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Critical Factors Affecting Cost and Time Overrun of Construction Projects in Pakistan

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Abstract

Construction industry plays a vital role in Pakistan's economic development. However, the success of construction projects is significantly influenced by well-structured plans and timelines. This study aims to explore the critical factors affecting the cost and duration of construction projects in Pakistan. To identify these factors, an in-depth literature review was conducted, followed by the Delphi technique, where a series of questionnaires were distributed to industry experts. Multiple rounds of surveys were carried out with professionals, including consultants, contractors, and clients. The collected responses were analysed and ranked using the Relative Importance Index (RII) method. The findings revealed several key contributors to time overruns, such as material selection, changes in material types and specifications during construction, poor equipment maintenance, shortages of construction materials, financial disputes between owners and contractors, and labour shortages. Similarly, major causes of cost overruns were identified, including inflation and rising material prices, inappropriate construction methods, project modifications by owners, frequent equipment breakdowns, and rework due to construction errors. Understanding these factors is crucial for improving project planning and execution, ultimately enhancing the efficiency of Pakistan's construction industry.

1. Introduction

Construction industry plays a vital role in the economic development of nations, particularly in developing countries [1]. This industry also serves as a basis for infrastructure development, housing, and urbanization and contributes significantly towards GDP and employment growth [2]. Despite its importance, the construction sector experiences many challenges, hindering its efficiency and effectiveness [3]. One of the most pressing issues is the cost and time overruns, which can heavily influence project outcomes and affect the development goals, especially national ones. Constant problems occurring in construction projects have been gradually increasing, placing bigger burdens on project managers to achieve timely and cost-effective delivery while

maintaining high quality [4]. Unlike many other industries, construction industries also encounter sudden changes in site conditions, regulatory requirements, and stakeholder expectations that often lead to cost and time overruns while making it challenging to adhere to original project plans and budgets.

Cost overruns, alternatively termed as cost escalation or budget overruns, pose a customary and formidable challenge within the construction industry, considerably hindering effective project management and financial control. A study reveals that 90% of construction projects met cost overruns, which is reflected as a common matter in construction [5]. Cost overruns occur when the actual costs exceed the initially projected costs estimated during the budgeting phase, thereby imposing financial pressures on project stakeholders [6]. This dilemma is particularly acute in developing economies, where cost overruns frequently escalate beyond 100% of the project's estimated cost, establishing a more noticeable deviation from financial potential [7]. Given the general nature of this challenge, addressing time completion is important for both developed and developing nations due to the need to ensure the successful and timely completion of construction projects while adhering to predefined financial constraints. Delay is defined as a prevalent, significant, and critical challenge impacting the time-based phases of civil engineering construction projects [8].

Despite advancements in technology and project management expertise, time overrun remains a dominant concern. In addition, relevant factors contributing to project delays are delays of material supplies, equipment malfunctions, political instability, and adverse weather conditions [9]. These delays often aggravate due to project complexities, compounding the challenges faced by project stakeholders. An imperative study is conducted to identify the root causes of delays and implement effective strategies to mitigate their adverse impacts on project durations. A holistic approach is essential to conduct further studies in current research for conducting in-depth evaluations and ensuring project success within defined timeframes.

2. Overview Time and Cost Overruns in Construction Projects

Time and cost overruns remain persistent challenges in the construction industry worldwide, particularly in developing nations like Pakistan. These overruns can have significant economic, social, and contractual implications, often leading to disputes, project abandonment, and financial losses for stakeholders. The construction sector, characterized by complex project environments and interdependencies, frequently experiences delays and budget escalations due to a variety of factors [5].

Variability in project execution, improper planning, financial constraints, resource mismanagement, inefficient procurement processes, and external disruptions such as inflation, currency fluctuations, and supply chain disruptions are among the primary causes of overruns. Additionally, unforeseen site conditions, poor risk management, lack of skilled labor, and regulatory challenges further exacerbate project inefficiencies. The involvement of multiple stakeholders including contractors, consultants, and government authorities adds another layer of complexity, making it difficult to maintain cost and schedule adherence [6].

A thorough review of the literature reveals that time and cost overruns are multifaceted problems influenced by a range of internal and external factors. Internal factors include design errors, scope changes, unrealistic scheduling, and inadequate project monitoring, while external factors encompass political instability, adverse weather conditions, legal disputes, and fluctuating material costs [10]. In developing countries like Pakistan, the lack of technological integration, bureaucratic delays, and ineffective contract administration further contribute to project inefficiencies.

Given the widespread impact of these overruns, researchers and industry professionals have explored various mitigation strategies, such as improved project planning, risk management frameworks, advanced scheduling techniques, and the adoption of digital tools like Building Information Modeling (BIM) [4]. Implementing effective governance mechanisms, fostering stakeholder collaboration, and ensuring realistic budgeting and scheduling practices are essential steps toward minimizing the adverse effects of time and cost overruns. Despite the existing body of research, there is a need for a more nuanced understanding of the causes of cost and time overruns in the Pakistani construction industry.

2.1 Factors Contributing to Time Overruns

Several studies have identified the critical factors responsible for delays in construction projects. One of the studies explored delays in India's construction industry and identified major causes, including adverse weather conditions, inaccurate scheduling, shortage of skilled labor, and ineffective site management [10]. These findings align with another study, which attributed delays to local political interference, delays in progress payments, and improper planning [11].

Similarly, a study emphasized contract adjustments and market fluctuations as significant causes of time overruns [12]. Another crucial perspective was presented, examining public sector construction projects in Pakistan and identified legal complications, technical errors, and poor project management as leading causes of delays [13]. These studies highlight a common pattern: ineffective planning and financial instability significantly contribute to time overruns, exacerbating project inefficiencies.

2.2 Factors Contributing to Cost Overruns

Cost overruns stem from various interrelated factors, including financial mismanagement, improper cost estimation, and fluctuating material prices. A study identified financial difficulties faced by contractors, cash flow issues, and poor site supervision as primary causes of cost overruns in Malaysia [14]. Similarly, the Relative Importance Index (RII) method was used in Turkey and found that inappropriate project cost estimation, high resource costs, and skilled labor shortages were key contributors [9].

A study categorized cost overrun factors in Jordan's public construction sector, identifying inflation, fuel price hikes, and lack of experience as major contributors [15]. Further, research noted that unexpected terrain conditions, weather fluctuations, and variations in orders substantially impact project costs [16]. These findings align with studies conducted in Pakistan, identified poor site management, material shortages, financial difficulties, and frequent design changes as dominant factors leading to cost escalations [17].

2.3 Comparative Analysis of Global and Regional Studies

A comparative analysis of global research indicates that while cost and time overruns are universal concerns, their causes vary by region. Studies from India emphasize economic instability, fluctuating material costs, and delays in financial clearances as predominant issues [18]. In contrast, research conducted in Pakistan highlights bureaucratic hurdles, frequent design changes, and payment delays as critical concerns [13], [17].

Further, Bhutan's construction industry faces delays due to financial mismanagement and shortages of local materials [19], whereas studies in Jordan emphasize inadequate experience and regulatory constraints as major causes [15]. These studies suggest that while certain factors such as financial difficulties and planning inefficiencies are common worldwide, localized issues such as political interference and legal barriers significantly impact specific regions like Pakistan.

2.4 Implications for Pakistan's Construction Sector

Pakistan's construction industry shares similarities with global trends but also exhibits unique characteristics, such as legal disputes, payment delays, and political interference. Addressing these concerns requires a multi-pronged strategy, including enhanced financial planning, improved regulatory frameworks, and the adoption of advanced project management techniques.

The findings from this literature review underscore the importance of adopting mitigation strategies tailored to Pakistan's construction industry. Risk management strategies, as emphasized by [22], play a crucial role in minimizing delays and cost escalations. Effective procurement planning, streamlined payment processes, and robust project monitoring mechanisms can significantly improve project efficiency.

3. Research Methodology

Various methodologies have been employed to assess and rank the significance of cost and time overrun factors. The Relative Importance Index (RII) method has been widely used in research [9], [14], [20], to determine critical delay factors. Additionally, Spearman's Rank Correlation Coefficient and Principal Component Factor Analysis (PCFA) have been utilized to establish relationships between different variables [11], [15].

The reliance on questionnaire surveys for data collection, as seen in studies by [11], [21], suggests that stakeholders' perspectives, whether contractors, consultants, or clients play a crucial role in understanding cost and time overruns. The use of descriptive statistics further enhances the reliability of findings by ranking key contributors to construction project inefficiencies [13].

The questionnaire was divided into two sections: the first section collected general information about the respondents, while the second section focused on resource constraint factors that lead to cost and time overruns in construction projects.

An extensive survey was carried out to determine the factors affecting construction project time and cost overruns. A survey questionnaire indicated that 33 time-overrun factors and 20 cost-overrun factors were attained in light of the factors influencing the cost and schedule overrun of construction projects in Pakistan. Before the distribution of the questionnaire, a pilot study was carried out. The key objective of the pilot study was to ensure that all the relevant factors were included in the questionnaire.

The Delphi technique is a structured process and typically involves multiple rounds of questionnaire distribution and collection to gradually gather expert opinions and reach consensus. The following are the specific steps for distributing and collecting three rounds of questionnaires using the Delphi technique. Three rounds of questionnaire survey are shown in figure 1.

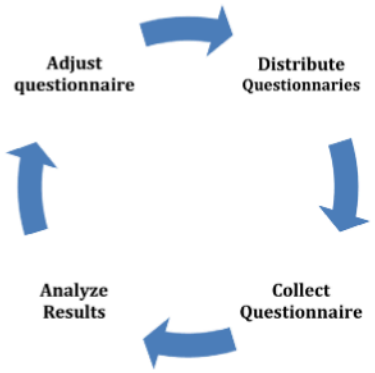

Fig. 1 *Steps in developing and implementing a questionnaire [23]*

The figure 1 illustrates the iterative process of distributing and collecting three rounds of questionnaires using the Delphi technique. This method involves multiple rounds of surveys to gather expert opinions and gradually reach a consensus. The process begins with the first round, where an initial questionnaire is distributed to selected experts. Participants provide their responses based on their expertise, and these responses are then collected and analyzed. Based on this feedback, a second-round questionnaire is developed, refining the questions and summarizing the initial responses. Experts review the revised content and provide further insights, allowing for a more focused discussion. In the third round, another iteration takes place where the questionnaire is again refined, incorporating the previous feedback. Participants reassess their responses, leading to a convergence of opinions. Finally, after the third round, the collected data is analyzed to establish a consensus on the subject. The cyclic nature of the figure emphasizes the structured and iterative feedback mechanism of the Delphi technique, ensuring that expert opinions are systematically refined through successive rounds.

3.1 Data Analysis

The method employed for data analysis was aimed at determining the relative importance of various factors that cause cost and time overruns and suggest reducing the overruns. The steps utilized for data analysis include the determination of the Relative Importance Index (RII), ranking of factors based on such index, and to assess the correlation degree by ranking factors among three groups.

3.2 Relative Importance Index (RII)

The analysis evaluated the contribution of each factor to overall delays, and the importance of these factors was assessed by respondents using the Relative Importance Index (RII). This index was calculated using an equation, and the results are displayed in Tables 2 and 3. To ascertain the ranking of various factors as perceived by owners, contractors, and consultants, the RII was computed accordingly using Equation 1.

$$RII = \sum W(AxN) \quad 1$$

Where:
W = Weightage given to each factor by the respondents
A = Highest weight (i.e., 5 in this case)
N = Total number of respondents

3.3 Questionnaire Design and Survey

A purposive survey approach was employed, and with a predefined list of target respondents, the survey was personally distributed to potential participants. The questionnaire was administered to owners, consultants, and contractors across diverse sectors within the construction industry. A total of 129 experts were selected based on expertise and past experiences out of 151 construction professionals. The demographic characteristics of the respondents are given in Table 1.

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Table 1 *Demographic characteristics of respondents*

Demographic Characteristic	Description	Frequency	Percentage
Gender	Male	114	88.4
	Female	15	11.6
Occupational level	Engineer	69	53.5
	Manager	43	33.3
	Others	17	13.2
Annual turnover (Rupees)	Less than 100crore	75	58.1
	100-500 crore	31	24
	501-1000 crore	23	17.9

The table presents the demographic characteristics of the 129 selected experts who participated in the study. These experts were chosen based on their expertise and past experience from a total of 151 construction professionals. The table categorizes respondents based on gender, occupational level, and the annual turnover of the organizations they represent. In terms of gender, the majority of respondents were male (88.4%), while female participants comprised 11.6% of the sample. This distribution reflects the male-dominated nature of the construction industry. Regarding occupational level, the largest group of respondents were engineers (53.5%), followed by managers (33.3%), and others (13.2%), which could include supervisors, consultants, or other professionals involved in construction projects. This distribution ensures representation from both technical and managerial roles within the industry. For annual turnover, the highest proportion of respondents (58.1%) represented organizations with an annual turnover of less than 100 crore rupees, followed by 24% from organizations with turnovers between 100-500 crore rupees, and 17.9% from organizations with turnovers between 501-1000 crore rupees. This indicates that a significant portion of the respondents were affiliated with small to medium-sized construction firms, with fewer participants from larger organizations.

Overall, the demographic distribution in Table 1 highlights the diversity of the selected experts, ensuring a balanced representation of professionals across different roles and organizational scales within the construction sector.

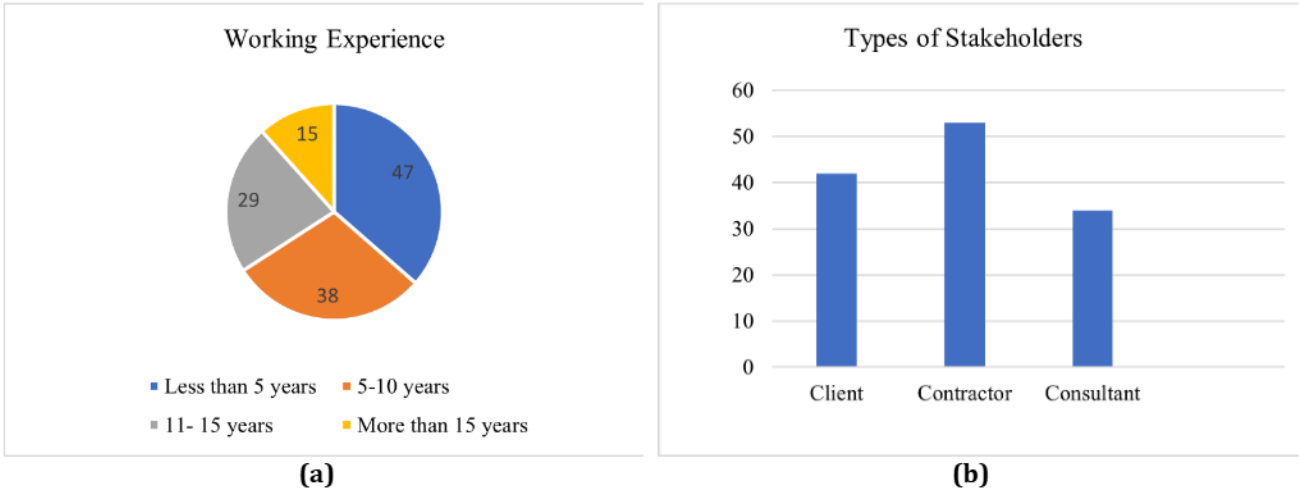

Fig. 2 *(a) Working experience of respondents; (b) Type of stakeholder*

The pie chart in figure 2 illustrates the distribution of respondents based on their years of professional experience in the construction industry. The largest proportion, 47 respondents, have less than 5 years of experience, indicating a significant presence of early-career professionals. This is followed by 38 respondents with 5 to 10 years of experience, showing a substantial group of mid-level professionals. The category of 11 to 15 years includes 29 respondents, while 15 respondents have more than 15 years of experience, representing the most experienced professionals in the study. This distribution ensures a mix of perspectives from professionals at different career stages.

The bar chart classifies the respondents based on their roles in the construction industry. The majority of respondents are contractors, representing the highest group, followed by clients, and then consultants, who form the smallest category. This distribution highlights that contractors, who are directly involved in project execution, form the largest portion of the sample, while clients and consultants also contribute to the study, ensuring a comprehensive stakeholder representation.

These charts provide an overview of the respondents' experience levels and professional roles, ensuring diversity in insights and perspectives within the research.

4. Result and Discussion

A hierarchical assessment of factors was conducted to establish an overall evaluation based on responses from all participants in the third (final) round of the questionnaire, with the results presented in Tables 6 and 7. The most significant factors contributing to cost and time overruns, as ranked by the respondents, were identified based on their levels of significance. The assessment utilized the Relative Importance Index (RII), calculated separately for each group of respondents, including owners, contractors, and consultants.

Table 6 presents the significance levels of factors contributing to cost overruns, as ranked by the respondents. These factors include inflation and the escalation of material prices, inappropriate construction methods, changes in project scope by the owner, frequent breakdowns of construction plants and equipment, and rework due to errors during construction. Inflation and the escalation of material prices ranked highest (RII = 61.21) based on the overall average score of all respondents. However, when analysed independently, owners and consultants ranked the same factor first, with RII scores of 61.47 and 65.5, respectively. In contrast, contractors held a different perspective, ranking "Change in project by the owner" as the most significant factor, with an RII score of 60.5.

Similarly, as illustrated in Table 7, the key factors contributing to time overruns included material selection and changes in types and specifications during construction, poor maintenance of equipment, shortages of construction materials, financial disputes between owners and contractors, and labour shortages. Among these, material selection and changes in types and specifications during construction ranked first based on the overall average RII score of 71.2. However, a detailed breakdown reveals variations in ranking among different respondent groups. Owners ranked "Poor maintenance of equipment" as the most critical factor, with an RII score of 77.1. Consultants identified "Lack of skilled labour" as the most significant issue, with an RII score of 73.3, while contractors ranked "Poor procurement of materials" as the highest contributing factor, with an RII score of 72.1.

4.1 First Round Results

In the first round of data collection through a questionnaire survey, experts were asked to rank the critical level of each factor that causes cost and time overruns. The questionnaire survey in the first round consisted of 20 factors related to cost overrun and 19 factors related to time overrun.

Table 2 *Ranking of critical factors causing Cost overrun (round 1)*

Factors of Cost overruns	Owner		Contractor		Consultant		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Inflation and Escalation of material price	55.54	2	53.6	1	63.3	1	57.48	1
Poor communication and coordination with other parties	53.8	3	48.3	6	58.8	2	53.63	2
Mistakes during construction	50.5	6	52.2	2	52.1	7	51.60	3
Change in project by owner	58.1	1	45.1	10	51.2	9	51.47	4
Rework due to errors during construction.	52.2	4	49.6	5	51.3	8	51.03	5
Inappropriate construction method	51.1	5	51.6	3	50.1	10	50.93	6
Wastage on site	47.2	10	45.1	10	58.4	3	50.23	7
Additional project management, consultancy and administrative cost.	46.4	12	47.8	7	55.6	5	49.93	8
Additional work at owners request	48.6	8	50.8	4	49.9	11	49.77	9

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Frequent breakdown of the construction plant and equipment	48.8	7	43.6	15	56.6	4	49.67	10
High transportation cost	46.5	11	47.2	9	53.8	6	49.17	11
Ineffective planning & scheduling of project by contractor.	48.6	8	45.1	10	48.1	12	47.27	12
High cost of machinery	45.6	13	47.5	8	46.5	15	46.53	13
Difficulties on importing equipment's and materials	45.1	14	44.6	13	45.6	16	45.10	14
High quality of work required	43.6	17	44.4	14	47.1	14	45.03	15
Shortage of materials	44.1	15	41.5	18	47.6	13	44.40	16
Unsafe practice at site	44.1	15	41.3	19	44.5	17	43.30	17
High maintenance cost of machinery	42.4	18	42.1	17	42.2	19	42.23	18
Lack of financial management and planning	40.2	20	42.2	16	43.1	18	41.83	19
Mistakes or discrepancies in documents or specification issued by consultant.	42.2	19	40.1	20	40.1	20	40.80	20

Table 2 depicts the results of 1st round of ranking of the factors of cost overrun in construction projects in Pakistan. It is reported that inflation and escalation of material price, poor communication and coordination with other parties, mistakes during construction, change in project by the owner and rework due to errors during construction are the top 5 causes of cost overrun in construction projects. The result shows that inflation and escalation of material prices have highest effect on cost overrun with an overall relative important index score of 57.48%.

Table 3 *Ranking of critical factors causing time overrun (round 1)*

Factors of Time Overrun	**Owner**		**Consultant**		**Contractor**		**Overall**	
	RII	**Rank**	**RII**	**Rank**	**RII**	**Rank**	**RII**	**Rank**
Poor procurement of material	73.5	1	64.3	1	60.4	1	66.06	1
Shortage of construction material	71.3	2	62.4	2	58.2	5	63.96	2
Financing between the owner and the contractor	69.2	6	59.3	5	56.2	10	61.56	3
Poor maintenance of equipment	69.3	5	61.4	3	53.5	16	61.4	4
Lack of skilled labour	70.1	4	54.2	16	59.6	2	61.3	5
Materials selection and change in types and specifications during constructions	70.4	3	57.3	7	55.9	13	61.2	6
Poor quality of materials	69.2	6	55.7	13	56.3	9	60.4	7
Shortage of labour	68.2	9	56.2	12	56.1	11	60.16	8
Cash Flow (Inflow & Outflow)	67.4	10	54.2	16	58.1	6	59.9	9
Imported, Ordered materials and plant items	66.4	11	56.4	10	56.1	11	59.63	10
Availability of equipment	66.2	12	54.4	15	57.7	7	59.43	11
Slab of payment during construction	69.1	8	57.1	8	52.1	19	59.43	12
Financing by contractor during construction	64.3	13	55.4	14	58.3	4	59.33	13
Unqualified work force / Team	62.5	14	58.2	6	53.2	17	57.96	14
Slow delivery of materials	52.5	19	59.4	4	58.9	3	56.93	15
Unavailability of financial incentive	58.2	15	56.3	11	52.4	18	55.63	16
Disruption of accessories	52.6	17	57.1	8	57.1	8	55.6	17
Lack of motivation	54.5	16	53.2	19	54.6	15	54.1	18

Lack of communication	52.6	17	53.6	18	55.2	14	53.8	19

Table 3 depicts the results of 1st round of ranking of the factors causing time overrun in construction projects in Pakistan. It is reported that poor procurement of materials, shortage of construction materials, financing between the owner and the contractor, poor maintenance of equipment and lack of skilled labour are the top 5 causes of time overrun in construction projects. The result shows that poor procurement of material has the highest effect on time overrun with an overall relative important index score of 66.06%.

4.2 Second Round Results

In the second round of data collection through a questionnaire survey, the factors were selected based on RII scores obtained from the previous 1st round of the questionnaire survey, the limit was set at 45% of RII for cost overrun and 58% for time overrun. By looking at the limits, a total of 15 factors related to cost overrun and 13 factors related to time overrun were selected for 2nd round of questionnaire survey and shared with the same group of experts to rank the critical level of each factor causing cost overrun and time overrun in the construction industry of Pakistan.

Table 4 *Ranking of critical factors causing Cost overrun (round 2)*

Factors of Cost overruns	Owner		Contractor		Consultant		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Inflation and Escalation of material price	58.54	1	52.6	1	65.3	1	58.81	1
Inappropriate construction method	54.6	3	47.3	3	55.8	4	52.56	2
Change in project by owner	43.5	13	49.2	2	63.1	2	51.93	3
Wastage on site	55.1	2	44.1	7	51.2	8	50.13	4
Rework due to errors during construction.	52.2	4	43.6	8	49.2	10	48.33	5
Poor communication and coordination with other parties	48.1	5	46.6	4	46.1	11	46.93	6
Additional project management, consultancy and administrative cost.	42.2	16	40.1	19	58.4	3	46.9	7
Frequent breakdown of the construction plant and equipment	41.4	18	42.8	11	55.6	5	46.6	8
High transportation cost	46.6	6	43.2	9	49.9	9	46.56	9
Mistakes during construction	42.8	14	42.6	12	53.6	7	46.33	10
Additional work at owners request	40.5	19	41.2	18	53.8	6	45.16	11
Ineffective planning & scheduling of project by contractor.	46.6	6	43.1	10	45.1	12	44.93	12
High cost of machinery	43.6	11	46.5	5	44.5	14	44.86	13
Difficulties on importing equipment's and materials	44.1	9	44.6	6	42.6	17	43.76	14
High quality of work required	43.6	11	42.4	14	44.6	13	43.53	15

Table 4 depicts the results of 2nd round of ranking of the factors that cause cost overrun in construction projects in Pakistan. It is reported that inflation and escalation of material price, inappropriate construction method, change in project by owner, wastage on site and rework due to errors during construction were ranked the top 5 causes of cost overrun in construction projects. The result shows that inflation and escalation of material prices had the highest effect on cost overrun with an overall relative important index score of 58.81%.

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Table 5 *Ranking of critical factors causing time overrun (round 2)*

Factors of Time Overrun	Owner		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Materials selection and change in types and specifications during construction	70.5	4	65.3	3	62.6	3	66.1	1
Shortage of labour	72.8	1	60.9	5	62.8	2	65.5	2
Financing between the owner and the contractor	70.8	2	63.6	4	61.7	5	65.4	3
Shortage of construction material	69.4	5	67.9	1	58.3	8	65.2	4
Poor maintenance of equipment	67.1	11	58.5	9	64.6	1	63.4	5
Poor procurement of material	58.2	14	66.2	2	62.5	4	62.3	6
Lack of skilled labour	67.3	10	57.3	14	59.3	6	61.3	7
Poor quality of materials	67.9	7	59.2	8	56.1	12	61.1	8
Availability of equipment	68.6	6	58.2	11	55.7	13	60.8	9
Cash Flow (Inflow & Outflow)	67.7	8	59.8	6	54.9	15	60.8	10
Imported and ordered materials and plant items	67.6	9	56.1	17	58.2	9	60.6	11
Unqualified workforce / Team	70.6	3	58.4	10	52.1	19	60.4	12
Financing by contractor during construction	66.1	12	57.7	13	56.4	11	60.1	13

Table 5 depicts the results of 2nd round of ranking of the factors that cause time overruns in construction projects in Pakistan. It is reported that materials selection and change in types and specifications during construction, shortage of labour, financing between the owner and the contractor, shortage of construction material and poor maintenance of equipment were ranked as the top 5 causes of time overrun in construction projects. The result shows that materials selection and change in types and specifications during construction had the highest effect on time overrun with an overall relative important index score of 66.1%.

4.3 Third Round Results

In the third round of data collection through a questionnaire survey, the factors were selected based on RII scores obtained in the 2nd round of questionnaire survey, the limit was set at 46% of RII for cost overrun and 61% for time overrun. By looking at the limits a total of 10 factors related to cost overrun and 8 factors related to time overrun were selected for 3rd round of questionnaire survey and shared with the same group of experts to rank the critical level of each factor causing cost overrun and time overrun in the construction industry of Pakistan.

Table 6 *Ranking of critical factors causing Cost overrun (round 3)*

Factors of Cost overruns	Owner		Contractor		Consultant		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Inflation and Escalation of material price	61.47	1	56.65	4	65.5	1	61.21	1
Inappropriate construction method	59.4	4	59.7	2	62.4	2	60.50	2
Change in project by owner	60.3	2	60.5	1	59.9	3	60.23	3
Frequent breakdown of the construction plant and equipment	58.1	5	57.8	3	59.7	4	58.53	4
Rework due to errors during construction.	59.9	3	55.9	5	57.3	6	57.70	5
Poor communication and coordination with other parties	58.9	5	57.4	5	54.2	10	56.83	6
Additional project management, consultancy and administrative costs.	55.3	7	54.7	10	58.9	5	56.30	7

Wastage on site	54.5	8	57.1	6	56.1	9	55.90	8
Additional work at owners request	51.6	10	59.5	3	56.2	8	55.77	9
Mistakes during construction	53.8	9	55.6	9	56.6	7	55.33	10

Table 6. depicts the results of 3rd round of ranking of the factors that cause cost overrun in construction projects in Pakistan. It is reported that inflation and escalation of material price, inappropriate construction method, change in project by owner, frequent breakdown of the construction plant and equipment and rework due to errors during construction were ranked the top 5 causes of cost overrun in construction projects. The result shows that inflation and escalation of material prices had the highest effect on cost overrun with an overall relative important index score of 61.21%.

Table 7 *Ranking of critical factors causing time overrun (round 3)*

Factors of Time over run	Owner		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Materials selection and change in types and specifications during constructions	75.3	2	71.2	2	67.1	3	71.2	1
Poor maintenance of equipment	77.1	1	68.2	6	67.1	3	70.8	2
Shortage of construction material	74.1	3	65.4	7	67.6	2	69.0	3
Financing between the owner and the contractor	72.5	4	70.5	3	63.4	6	68.8	4
Shortage of labour	72.3	5	68.5	5	64.2	5	68.3	5
Poor procurement of material	68.2	9	62.2	8	72.1	1	67.5	6
Lack of skilled labour	69.1	7	73.3	1	58.6	7	67.0	7
Availability of equipment	71.4	6	69.6	4	58.3	8	66.4	8

Tables 7. depicts the results of 3rd round of ranking of the critical factors that cause time overruns in construction projects in Pakistan. It is reported that materials selection and change in types and specifications during constructions, poor maintenance of equipment, shortage of construction material, financing between the owner and the contractor and shortage of labour were ranked as the top 5 causes of time overrun in construction projects. The result shows that materials selection and change in types and specifications during construction had the highest effect on time overrun with an overall relative important index score of 71.2%.
The reduction of factors in the third round compared to the first round can be attributed to several key reasons. Some factors identified in Round 1 may have been more applicable to global contexts but did not align with Pakistan's construction industry due to differences in local practices, regulations, and socio-economic conditions. Additionally, factors that experts collectively ranked as less critical or redundant were eliminated to prioritize the most impactful issues.

The filtering process was also guided by statistical thresholds, such as the Relative Importance Index (RII). Factors with consistently low RII values were naturally deprioritized. Furthermore, some factors overlapped with others, leading to their consolidation or removal to avoid redundancy. It is important to note that the exclusion of certain factors does not imply their complete irrelevance to Pakistan's construction industry. Instead, it indicates that they are comparatively less critical or have a lower direct impact in the local context. Factors that did not receive strong consensus among experts or were considered less actionable were deprioritized. The Delphi process played a crucial role in identifying the most significant factors contributing to cost and time overruns in Pakistan's construction sector. The systematic reduction process ensured that only the most influential and actionable factors were retained. Findings highlight inflation, poor material procurement, and labor shortages as the most pressing challenges, emphasizing key areas for mitigation strategies.

Moreover, variations in expert opinions such as differing rankings by owners, contractors, and consultants indicate that construction challenges are perceived differently across stakeholder groups. By adopting this structured approach, the study ensures that the final set of factors is well-supported by expert consensus, highly relevant to Pakistan's construction industry, and practical for implementation.

5. Conclusion

The success of construction projects mainly depends upon effective cost management and timely project completion. The aim of this research work is to explore the critical causes of time and cost overruns in the

projects in Pakistan. For that purpose, the Delphi technique, and Relative Importance Index (RII) methodology are utilized, and data were collected in multiple rounds from experts working in, client, consultant, and contractor-related organizations in the Pakistan construction industry. The primary factors for cost overrun, ranging in relative importance index from 61.21 per cent to 57.70 per cent in the index table, are considered significant based on the statistical findings. Based on the aforementioned findings, it is concluded that the top five factors contributing to cost overrun include "Inflation and escalation of material prices," "Inappropriate construction method," "Change in project by owner," " Frequent breakdown of the construction plant and equipment", "Rework due to errors during construction". The primary factors for time overrun, ranging in relative importance index from 71.2 per cent to 68.3 per cent in the index table, are identified as "material selection and changes in types and specifications during construction," "poor maintenance of equipment," "shortage of construction material," " financing between the owner and the contractor and "shortage of labour".

The findings of this study provide valuable insights for Pakistan's construction industry by highlighting critical areas that require targeted interventions. Implementing proactive risk management strategies, enforcing stricter contract administration, and adopting digital project management tools such as Building Information Modelling (BIM) can significantly enhance project efficiency. Additionally, embracing lean construction techniques, improving quality control, and integrating predictive maintenance for equipment will further reduce time and cost overruns. By addressing these factors, stakeholders can improve project outcomes, minimize financial losses, and enhance overall industry productivity. Government agencies should also focus on capacity-building initiatives, encourage the adoption of modern construction technologies, and implement stringent monitoring mechanisms to ensure project efficiency. A structured approach to tackling these critical challenges will lead to more sustainable and cost-effective construction practices in Pakistan.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Samiullah Sohu, Tahara Ramadzan Md Kassim;* ***data collection:*** *Samiullah Sohu, Najaumuddin;* ***analysis and interpretation of results:*** *Samiullah Sohu, Tahara Ramadzan Md Kassim, Karthikeyan Loganathan;* ***draft manuscript preparation:*** *Samiullah Sohu, Najamuddin. All authors reviewed the results and approved the final version of the manuscript.*

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