7	5	2.80	93.17	High
78.	Do you think that the lack of specialized staff, the lack of experience of the implementers and the adoption of inappropriate construction methods can affect the quality and stability of the constructed bridges?	67	10	6	2.73	91.16	High
79.	Do you think that the lack of some specialized construction and import materials can affect the quality and durability of bridges?	65	12	6	2.71	90.36	High
80.	Do you think that the lack of complete and appropriate safety programs at the workplace can affect the safety of workers and expose them to risks?	46	20	17	2.35	78.31	High

81.	Do you think that not conducting careful soil checks at the specific location of the bridge can affect the stability of the bridge and cause problems in the future?	69	10	4	2.78	92.77	High
82.	Do you think that not periodically monitoring the deviation of the piles and taking the necessary measures in case of any unacceptable tilt can affect the stability of the bridge and pose a risk to users?	70	9	4	2.80	93.17	High
83.	Do you think that the lack of advance plans for the lifting and installation work can cause project delays or errors in the implementation process?	77	4	2	2.90	96.79	High
84.	Do you think that the lack of heavy equipment such as cranes and long conveyors can affect the efficiency and quality of carrying out works in the bridge?	72	6	5	2.81	93.57	High
85.	Do you think that the absence of workers and sudden breakdown of machinery can lead to delays in the implementation of bridges and negatively affect the quality of work?	54	24	5	2.59	86.35	High
86.	Do you think that the failure of roof bridge bases can lead to the instability of bridges and increase the risk of their collapse?	39	30	14	2.30	76.71	Medium
87.	Do you think that the presence of old beams that oppose the work of the implementation of the piles can cause difficulty in the implementation of bridges?	41	22	20	2.25	75.10	Medium

88.	Do you think that referring projects to companies that do not have sufficient experience in the implementation of bridges can lead to inadequate implementation and bad quality of bridges?	47	22	14	2.40	79.92	High
89.	Do you think that the collapse and tilt of the bases due to the lack of shear or bending ability can cause a negative impact on the stability and integrity of bridges?	59	17	7	2.63	87.55	High
90.	Do you think that damage to bridges designed with flexibility can reduce the life of bridges and increase maintenance costs?	46	20	17	2.35	78.31	High
91.	Do you think that stopping financial funding can negatively affect the implementation of bridges and delay or cancel them completely?	46	26	11	2.42	80.72	High
92.	Do you think that the occurrence of decay or isolation in concrete can adversely affect its stability and durability?	41	28	14	2.33	77.51	Medium
93.	Do you think that pulling joists due to overloads or unexpected overloads on a bridge can seriously damage the bridge and increase the risk of it collapsing?	59	18	6	2.64	87.95	High
94.	Do you think that a bad choice of assignment method can lead to problems in the implementation of bridges and increase project costs and delays?	38	30	15	2.28	75.90	Medium

95.	Do you think that the poor choice of the type of engineering contract can cause a lack of clarity of the responsibilities and obligations of the parties involved in the implementation of the bridge?	46	27	10	2.43	81.12	High
96.	Do you think that not choosing the right location for the construction of the bridge can lead to problems with the stability of the foundations and a negative impact on the durability of the bridge?	56	15	12	2.53	84.34	High
97.	Do you think that not using modern methods in the implementation of river pillars and columns can affect the quality of the bridge and its ability to withstand loads?	51	25	7	2.53	84.34	High

Appendix (4): The Main Reason for the Employer

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)				
			Designer	Advisor	Resident Engineer	Employer	Feasibility Study
1	Inventing wrong assumptions when implementing Bridges	1.55	43%	23%	33%	0%	1%
2	Making frequent changes to the design during Implementation	1.99	36%	21%	30%	11%	1%
4	The ability of the owner to provide resources and adequate support to the design and construction Authority	2.59	1%	4%	7%	76%	11%
6	The cost of overtime of the project	2.40	11%	11%	33%	29%	16%
10	Inaccuracy of hydraulic information	2.01	44%	19%	16%	9%	13%
11	Failure to choose the appropriate construction system	2.80	50%	21%	19%	10%	0%
12	Failure to match the plans with the prepared bills of quantities	2.88	43%	20%	14%	13%	10%
14	The cost of designing the project relative to its size	2.31	33%	10%	1%	33%	23%
15	The cost of owning the land	1.71	0%	4%	3%	57%	36%
17	Adopting previous designs of the classical type and not adopting modernity in the design of modern bridges that are of architectural designs and masterpieces	2.36	64%	7%	6%	21%	1%
21	Not financing the project due to the country's budget.	2.70	0%	1%	4%	75%	20%
23	Change the design before implementation due to unexpected conflicts	2.31	33%	19%	16%	21%	11%
24	Inaccuracy of estimating of the required cost	2.61	21%	19%	11%	13%	36%
26	Failure to use modern methods in checking the loading of piles	2.71	4%	36%	49%	9%	3%
29	Changes in the project such as deleting and creating (change orders)	2.66	21%	9%	43%	20%	7%
31	Lack of emphasis on quality control and continuous treatment of concrete	2.69	1%	20%	71%	7%	1%
32	Bad preparation of architectural and structural design	2.11	76%	7%	1%	7%	9%
33	Bad preparation of project statements	2.23	23%	14%	24%	21%	17%
34	Bad planning and mismatch of plans with the reality of the situation	2.07	43%	10%	19%	13%	16%

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)				
			Designer	Advisor	Resident Engineer	Employer	Feasibility Study
35	Bad design on the basis of assumptions that may be realistic and may be far from reality	2.00	69%	7%	% 1	% 15	% 7
36	Pressure of work from leadership to speed of completion so that crowding occurs	2.66	6%	7%	39%	43%	6%
37	Inaccuracy of bills of quantities	1.94	% 50	% 21	% 3	% 2	% 24
38	Problems in cash flow that available to the project	2.47	7%	4%	10%	71%	7%
40	The presence of hidden obstacles according to the reality of the site and not mentioned in the designplans	2.43	39%	10%	16%	16%	20%
41	Exaggerating the increase in the safety factor	2.40	66%	17%	13%	3%	1%
43	Lack of contracting with consulting bodies to solve problems, thus giving wrong decisions	2.40	4%	7%	11%	69%	9%
44	Exaggerating the quantities and diameters of iron used in concrete structures, as well as exaggerating the sizes of pillars, columns and joists	2.12	66%	11%	16%	4%	3%
46	Problems in occupational safety	2.53	0%	4%	60%	29%	7%
88	Referring projects to companies that do not have sufficient experience in the implementation of bridges	2.40	1%	10%	10%	71%	7%
89	Collapse and tilt of bases due to lack of shear or bending ability	2.63	44%	13%	40%	0%	3%
90	Damage to bridges designed with flexibility	2.35	51%	11%	33%	3%	1%
91	Cessation of financial funding	2.42	0%	0%	14%	71%	14%
92	The occurrence of decay or isolation with concrete	2.33	4%	4%	86%	1%	4%
93	Pulling of joists due to excessive or unexpected loads on the bridge	2.64	43%	13%	37%	1%	6%
94	Bad choice of referral method	2.28	0%	13%	14%	60%	13%
95	Bad selection of the type of engineering contract	2.43	0%	20%	13%	54%	13%
96	Failure to choose the appropriate site for the construction of the bridge	2.53	16%	29%	9%	24%	23%
97	Failure to use modern methods in the implementation of river pillars and columns	2.53	14%	34%	39%	7%	6%

Appendix (5): The Main Causative for the Executing Company

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)						
			Construction Management	Supervising Engineer	Bad Decision-Making by Contractor	The Contractor's Financial Difficulties	Difficulty in Preparing Materials	Department of Planning and Occupational Safety	Old Machineries
3	Not transferring what is in the plans through implementation stage and controlling the large loads of the pillars	2.81	13%	%60	%25	%1	%0	1%	%0
5	The ability of the executing entity (contractor) to achieve the requirements of the project	2.49	4%	7%	24%	43%	0%	16%	6%
7	The cost of materials and equipment related to the size of the project	2.54	4%	1%	21%	39%	19%	10%	6%
8	Lack of sufficient time to prepare the requirements for starting the project	2.42	17%	3%	33%	6%	3%	39%	0%
9	The speed of implementation was affected due to the distance of the site from the construction materials	2.30	19%	3%	16%	4%	36%	20%	3%
13	The speed of project implementation is subject to slow down due to contractor delay and bad administrative routine	2.88	%33	%20	%40	3%	0%	%4	0%
16	Not using modern methods in casting the surface of bridges and the lack of equipment and tools for them	2.45	9%	14%	20%	29%	7%	%1	20%
18	Lack of good coordination of the transfer of materials to the site when the schedule of the paragraph approaches and on time	2.39	11%	21%	33%	6%	9%	19%	1%
19	Delayed installation of joists on the bridge pillars accurately	2.08	17%	34%	18%	3%	%1	9%	19%
20	Delayed manufacturing, transportation and lifting of beams	2.07	10%	6%	43%	%20	0%	%3	18%
	Not allocating a central mixer								

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)						
			Construction Management	Supervising Engineer	Bad Decision-Making by Contractor	The Contractor's Financial Difficulties	Difficulty in Preparing Materials	Department of Planning and Occupational Safety	Old Machineries
22	close to the site and preparing roads so that the concrete preparation is not delayed.	2.61	19%	9%	29%	17%	7%	16%	4%
25	Stopped of the work by the executing party due to the currency difference and the increase in its exchange rate	2.00	%1	%0	%30	%54	%8	%7	%0
27	Bad quality and accuracy of the installation of the mold in the event that the bridge is concrete	2.84	14%	49%	12%	6%	0%	4%	15%
28	Difficulty of implementation in the river basin (in the presence of water)	2.46	13%	11%	11%	10%	7%	18%	29%
30	Non-compliance with the plans, which leads to errors in the work of the executing staff	2.28	7%	57%	17%	7%	0%	11%	0%
39	Lack of control over large loads starting from the pillars and allowing subsidence	2.57	16%	56%	16%	4%	4%	%2	1%
42	Lack of sufficient time to review detailed plans and drawings	2.46	11%	34%	16%	1%	0%	37%	0%
45	Making inappropriate decisions when a failure in examinations appears	2.16	16%	70%	%11	%0	0%	%3	0%
47	The rush of newly graduated engineers and the inexperienced to work so that they are in places that do not need their presence, especially with the lack of safety means	2.47	9%	13%	14%	1%	0%	%60	3%
48	Collapse of bridge openings due to slipping from its bases	2.59	13%	44%	13%	1%	1%	%17	10%
49	Establishing a nearby department of resident engineer with no interference with site work.	2.35	30%	20%	14%	3%	1%	%27	4%

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)						
			Construction Management	Supervising Engineer	Bad Decision-Making by Contractor	The Contractor's Financial Difficulties	Difficulty in Preparing Materials	Department of Planning and Occupational Safety	Old Machineries
50	Exposure of bridges to fire risks resulting from the use of an oxygen torch during metal cutting	2.65	11%	10%	9%	1%	0%	%66	3%
51	Exposure of workers or engineers to gases resulting from epoxy, paints and dyes	2.64	0%	0%	3%	4%	4%	%87	1%
52	Exposure of workers or engineers to drowning	2.41	0%	0%	4%	1%	3%	%90	1%
53	Exposure of workers to electric shocks as a result of the use of welding, lighting and punching machines	2.53	1%	0%	6%	1%	1%	%88	1%
54	Exposure to running over by large machinery and equipment that carry out excavation, burial and lifting of materials	2.37	3%	3%	4%	1%	1%	%86	1%
55	Exposure to falling from the top of the bridge such as columns, main bridges and the surface of the Bridge	2.77	4%	3%	4%	4%	0%	%83	1%
56	Demolished or collapsed of the bridge due to failure to take the necessary measures to dig for the pillars	2.57	16%	46%	14%	1%	1%	%18	3%
57	Bad in administrative routine such as delayed tests and inaccurate laboratories	2.65	27%	33%	10%	3%	0%	24%	3%
58	Bad processing the specialized installation equipment	2.64	7%	7%	29%	20%	6%	%13	19%
59	Bad implementation of panel pillars	2.47	16%	53%	17%	6%	1%	1%	6%
60	Bad in accuracy of surveying works	2.55	7%	64%	7%	6%	1%	7%	7%
61	Bad of iron quality and concrete mix materials, type of felts strength and strength of joists according to the required specification.	2.57	13%	51%	11%	9%	11%	4%	0%

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)						
			Construction Management	Supervising Engineer	Bad Decision-Making by Contractor	The Contractor's Financial Difficulties	Difficulty in Preparing Materials	Department of Planning and Occupational Safety	Old Machineries
62	Weak reports of investigations on the ability of the soil to withstand the weight	2.57	39%	27%	3%	6%	0%	22%	3%
63	Failure to conduct laboratory tests during the preparation of materials before the implementation of any part	2.69	14%	63%	6%	4%	0%	10%	3%
64	Not counting the paths of public services and the overlap of the bridge with these paths at the time of implementation	2.66	16%	29%	13%	0%	0%	43%	0%
65	Not choosing the right materials	2.77	27%	31%	21%	10%	6%	3%	1%
66	Lack of attention to the placement of the joists correctly	2.41	9%	63%	19%	3%	0%	4%	3%
67	Lack of attention to safety procedures when working on the project	2.59	3%	6%	3%	1%	1%	84%	1%
68	Lack of careful care of the expansion joints during the implementation of the pillow area under the joists	2.35	9%	76%	7%	3%	1%	1%	3%
69	Failure to install rails and heights safely and provide protective barriers for workers	2.42	3%	3%	11%	6%	0%	75%	1%
70	Failure to prepare materials at the required time	2.47	13%	4%	26%	24%	24%	7%	1%
71	Failure to determine the route of Transporting materials and equipment from workshops and warehouses to the site	2.47	26%	9%	23%	4%	14%	21%	3%
72	Failure to train and place qualified engineers in sensitive positions.	2.57	21%	16%	26%	3%	3%	30%	1%

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)						
			Construction Management	Supervising Engineer	Bad Decision-Making by Contractor	The Contractor's Financial Difficulties	Difficulty in Preparing Materials	Department of Planning and Occupational Safety	Old Machineries
73	Failure to carry out the work of pouring concrete parts correctly	2.65	7%	69%	14%	0%	1%	3%	6%
74	Lack of caution about the fall of materials from the top	2.73	1%	6%	11%	1%	0%	79%	1%
75	Lack of caution during bridge implementation operations to avoid overloading them with axial loads	2.65	20%	30%	14%	3%	0%	33%	0%
76	Lack of skilled manpower	2.61	9%	10%	36%	23%	1%	17%	4%
77	Lack of expertise among executing engineers	2.80	23%	23%	27%	6%	1%	20%	0%
78	Lack of specialized cadres and lack of experience of executors and the adoption of appropriate construction methods for the implementation of bridges	2.73	16%	10%	31%	21%	0%	16%	6%
79	Lack of availability of some specialized construction and Import materials for the implementation of bridges	2.71	13%	6%	16%	29%	30%	6%	1%
80	Failure to provide appropriate safety programs for workers at the construction site to ensure their safety	2.35	1%	4%	3%	3%	0%	89%	0%
81	Failure to conduct soil investigations at the specified site of the bridge or that the soil investigations carried out are inaccurate	2.78	24%	43%	6%	6%	0%	20%	1%
82	Do not monitor the deviation of the piles periodically and take the necessary measures in case of any unacceptable inclination	2.80	10%	76%	6%	1%	0%	5%	1%
83	Lack of advance plans for lifting and installation work	2.90	13%	30%	18%	1%	0%	39%	0%
84	Lack of special heavy equipment such as cranes and long conveyors	2.81	3%	1%	18%	45%	1%	2%	30%

Items No.	Problems Causing Risk	Weighted Mean	The Main Causative (%)							
			Construction Management	Supervising Engineer	Bad Decision-Making by Contractor	The Contractor's Financial Difficulties	Difficulty in Preparing Materials	Department of Planning and Occupational Safety	Old Machineries	
85	Absence of workers and sudden breakdown of machinery	2.59	16%	4%	34%	14%	1%	7%	23%	
86	Failure of the bases of bridges supporting the roofs	2.30	24%	50%	9%	1%	0%	13%	3%	
87	The presence of old beams that oppose the implementation of the pillars	2.25	20%	10%	16%	4%	3%	37%	10%	

RESUME

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EDUCATION:

- High School: 2014 graduated from Saad ibn Abi Waqqas High School
- Bachelor: 2019 graduated from Tikrit University, Faculty of Engineering, Civil Engineering Department.

PROFESSIONAL EXPERIENCE AND REWARDS:

- A Volunteer data collector in the Seneia district directorate
(1 Dec 2018 – 30 May 2019)
 - Salahaadin Governorate
 - Salahaadin (Baiji/ Seneia Town)
- Bayti Housing Complex Project Trained engineer
(1 Jun 2019 – 18 Aug 2019)
 - Al-Handhal Company
 - Salahaadin (Tikrit)
- The building of the arts halls Project Supervisor engineer
(6 Oct 2019 – 30 Mar 2020)
 - Rueat Amwaj Alkhalij Company
 - Salahaadin (Tikrit University)
- Water, Hygiene and Sanitation support to most vulnerable displaced population in camps of Diyala and Baghdad Governorates and out of camps in Ninewa, Salah Al Din and Al Anbar
(5 Apr 2020 – 26 Sep 2020)
 - Sahari Organization for Development
 - Salahaddin (Tuz)
- Health center Project Supervisor engineer
(1 Oct 2020 – 5 Des 2020)
 - Tabarak International Company with UNDP
 - Salahaadin, Baiji