Journal of Civil Aspects and Structural Engineering

www.case.reapress.com

J. Civ. Asp. Struct. Eng. Vol. 2, No. (2025) 155–176.

Paper Type: Original Article

Investigating the Challenges of Management and Construction in Construction Projects with Respect to the Two Factors of Risk and Time in Completing the Project

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Citation:

Received: 13 October 2024 Revised: 08 November 2024 Accepted: 17 March 2025	Bolidehei, M. (2025). Evaluation of different methods of seismic improvement of structures for the best performance against progressive failure. *Journal of civil aspects and structural engineering*, 2(2), 155–176.

Abstract

The purpose of this research is to examine the challenges of management and construction in construction projects with regard to two factors: risk and time in completing the project. One of the signs and indicators of development in a country is the amount of construction projects in it. The implementation of a construction project has various dimensions and can bring many challenges. These project challenges can arise under the influence of various factors such as lack of proper management, price fluctuations, some national regulations, and weather issues. Managing the challenges of construction projects is essential and is very effective in better advancing construction projects. This research is applied in terms of purpose and descriptive-exploratory in terms of nature. In terms of data collection method, it is a survey and the research method is mixed (Qualitative-quantitative). The statistical population of the present study was all contractors, employers, and supervisors of construction projects in Chabahar city; For the qualitative part, the sample size was considered based on the snowball method until theoretical saturation was reached. To identify risks from the data collected through interviews, the grounded theory approach and coding were used. These codes were open-ended, axial, and selective. In this study, all statistical analyses in the qualitative part were performed with the help of Nvivo8 software. Poor management is one of the important risks in the field of construction projects, which can disrupt the project progress process or cause delays in project implementation through wrong decisions. One of the important pillars in every project is human resources and people involved in the project. Selecting capable people and also trying to empower them is very important. The results showed that design errors and rework, changes in design and redesign, using inexperienced people to design the project, and failure to determine requirements during design can cause risks in carrying out construction projects. Other challenges in the field of construction projects were time challenges. Time management actually includes monitoring and controlling the start time, duration of execution and timely completion of executive activities, timely provision and procurement of human resources, machinery and materials, and predicting possible delays and taking appropriate measures to prevent delays using project control and scheduling methods.

Keywords: Management and construction challenges, Construction projects, Risk and time.

1 | Introduction

Due to their high volume and numerous complexities, civil engineering and construction projects always present many challenges in the field of management and construction [1]. However, two very important factors in the completion of civil engineering projects are risk and time. These two factors, as two basic

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10.48314/jcase.v2i2.57

components in the completion of civil engineering projects, are very important. Risk in civil engineering projects means the chance of unwanted events that may lead to delays in project completion, increased costs, and reduced work quality [2]. Common risks in civil engineering projects include problems related to resource shortages, changes in requirements, delays in the delivery of equipment and materials, problems related to establishing communications with other project factors, etc. [3]. Time is also crucial as one of the basic components in the completion of civil engineering projects [4]. Any delay in project completion can lead to increased costs and reduced work quality. Various factors, such as delays in the delivery of equipment and materials, deficiencies in the provision of resources, errors in time planning, etc., can lead to delays in project completion [5]. Given that risk and time are considered two very important factors in the completion of construction projects, it is necessary to examine the challenges of management and construction in construction projects with respect to these two factors.

In this review, issues such as risk management, time planning, cost control, resource management, and project communications can be mentioned [6]. Risk management in construction projects means identifying and assessing various risks in the project and carrying out different activities to reduce and manage them. For example, if there is a risk related to a deficiency in the provision of resources, measures such as providing additional resources or changing the way existing resources are used should be taken [7]. Time planning is also vital as one of the basic components in the completion of construction projects. In this section, careful planning should be made to complete the project within the specified time.

For example, the delivery time of equipment and materials should be carefully examined, and the necessary planning should be done to carry out the related work [8]. Cost control is also crucial as another essential component in completing construction projects. In this section, project costs should be carefully examined, and necessary measures should be taken to reduce costs. For example, project costs can be reduced by using the project's resources or by taking advantage of special discounts [9]. Resource management is also crucial as a vital component in completing construction projects.

In this section, project resources should be carefully examined, and necessary measures should be taken to utilize them optimally. For example, using existing resources, necessary planning should be done to utilize them optimally. Project communication is also essential as another vital component in completing construction projects [10]. In this section, communications with other project factors should be carefully examined, and necessary measures should be taken to improve them. For example, by using different communication methods, communication with other project factors should be improved. Finally, according to the explanations provided, the present study will examine the challenges of management and construction in construction projects with regard to the two factors of risk and time in completing the project.

Khan et al. [11] examined the risk assessment of challenges faced by construction projects. The use of concrete as the main material is now an old technique, but it is widely used today due to its unique properties. India has witnessed years of development in the field of construction from the Harappan civilization to the British era. Even after independence in 1947, India has made progress in construction techniques at the right time. But poor management, design, and ignorance about structural repairs and reconstruction cause buildings to collapse, which causes many deaths every year in Mumbai and across the country. But people living in dilapidated buildings are putting their lives at risk.

Many people are forced to live in them for various reasons, such as skyrocketing property prices, fear of losing their homes after they are vacated for reconstruction projects. Repair and rehabilitation are essential to maintain the capacity of the structure and increase its performance capacity, which is deteriorating due to aging and environmental factors. The recent collapse of a building named Tariq Garden in Mahd killed 20 people. Considering this as a man-made disaster, it became a national highlight that attracted the attention of the mainstream media. A sample space of buildings from the city of Khad, about 200 km from Mumbai, is considered as a research area because it is a developing city near Mahd where the incident occurred. This paper aims to determine the various hazards of dilapidated buildings by studying various health and safety factors affecting the age of the building. The research also focuses on a detailed study of various problems faced by people living in dilapidated buildings. The methodology adopted in this research is to conduct unstructured interviews with a questionnaire survey of the tenants, conduct field surveys of different structures in the study area, and categorize the buildings based on other safety and health conditions of the building. The result shows the Deterioration Index (DI) score, which is based on the comfort level of the tenants. Finally, this research indicates the implementation of various operational plans by government authorities towards dilapidated buildings and suggests some measures to minimize such incidents [11].

Tsima et al. [12] investigated the assessment of risk factors in urban construction projects. Construction projects are highly dynamic, which means there are many risks that can affect the success of the project in Gondar, Ethiopia. Therefore, the study aimed to identify the risk factors affecting project performance and also to develop a research model indicating the risk factors affecting project performance. Data were collected from 26 valid responses that were collected through a questionnaire from construction professionals. The present study used a stratified simple random sampling method. A total of 26 completed and valid questionnaires were returned, yielding a response rate of 81.25%. Factor Analysis (FA) was used to extract the factors of construction projects, in which seventeen independent factors (Risk factors) and one dependent factor (Project performance) were extracted. SPSS-23 software was used to analyze the relationship between the three risk factors and their impact on project performance.

The results showed that the five risk variables with the highest impact, based on quantitative risk analysis using the RII method and risk allocation number, were inflation and price increases. Incomplete design, poor quality of materials, late payment to the contractor, and subcontractor. The five risk variables that were least important and had the least impact were labor strikes, lack of clear scope of work, delay in site access, and lack of site access. FA and regression modeling were used to determine the importance of risk factors. Eight important risk variables for construction projects were determined using the results of FA, which are as follows: construction and design risk, poor management, inadequate budget, uncertain political conditions, uneconomical project budget, lack of law and order, unfavorable weather, and other risk factors are just a few examples of risk factors. The regression model shows that inflation and price increases, delay in site access, and late payment by the contractor have a significant impact on the overall project risk factors. It is anticipated that the construction sector in Gondar, Ethiopia, will benefit significantly from these findings in terms of managing risk factors in construction contracts [12].

Jahan et al. [13] investigated the modeling of risk factors affecting profitability for construction projects. This study addressed the complexity of integrating risk factors affecting construction profitability. Most existing studies cover the individual effects of factors affecting profitability. Very few focus on the systematic impact without considering the complexity and dynamics involved, presenting a gap that is addressed by the current study.

The present study aimed to assess the interrelationships and interdependencies between risk factors affecting profitability through systems thinking and system dynamics modeling. Factors affecting construction profitability were identified through a comprehensive literature review. These were ranked using content analysis and categorized into essential themes. A quantitative and qualitative assessment pathway was provided through 250 structured surveys and 15 expert opinion sessions. Following these reviews, a causal loop diagram was created using the systems thinking technique, and the integrated effect was quantified using system dynamics modeling. The study identifies material cost increases, supply chain process, payment issues, planning and scheduling issues, financial issues, and effective control of human and equipment resources as the most critical risks affecting profitability. The integrated effects on profitability risk were measured using system dynamics modeling. The study helps field professionals identify the factors affecting profitability, identify issues, and integrate their impacts for decision-making and policy formulation. For researchers, it provides a list of factors that can be examined in detail and holistic interrelationships established [13].

Javed et al. [14] examined the challenges of risk management in green construction projects. It was found that high initial cost, lack of experienced contractors and subcontractors, consideration of life cycle inflation, and experience in green building project management are the most critical risks. To address them, this framework suggests careful selection of contractors, provision of financial incentives by the government, setting a time buffer for compliance with the legal process, and developing a proactive financial model. This paper contributes to the body of knowledge and practice by providing a reasonable strategy for applying the framework that is capable of effectively managing risk in green building projects to maintain the competitiveness of organizations in the business environment. The overall objective of this study is to contribute to the further development of the field of risk assessment and risk management from a knowledge-based perspective [14].

Siraj and Faik [15] examined the challenges of construction management in civil engineering projects. This paper reviews common risk identification tools and techniques, risk classification methods, and common risks for construction projects. A systematic review and detailed content analysis of 130 selected articles from reputable and relevant academic journals published in the past three decades were conducted. The findings of the content analysis showed that most of the selected articles identified risks for construction projects– mainly infrastructure projects – in Asia and Europe, and most cases, the identified risks were either classified by their nature or listed without any classification. To identify risks, a combination of different data collection techniques was mainly used in the selected articles, while graph-based and analysis-based techniques were rarely used. The most common risk identified was an unanticipated change in the inflation rate. Poor design and engineering errors, changes in laws, regulations, and government policies affecting the project. This paper addresses the lack of a systematic review and content analysis of published literature related to risk identification and provides researchers and industry practitioners with data on the most common risks affecting construction projects [15].

Mahamid [16] examined the common challenges affecting the passage of time in construction projects from the perspective of contractors. The construction sector is one of the key economic sectors and is the main driving force of the Palestinian national economy. However, it suffers from several problems that affect time, cost, and quality performance. This study aimed to identify common risks affecting the passage of time in road construction projects in the West Bank in Palestine from the perspective of contractors. Forty-five factors that may cause delays in road construction projects were identified through a detailed literature review. A questionnaire was administered to rank the factors considered in terms of severity and frequency. Analysis of this survey indicates that the most critical risks affecting the passage of time in road construction projects in Palestine are: The financial situation of contractors, delays in payment by the owner, the political situation and division of the West Bank, poor communication between the construction parties, lack of equipment efficiency, and high competition in bidding [16].

In a society where civil development is considered one of the basic principles of development, civil projects are significant as one of the crucial components in this field. Due to their special characteristics, these projects have various challenges, such as time and risk. Risk means the chance of unwanted events occurring in the project that may lead to delays in project completion, increased costs, and reduced quality of work. Time is also significant as one of the basic components in completing civil projects, and any delay in completing the project can lead to increased costs and reduced quality of work. Considering that risk and time are regarded as two very important factors in completing civil projects, many studies have been conducted on the challenges of management and construction in civil projects with regard to these two factors.

The results of this research show that the challenges of management and construction in civil projects are very complex and challenging with regard to risk and time. Therefore, considering the challenges of management and construction in construction projects in relation to the two factors of risk and time, it is imperative to examine these challenges and provide appropriate solutions for the management and construction of construction projects. By applying these solutions, it is possible to improve the performance in completing construction projects and improve the quality of work in this area.

2 | Research Method

What the researcher finds depends to a large extent on the type of exploration he undertakes to achieve it. In other words, after the nature of the research subject, its objectives, and scope have been determined by the researcher, he must decide which research method is appropriate for his chosen subject. Therefore, the choice of research method depends on the objectives, the nature of the research subject, and its implementation possibilities. The third chapter of this research is dedicated to the research method. In this chapter, in addition to introducing the type of research, the method of conducting it, and the method of data collection and data analysis have also been introduced.

The research is applied in terms of purpose and descriptive-exploratory in terms of nature. In terms of the data collection method, this research is a survey research. The research method is mixed (Qualitative-quantitative). This design began with qualitative data in the first stage to understand the phenomenon, and then the second stage was quantitative. In this design, the qualitative phase was used as a foundation for creating an instrument, identifying variables, or describing the necessary cases to test a new theory or framework. Since this design begins qualitatively, more emphasis is placed on qualitative data, and the quantitative phase was conducted in a survey manner. Such research that combines qualitative and quantitative methods is called mixed methods research.

2.1 | Statistical Population

The statistical population of this study was all contractors, employers, and supervisors of construction projects in Chabahar city.

2.1.1 | Sample Size and Sampling Design

A statistical sample is a set of indicators that are selected from a larger group or community. Estimating the sample size is one of the most essential parts of any research that is closely related to the size of the statistical population and the level of research confidence [17]. For the qualitative part, the sample size was considered based on the snowball method until theoretical saturation was reached. Snowball sampling is a non-probability sampling method for times when the units under study are not easily identifiable. Especially when these units are very rare or form a small part of a vast community. In this method, after identifying or selecting the first sampling unit, the statistician uses or assists it to identify and select the second sampling unit. In the same way, other sample units are identified and selected [18].

2.1.2 | Data Collection Tools

The data required for this study were collected based on the following methods:

I. Reviewing and studying primary sources or books that were written about the topic in various aspects, and other research factors.

II. Using domestic and foreign articles and theses that were written related to the research topic, and related to its effectiveness and the development of its framework.

III. Using interviews in the qualitative part of the research.

IV. Using other data collection methods such as interviews, tests, questionnaires, sampling, existing databases, and similar procedures, especially in the construction sustainability section.

V. Using the Internet and reputable sites to review the research background in the field of construction sustainability challenges as a source of information.

Also, in this study, the data collection tool in the qualitative part was interviews; the questions in this section were based on the grounded theory model.

2.2 | Validity and Reliability of the Instrument

2.2.1 | Examining the Validity (Validity) of the Instrument

Validity refers to the extent to which the data collection method or instrument measures what it is supposed to measure. In other words, does the measurement instrument have the necessary efficiency for the intended purpose? In this study, face, content, and construct validity were used to measure the validity of the instrument.

Face validity: face validity is related to the apparent or formal strength and elasticity of the instrument or data collection method. It is achieved when non-specialists, including the instrument designer and the subjects under study, determine that it is suitable for measuring the desired characteristic or trait. In other words, a tool with face validity appears to measure what it was supposed to measure [19]. In order to confirm the face validity of the model, the opinions of the supervisor and consulting professors were used. Face validity is determined through a relatively superficial examination of the appearance of the questions, in which the writing, content, and meaning of the questionnaire questions are examined.

2.3 | Model Validation

The purpose of model validation is to determine whether relevant experts approve of the components and the whole model. Model validation was carried out by examining the validity and reliability, as well as examining the model fit criteria, which are explained in the following steps.

2.3.1 | Examination of the Validity (Validity) of the Instrument

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Content validity: at this stage, the proposed model was provided to the statistical sample along with explanations about the process of achieving the model, as well as an appropriate questionnaire with a content validity study that evaluated the model based on various criteria. According to the responses received, first using the t-test and comparing the average score of each criterion with the average (3) as the t-value, irrelevant criteria with low averages were removed from the model. Then, the content validity of the model was examined using the CVI and Content Validity Ratio (CVR) criteria.

CVR is a method of measuring the validity of a questionnaire. To calculate this ratio, the opinions of experts specializing in the content of the test in question were used. First, the objectives of the test were explained to the experts, and operational definitions related to the content of the questions were stated. Then, they were asked to classify each of the questions based on a three-part Likert scale:

I. The item is necessary.

II. The item is useful but not necessary.

III. The item is not necessary.

After gathering expert opinions, CVR can be calculated using the following equation:

$$\mathrm{CVR} = \frac{\mathrm{ne} - \mathrm{N}/2}{\mathrm{N}/2}. \quad (1)$$

In *Relation (1)*, N is the total number of experts, and ne is the number of experts who have selected the necessary option.

Based on the number of experts who have evaluated the questions, the minimum acceptable CVR value is determined according to the table below. Questions for which the calculated CVR value is less than the desired value, according to the number of experts evaluating the question, should be excluded from the test. Since they are obtained based on CVR, they do not have acceptable validity.

Table 1. Minimum acceptable CVR value based on the number of experts.

Number of Experts	CVR Value	Number of Experts	CVR Value	Number of Experts	CVR Value
5	0.99	11	0.59	25	0.37
6	0.99	12	0.56	30	0.33
7	0.99	13	0.54	35	0.31
8	0.78	14	0.51	40	0.029
9	0.75	15	0.49		
10	0.62	20	0.42		

Table 1 shows the minimum acceptable CVR value based on the number of experts.

The second index for examining content validity is the CVI index, which is used to measure the validity of the questionnaire. Waltz and Bassel presented this CVI index. To calculate CVI, experts are asked to determine the level of relevance of each item with the following four-part spectrum:

I. Not relevant.

II. Needs major revision.

III. Relevant but needs revision.

IV. Completely relevant.

The number of experts who chose options 3 and 4 is divided by the total number of experts. If the resulting value is less than 0.7, the item is rejected; if it is between 0.7 and 0.79, revision should be performed; and if it is greater than 0.79, it is acceptable [18].

2.4 | Analysis Tools

The qualitative section aimed to identify the basic concepts related to risks in the construction and management of construction projects. In the qualitative section, information was first collected to discover phenomena. Accordingly, at this stage, through a study of the literature and theoretical foundations of the research and specialized sources and studies, the researcher's mental framework for conducting interviews and what is needed to achieve this model was determined.

Then, in order to confirm the criteria and characteristics extracted from previous research and theoretical foundations, a semi-structured questionnaire was prepared and provided to the statistical sample so that the main and key risks were identified and irrelevant factors were eliminated. Also, characteristics that have not been mentioned in existing research were identified and entered into the research.

To identify risks from the data collected through interviews, the grounded theory approach and coding were used. These codes were open-ended, axial, and selective. It should be noted that in this study, all statistical analyses in the qualitative section were carried out with the help of NVivo8 software.

In the data-based approach, three types of coding are considered.

Open coding: coding is the process of analyzing data. Open coding is a part of the data analysis process that involves breaking down, comparing, naming, conceptualizing, and categorizing data. During open coding, data is broken down into discrete parts and examined for similarities and differences. Open coding involves the following procedures:

I. Axial coding: Axial coding is the second stage of analysis in grounded theory. The goal of this stage is to establish relationships between the categories generated in the open coding stage. This coding is called axial because the coding occurs around a single category. In this step, the researcher selects one of the categories as the central category, explores it as the central phenomenon at the center of the process, and identifies the relationship of other categories to it.

II. Selective coding: In this step of coding, the theorist writes a theory from the relationships between the categories in the central coding. This process is based on methods such as writing a storyline that integrates the categories and ends with a theory. Another method is to use a conditional matrix for theorizing.

3|Findings

3.1|Descriptive Statistics

In this section of the study, the characteristics of the statistical sample of the study are stated. The statistical population of this study was all contractors, employers, and supervisors of construction projects in the city of Chabahar. *Table 2* shows the demographic characteristics of the statistical sample of the study.

Table 2. Demographic characteristics of the quantitative section statistical sample.

Feature	Domain	Number	Percentage
Gender	Male	26	86.67
	Female	4	13.33
Education	Bachelor's degree	17	56.66
	Master's degree	12	40
	PhD	1	3.33
Work history	Under 5 years	4	13.33
	6 to 10 years	15	50
	11 to 20 years	4	13.33
	21 years and above	7	23.33
Age	Under 30 years	5	16.66
	30 to 40 years	7	23.33
	40 to 50 years	6	20
	50 years and above	12	40

According to the data in *Table 2*, 30 contractors, employers, and supervisors of construction projects in Chabahar city cooperated with the research, 17 of whom, equivalent to 56.66%, had a bachelor's degree, and 12 others had a master's degree. Also, 86.67% of the statistical sample were male, and the rest were female. The study of the demographic data of the statistical sample also showed that 50% of the statistical sample had a work experience between 6 and 10 years, which was the highest frequency among the statistical sample's work experience.

Also, work experience of 11 to 20 years and work experience of less than 5 years had the lowest frequency among the statistical sample. Also, the lowest frequency of age among the statistical sample was under 30 years, which included 16.66% of the statistical sample, and the highest frequency was 50 years and above, which included 40% of the statistical sample.

3.2|Data Analysis in the Qualitative Phase (Coding)

In the qualitative phase, 40 experts and specialists with at least 1 year of work experience were selected for semi-structured interviews on the challenges of risk and time in completing construction projects using the (Snowball) method, and the interview was concluded based on the findings obtained from 30 people according to the theoretical saturation rule. After being implemented on paper, the set of experts' opinions was divided into two categories, including Risk challenges and time challenges.

According to the participants' perspective, the focus of the interviews is on achieving the desired state of affairs in answering these two questions:

I. What are the risk challenges in completing construction projects?

II. What are the time challenges in completing construction projects?

Achieving the answer is based on specific objectives that have been separately stated in the interview conditions, and many of these objectives have been considered in the interview as follows.

The coding process was as follows: First, all theoretical foundations were collected and the interviews were read, and the main meanings and concepts in them were identified descriptively. What was obtained from this stage gave a general and descriptive picture of each interview. In the next stage, all interviews were considered for initial analysis and coding. For coding, the selected interview text was segmented, and each segment was considered as a code (The basis of segmentation is content; in other words, any meaning, content, and theme that covers the research objective). The name of each code was chosen in such a way that it accurately and objectively describes the specified segment (Open coding stage). This work continued until the theoretical saturation stage, where no new codes were identified. The result of this stage was the identification of a large number of open codes. The codes obtained in the first stage were merged, after several screenings and considering their similarities and differences, and finally, the codes were reduced to a limited number, and based on that, a number of final codes were identified (Axial coding stage). Subsequently, the final codes were analytically transformed into the central theme or theme (Selective coding stage).

Table 3. Coding of interviews (Open, axial, selected).

Open Coding	Axial Coding	Selected Encoding
Poor human resource management	Management risks	Risk challenges
Poor project management		
Risks arising from contractual factors		
Incorrect budget estimates		
Shortage of experienced contractors and subcontractors	Human resource risks	
Shortage of skilled and expert workers		
Labor Laws		
Poor design and engineering errors	Risks arising from design	
Design changes		
Poor documentation		
Incorrect selection of materials	Implementation risks	
Insufficient financial resources		
Faulty construction procedures		
Safety hazards		
Inconsistent reporting and errors		
Inflation	External risks	
Uncertainty of resources and availability of materials		
Changes in laws and regulations		
Risks arising from environmental factors		
Risks arising from social factors		
Risks arising from political factors		

Table 3. Continued.

Open Coding	Axial Coding	Selected Encoding
Lengthening execution time	Poor time management	Challenges of time
Resource scheduling		

Incorrect estimation of activity time	
Incorrect estimation of activity execution order	
Delayed implementation due to natural disaster conditions	External time risks
Delayed implementation due to political events	
Delayed implementation due to social events	
Ignoring the required resources	Delay in execution
Lack of available resources	
Lack of budget	
Raw material supply cycle	
Slow project implementation process	

3.2.1 | Reliability Assessment of Extracted Codes

To calculate the reliability of extracted codes, the Holst reliability coefficient was used. In this method, coding was performed by two researchers, and the percentage of agreement between them was calculated.

$$PAO = 2M / (N1 + N2). \quad (2)$$

In the above formula, M is the number of common coding items between the two coders, and N1 and N2 are the number of all items coded by the first and second coders, respectively. The PAO value is between zero (No agreement) and one (Complete agreement), and if it is greater than 0.7, it is desirable. *Table 4* presents the reliability value of extracted codes:

Table 4. Reliability of extracted codes using the Holst reliability coefficient.

Number of Extracted Codes of the First Person N1	Number of Extracted Codes of the Second Person N2	Number of Common Codes M	Holst Reliability Coefficient PAO	Result
35	39	33	0.89	Reliability confirmation

3.2.2 | Content Validity Study of Axial Codes

Given that axial codes formed the basis of the quantitative section of the questionnaire. Accordingly, after designing a questionnaire based on the 5-point Likert scale, the content validity of this questionnaire was examined using the CVI and CVR criteria, the results of which are presented below.

Examination of the CVR Index

In this section, the opinions of 30 experts participating in the qualitative section were used, and the extracted axial codes were examined from the perspective of necessity. For each item, the expert was required to choose one of these three ranges:

I. The item is necessary.

II. The item is useful but not necessary.

III. The item is not needed.

The results of this criterion are shown in *Table 5*.

Table 5. Content validity based on the CVR criterion.

Row	Item (Axis Code)	Essential	Useful but Unnecessary	Unnecessary	CVR Criteria	Validity Result
1	Poor human resource management	30	0	0	100	Approved
2	Poor project management	30	0	0	100	Approved
3	Risks arising from contractual factors	22	7	1	0.46	Approved
4	Inaccurate budget estimates	24	3	3	0.6	Approved
5	Lack of experienced contractors and subcontractors	28	2	0	0.86	Approved
6	Lack of specialized and skilled labor	21	5	4	0.4	Approved
7	Labor laws	20	7	3	0.33	Approved
8	Poor design and engineering errors	22	8	0	0.46	Approved
9	Changes in design	29	1	0	0.93	Approved
10	Poor documentation	27	2	1	0.8	Approved
11	Incorrect selection of materials	25	2	3	0.66	Approved
12	Lack of sufficient financial resources	22	3	5	0.46	Approved
13	Faulty construction procedures	20	5	5	0.33	Approved
14	Safety hazards	21	2	7	0.4	Approved
15	Inconsistent reporting and errors	20	4	6	0.33	Approved
16	Inflation	24	3	3	0.6	Approved
17	Uncertainty of resources and availability of materials	27	3	0	0.8	Approved
18	Changes in laws and regulations	24	3	3	0.6	Approved
19	Risks arising from environmental factors	22	2	2	0.46	Approved
20	Risks arising from social factors	24	1	0	0.6	Approved
21	Risks arising from political factors	24	6	0	0.6	Approved
22	Lengthening the implementation time	25	3	2	0.66	Approved
23	Resource scheduling	26	3	1	0.73	Approved
24	Inaccurate estimation of the time of activities	24	2	4	0.6	Approved
25	Inaccurate estimation of the sequence of activities	23	3	4	0.53	Approved
26	Delays in implementation due to natural disaster conditions	25	2	3	0.66	Approved
27	Delays in implementation due to political events	20	3	7	033	Approved
28	Delays due to social events	20	2	8	0.33	Approved
29	Ignoring the required resources	20	3	7	0.33	Approved
30	Lack of available resources	25	3	2	0.66	Approved
31	Lack of budget	26	3	1	0.73	Approved
32	Raw material supply cycle	24	2	4	0.6	Approved
33	Slow project implementation process	25	3	2	0.66	Approved

By comparing the values obtained for the CVR of each item with the guide *Tables 1-3* and considering that the number of statistical samples (Experts) of commenters was 30, criteria greater than 0.33 confirmed content validity, and therefore, all the items obtained had appropriate content validity.

CVI index examination: another method for examining content validity is to use the CVI criterion. At this stage, the experts selected one of the following ranges for each item.

I. Not relevant

II. Needs substantial revision

III. Relevant but needs revision

IV. Fully relevant

The results of this Examination are shown in *Table 6*.

Table 6. Content validity based on CVI criteria.

Row	Item (Core Code)	Unrelated	Need for a Fundamental Review	Relevant but Needs Review	Completely Relevant	Criteria CVI	Validity Result
1	Poor human resource management	0	0	4	26	100	Confirm
2	Poor project management	0	0	6	24	100	Confirm
3	Risks resulting from contractual factors	2	4	5	19	0.8	Confirm
4	Incorrect budget estimates	3	2	5	20	0.83	Confirm
5	Lack of experienced contractors and subcontractors	0	2	7	21	0.93	Confirm
6	Lack of specialized and skilled labor	3	3	11	13	0.8	Confirm
7	Labor laws	3	3	14	10	0.8	Confirm
8	Poor design and engineering errors	2	4	13	11	0.8	Confirm
9	Changes in design	2	4	10	14	0.8	Confirm
10	Poor documentation	2	2	10	16	0.86	Confirm
11	Incorrect selection of materials	2	0	10	18	0.93	Confirm
12	Lack of sufficient financial resources	3	2	9	15	0.8	Confirm
13	Faulty construction procedures	3	5	12	10	0.73	Needs Review
14	Safety hazards	2	4	14	10	0.8	Confirm
15	Inconsistent reporting and errors	2	4	12	12	0.8	Confirm
16	Inflation	3	3	12	12	0.8	Confirm
17	Uncertainty of resources and availability of materials	3	3	12	9	0.8	Confirm
18	Changes in laws and regulations	2	2	15	10	0.86	Confirm
19	Risks resulting from environmental factors	3	5	15	15	0.83	Confirm

Table 6. Continued.

Row	Item (Core Code)	Unrelated	Need for a Fundamental Review	Relevant but Needs Review	Completely Relevant	Criteria CVI	Validity Result
20	Risks resulting from social factors	3	5	10	10	0.73	Needs Review
21	Risks resulting from political factors	3	2	12	11	0.76	Needs Review
22	Longer implementation time	0	3	12	16	0.86	Confirm
23	Resource scheduling	3	2	10	17	0.9	Confirm
24	Incorrect estimation of activity time	5	4	10	14	0.8	Confirm
25	Incorrect estimation of activity execution sequence	1	3	10	15	0.83	Confirm
26	Delays due to natural disaster conditions	1	4	10	15	0.83	Confirm
27	Delays due to political events	2	4	10	14	0.8	Confirm
28	Delays due to social events	2	3	10	15	0.83	Confirm
29	Ignoring required resources	1	3	10	16	0.8	Confirm
30	Lack of available resources	2	2	10	14	0.8	Confirm
31	Lack of budget	2	0	8	16	0.86	Confirm
32	Raw material supply cycle	3	4	10	18	0.93	Confirm
33	Slow project implementation process	2	0	10	14	0.8	Confirm

As stated in the third chapter, if the CVI value is less than 0.7, the item is rejected. If it is between 0.7 and 0.79, it must be reviewed, and if it is greater than 0.79, it is acceptable. The codes for improper project implementation and risks arising from social factors were reviewed and approved by experts after further explanation.

3.3 | Quantitative Section

After obtaining the axial and selective codes and finally the model related to the challenges of carrying out construction projects, in the quantitative section, first using exploratory FA, the different dimensions of the model were validated statistically and according to the opinion of the statistical sample of the desired model. For this purpose, the questionnaire was distributed among the statistical sample based on the 5-spectrum Likert scale.

3.3.1 | Description of the Dimensions of the Model

According to the model obtained in the qualitative section, the model includes two different dimensions, which were: Risks of construction projects and the challenge of time in construction projects.

In this section, descriptive statistics related to these dimensions are presented, based on the scores obtained from the questionnaire:

Table 7. Descriptive statistics related to model dimensions.

Dimension	Challenge	Average	Standard Deviation	Maximum	Minimum
Project risk challenges	Management risks	3.22	0.56	20	4
	Human resources risks	3.26	1.22	15	3
	Design risks	3.54	0.78	15	3
	Executive risks	3.25	0.89	25	5
	External risks	3.29	0.91	30	6
Project time challenges	Poor time management	3.28	0.87	20	4
	External time risks	3.03	0.84	15	3
	Delays in implementation	3.56	1.02	25	5

3.3.2 | Examining the Data Distribution

Next, the data distribution is examined for normality. For this purpose, the Kolmogorov-Smirnov method was used. In this method, if the statistical value is greater than 0.05, the data has a proper distribution.

Table 8. Results of examining data distribution using the Kolmogorov-Smirnov test.

Challenge	Meaningful Value	Distribution Status
Management risks	0.12	Normal
Human resource risks	0.15	Normal
Design risks	0.089	Normal
Execution risks	0.125	Normal
External risks	0.196	Normal
Poor time management	0.065	Normal
External time risks	0.200	Normal
Delays in implementation	0.200	Normal

Given that the significance value for all components of the model is greater than 0.05, it can be said that the data distribution follows a normal distribution at a 95% confidence level.

3.3.3 | Exploratory Factor Analysis

In the next section, the factor loading of the components and the discovery of the dimensions of the model are examined using the exploratory FA method. This section aims to compare the dimensions identified by FA with the dimensions considered based on the two selected codes and to modify them if necessary.

Checking the Adequacy of Sampling

Before using the exploratory FA method, it is necessary to ensure that the sample size is sufficient. The sample size is a determining factor in the accuracy of clustering elements with the exploratory FA technique. One of the methods for checking the adequacy of the sample for FA is to calculate the sample adequacy index. The sample adequacy index was invented by Kaiser et al. [20] and is therefore represented by the symbol KMO. This index should be above 0.7. However, between 0.5 and 0.7 is also acceptable with caution. Small KMO values indicate that other variables cannot explain the correlation between pairs of variables.

First, the results of the KMO and Bartlett tests for assessing the adequacy of the statistical sample are presented in *Table 9*.

Table 9. Results of KMO and Bartlett tests.

	Bartlett Test		
KMO Coefficient	Chi-Square Statistic	Degree of Freedom	Meaningfulness
0.791	6236.140	406	0.00

The KMO statistic is 0.791, which is greater than 0.7. The KMO test indicates whether the sample data is suitable for FA or not. The value of this index varies between zero and one. If the index value is close to one (At least 0.7), the data in question is suitable for FA. Otherwise (Usually less than 0.7), the results of FA are not suitable for the data in question.

Therefore, the sample size is sufficient for FA, and the significance value of Bartlett's test is 0.00, which indicates that the results are significant. Thus, an exploratory FA test can be used. The Bartlett's test tests the hypothesis that the correlation matrix of the observed variables is unitary. This test confirms that the variables are not related to each other, which is obtained through the significance of the chi-square test. Suppose the significance level in Bartlett's test is less than 5%. In that case, the correlation matrix will not be unit, meaning that there is a relationship between the variables, and the null hypothesis will be rejected. According to the table, the significance level of the test is 0.00, which means that the null hypothesis is rejected and there is a significant relationship between the variables.

Next, the exploratory FA method was used to identify the factors of the model.

Another indicator for the adequacy and suitability of variables in FA is the use of the anti-image correlation criterion matrix, which is calculated and used based on the KMO and Bartlett indices. In FA, the anti-image correlation matrix is the basis for examining whether a data set with m indicators (Variables) can extract a factor or factors or not. The anti-image correlation matrix can be shown by this matrix and its main diagonal elements. Due to the large number of components, the main diameter value is shown in *Table 10*:

Table 10. Anti-image matrix.

Component Name	Component	Autocorrelation Value	Component
Poor human resource management	Q1	0.645	Q1
Poor project management	Q2	0.637	Q2
Risks from contractual factors	Q3	0.750	Q3
Budget estimates	Q4	0.807	Q4
Lack of experienced contractors and subcontractors	Q5	0.844	Q5
Lack of expert and skilled labor	Q6	0.856	Q6
Labor Laws	Q7	0.864	Q7
Poor design and engineering errors	Q8	0.825	Q8
Design changes	Q9	0.832	Q9
Poor documentation	Q10	0.872	Q10
Incorrect material selection	Q11	0.824	Q11
Lack of adequate financial resources	Q12	0.803	Q12
Faulty construction procedures	Q13	0.816	Q13
Safety hazards	Q14	0.828	Q14
Inconsistent Reporting and Errors	Q15	0.731	Q15
Inflation	Q16	0.848	Q16
Uncertainty of resources and material availability	Q17	0.648	Q17
Changes in laws and regulations	Q18	0.673	Q18
Risks from environmental factors	Q19	0.809	Q19
Risks from social factors	Q20	0.844	Q20
Risks from political factors	Q21	0.695	Q21
Extended execution time	Q22	0.826	Q22
Resource scheduling	Q23	0.839	Q23
Inaccurately estimating the time of activities	Q24	0.825	Q24
Inaccurately estimating the sequence of activities	Q25	0.856	Q25
Delays due to natural disasters	Q26	0.725	Q26

Table 10. Continued.

Component Name	Component	Autocorrelation Value	Component
Delays due to political events	Q27	0.822	Q27
Delays due to social events	Q28	0831	Q28
Ignoring required resources	Q29	0.806	Q29
Lack of available resources	Q30	0.732	Q30
Lack of budget	Q31	0.812	Q31
Raw material supply cycle	Q32	0.819	Q32
Extended execution time	Q22	0.826	Q22
Resource scheduling	Q23	0.839	Q23
Inaccurately estimating the time of activities	Q24	0.825	Q24
Inaccurately estimating the sequence of activities	Q25	0.856	Q25
Delays due to natural disasters	Q26	0.725	Q26
Delays due to political events	Q27	0.822	Q27
Delays due to social events	Q28	0.831	Q28
Ignoring required resources	Q29	0.806	Q29
Lack of available resources	Q30	0.732	Q30
Lack of budget	Q31	0.812	Q31
Raw material supply cycle	Q32	0.819	Q32

Table 10 shows the values of the central column in the anti-image matrix. It indicates that the components also have an acceptable adequacy value, because the value of all of them is greater than 0.5.

In the next step, the correlation matrix between the question scores and the total score was calculated, which is presented in *Table 11*.

Table 11. Correlation matrix of scores with total score.

Component Name	Component	Correlation Value with Total Score
Poor human resource management	Q1	0.711
Poor project management	Q2	0.744
Risks from contractual factors	Q3	0.536
Budget estimates	Q4	0.558
Lack of experienced contractors and subcontractors	Q5	0.0749
Lack of expert and skilled labor	Q6	0.800
Labor laws	Q7	0.700
Poor design and engineering errors	Q8	0.861
Design changes	Q9	0.536
Poor documentation	Q10	0.705
Incorrect material selection	Q11	0.712
Lack of sufficient financial resources	Q12	0.747
Faulty construction procedures	Q13	0.837
Safety hazards	Q14	0.792
Inconsistent reporting and errors	Q15	0.945
Inflation	Q16	0.896
Uncertainty of resources and material availability	Q17	0.946
Changes in laws and regulations	Q18	0.923
Risks from environmental factors	Q19	0.699
Risks from social factors	Q20	0.656
Risks from political factors	Q21	0.962
Extended execution time	Q22	0.856

Table 11. Continued.

Component Name	Component	Correlation Value with Total Score
Resource scheduling	Q23	0.758
Inaccurately estimating activity timing	Q24	0.825
Inaccurately estimating activity sequence	Q25	0.743
Delays due to natural disasters	Q26	0.910
Delays due to political events	Q27	0.742
Delays due to social events	Q28	0.816
Ignoring required resources	Q29	0.833
Lack of available resources	Q30	0.77
Lack of budget	Q31	0.854
Raw material supply cycle	Q32	0.862
Poor human resource management	Q33	0.841

The results of *Table 11* indicate a high correlation of the questionnaire components with the total score of the questionnaire.

Before exploratory FA, the stage of examining the normality of the data, as well as the correlation of the questions with the total score, and the adequacy of the data and the anti-image matrix, was examined to examine the conditions for conducting exploratory analysis. The answers to the research questions, including exploratory FA, are stated below.

Next, the factor structure of the model was examined. For this purpose, exploratory FA was performed. For this purpose, a total variance table was obtained, and the main factors were identified based on the factors whose explained variance value is greater than 1.

Table 12. Total explained variance table.

	Initial Eigenvalues			Rotation of the Sum of Squares of Times		
Factor	Total	Percentage Of Variance	Cumulative Percentage	Total	Percentage of Variance	Cumulative Percentage
1	7.351	22.276	22.276	4.822	14.611	14.611
2	5.677	17.203	39.479	4.570	13.848	28.459
3	4.389	13.300	52.779	3.919	11.875	40.334
4	2.862	8.671	61.451	3.504	10.618	50.953
5	2.168	6.570	68.021	3.278	9.933	60.886
6	2.016	6.108	74.129	3.025	9.166	70.052
7	1.702	5.156	79.286	2.562	7.764	77.815
8	1.123	3.742	83.028	1.720	5.212	83.028
9	0.992	3.005	86.032			
10	0.856	2.585	88.617			
11	0.633	1.918	90.536			
12	0.559	1.693	92.229			
13	0.443	1.343	93.572			
14	0.369	1.118	94.690			
15	0.354	1.072	95.762			
16	0.294	0.891	96.653			
17	0.221	0.668	97.322			
18	0.197	0.598	97.920			
19	0.175	0.531	98.451			
20	0.151	0.457	98.908			
21	0.117	0.356	99.264			

Table 12. Continued.

	Initial Eigenvalues			Rotation of the Sum of Squares of Times		
Factor	Total	Percentage Of Variance	Cumulative Percentage	Total	Percentage of Variance	Cumulative Percentage
22	0.073	0.222	99.486			
23	0.052	0.157	99.643			
24	0.047	0.144	99.787			
25	0.022	0.067	99.853			
26	0.017	0.052	99.906			
27	0.014	0.042	99.948			
28	0.011	0.034	99.982			
29	0.006	0.018	100.000			
30	0.0069	0.019	100.000			
31	0.00036	0.0159	100.000			
32	0.000025	0.00125	100.000			
33	0.000012	0.000	100.000			

Based on *Table 10*, the 8-dimensional structure of the model was confirmed. Based on the information in this table, seven factors were able to explain 83.028% of the total variance. The following diagram, which is related to the pebble diagram, clearly identifies factors with a value above one as the main factors.

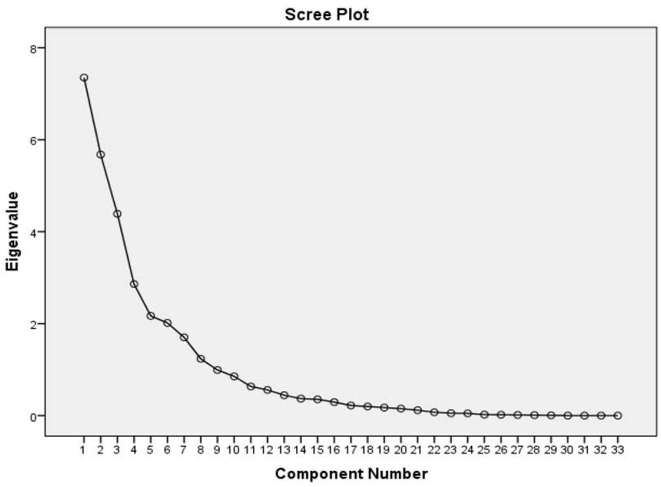

Fig. 1. Pebble diagram (There are eight factors greater than one).

As mentioned, a rotated matrix using the varimax method was used for FA. The result of this rotation is shown in *Table 13*.

Table 13. Rotated matrix of factors.

Component Name	Component	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Poor human resource management	Q1				0.776				
Poor project management	Q2				0.797				
Risks from contractual factors	Q3				0.893				
Budget estimates	Q4				0.724				
Lack of experienced contractors and subcontractors	Q5					0.943			
Lack of expert and skilled labor	Q6					0.902			

Table 13. Continued.

Component Name	Component	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Labor laws	Q7					0.908			
Poor design and engineering errors	Q8								0.702
Design changes	Q9								0.570
Poor documentation	Q10								0.572
Incorrect material selection	Q11			0.731					
Lack of sufficient financial resources	Q12			0.919					
Faulty construction procedures	Q13			0.874					
Safety hazards	Q14			0.875					
Inconsistent reporting and errors	Q15			0.777					
Inflation	Q16		0.676						
Uncertainty of resources and material availability	Q17		0.713						
Changes in laws and regulations	Q18		0.864						
Risks from environmental factors	Q19		0.673						Q19
Risks from social factors	Q20		0.792						
Risks from political factors	Q21		0.842						
Extended execution time	Q22						0.808		
Resource scheduling	Q23						0.768		
Inaccurately estimating activity timing.	Q24						0.783		
Inaccurately estimating activity sequence.	Q25						0.707		
Delays due to natural disasters	Q26							0.879	
Delays due to political events	Q27							0.683	
Delays due to social events	Q28							0.9	
Ignoring required resources	Q29	0.938							
Lack of available resources	Q30	0.931							
Lack of budget	Q31	0.885							
Raw material supply cycle	Q32	0.918							
Poor human resource management	Q33	0.791							

Table 13 shows the components of the eight groups related to the model.

4 | Conclusion

One of the signs and indicators of development in a country is the number of construction projects in it. In a construction project, achieving the goals of a project is desired by observing cost and time constraints while maintaining the desired quality. The implementation of a construction project has various dimensions and can bring many challenges. These project challenges can arise under the influence of multiple factors such as a lack of proper management, price fluctuations, some national regulations, and weather issues. Managing the challenges of construction projects is essential and is very effective in advancing construction projects.

In construction project management, events that can occur during project implementation and jeopardize the project are referred to as risks. Rapid technological changes, temporary markets, globalization, and irregularity are all factors that expose organizations to risk, whether financial or non-financial. In other words, the more complexity increases, the more variability increases, and if it is not managed in a desirable way, the risk increases.

A category of risks in construction projects is management risks. Among these risks, it should be noted that poor human resource management causes the human resource not to be productive enough to implement the project, hiring with incompetent criteria, poor management in project implementation, and risks arising from contractual factors have been recognized as management risks. Poor management is one of the critical risks in the field of construction projects, which can disrupt the project progress process or cause delays in project implementation through wrong decisions. Other challenges identified in this field were human resource challenges. Human resources and labor management are vital challenges in construction projects. Human resource management is a set of measures that are taken to use the existing forces in the project effectively. One of the essential elements in every project is human resources and the people involved in the project. Selecting capable people and also trying to empower them is very important. Hiring employees with sufficient knowledge and experience is an essential issue in today's projects. Their abilities and skills should be well reviewed and, if necessary, trained, or new personnel should be hired. Two key elements in human resource management are the challenge of training and maintaining motivation in people.

The presence of skilled and specialized personnel is an essential factor in the successful implementation of construction projects. The successful implementation also applies to experienced and competent contractors. Lack of attention to the qualifications of human resources can bring many challenges to construction projects.

Another critical challenge of the project is the challenges related to specialized discussions and design. Deficiencies and errors in the design or lack of proper supervision of the implementation of the plan can cause irreparable problems or the need to redo some work. Making changes to the project scope and requirements causes changes in the design and brings challenges to the design team. Failure to communicate the implementation plans and necessary information on time creates challenges, inconsistencies, and delays in the project.

The results also showed that design errors and rework, changes in design and redesign, the use of inexperienced people to design the project, and the failure to determine the requirements during design can cause risks in the implementation of construction projects.

Other challenges in the field of construction projects were time challenges. As the project process becomes longer and more delayed, contractors incur high costs, and sometimes these costs are so high that they lead to the complete halt of the project.

Time management actually includes monitoring and controlling the start time, the duration of the implementation, and completion of the implementation activities on time, the timely provision and procurement of human resources, machinery, and materials, and predicting possible delays and taking appropriate measures to prevent delays using project control and scheduling methods.

The schedule must be appropriate and consistent with the reality of the project, and guiding and adapting time to construction projects is considered part of the challenge. Optimistic schedules and failure to adhere to the schedule cause delays, tension between people, and increased costs. Time management is crucial because time constraints will reduce the quality of work, employer dissatisfaction, and increase accidents and incidents during work.

Funding

This research received no external funding.

Data Availability

The data supporting the findings of this study are available from the author upon reasonable request.

Consent for Publication

The authors confirm consent for the publication of this work

Ethics Approval and Consent to Participate

The authors confirm that this research did not involve human participants or animal subjects.

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