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RESEARCH ARTICLE

Identifying and Statistically Analyzing the Causes and Impact of Implementation Delays in Construction Projects on Various Criteria and Providing Reduction Solutions for Future Research

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Abstract: Nowadays, significant efforts are made by stakeholders to ensure project success. Despite these efforts, due to ongoing diversity and changes, projects are still completed with delays, and it appears that preventing delays in projects has become an unavoidable challenge. This study focuses on identifying and statistically analyzing the causes and impacts of executive delays in civil engineering projects on various criteria, as well as proposing mitigation strategies for future research. The statistical population of this research includes contractors of the Maskan Mehr housing projects in Fooladshahr, Isfahan Province. A descriptive, survey-based, and applied research method was adopted. The sample size was randomly selected, and a census sampling method was used by distributing questionnaires to all members of the population. The received responses constituted the sample size, with 30 responses collected in this study. The findings were analyzed using the Friedman test in SPSS software and ranked by importance. Additionally, Cronbach's alpha coefficient was used to assess data reliability. According to the respondents' ranking of factors by importance, the parameter "side issues" (*e.g.*, serious unpredictable complications such as seasonal rainfall) had the highest priority, while "customs clearance problems" had the least impact. The findings reveal a positive and significant relationship between the research variables. Data reliability was estimated using Cronbach's alpha coefficient (0.807), indicating acceptable reliability.

Keywords: executive delays, project challenges, importance ranking, civil engineering project management, construction management, delay mitigation strategies

1 Introduction

One of the hallmarks of a nation's growth and development is the success of its civil engineering projects. Implementing infrastructure projects in any region enhances economic conditions and trade exchanges. Civil engineering projects, which form the backbone of a nation's infrastructure, typically require substantial budgets and extended timelines (Javadinejad et al., 2021). Key indicators of project success include timely and high-quality delivery; thus, delays in such projects inflict irreversible damage on the economy. Delays can escalate project costs to several times the initial estimates and hinder the realization of project benefits (Khayati, 2018; Javadinejad et al., 2019, 2020; Mirramazani et al., 2019).

However, many projects face significant delays despite the efforts of clients, contractors, and consultants. These delays are particularly evident in projects awarded through traditional methods or low-bid tenders. In civil engineering projects, "delay" refers to the extension of project delivery beyond the agreed contractual timeline. Delays are a common and unwelcome issue for all stakeholders: clients lose potential profits due to postponed operations, contractors face rising costs and resource inefficiencies, and the public is deprived of social benefits. In Iran, numerous civil projects are under execution, and delays often become so prolonged that they waste national resources, inflict social losses, and render projects economically unjustifiable. Direct and indirect damages from delays sometimes exceed the project's actual value (Ahmadi & Sepahi, 2013; Javadinejad et al., 2019).

Delays in construction projects are critical due to their impact on large-scale investments, operational timelines, and inherent complexities involving uncertainties. Consequently, researchers worldwide have studied delays and their management in construction projects.

Delays in completing civil projects lead to resource wastage, reduced profits, and missed opportunities. They remain one of the most frequent and impactful challenges, negatively affecting project success in terms of cost, time, quality, and safety (Shool & Hakimi, 2019; Javadinejad et al., 2016, 2020). Since delays are a major point of contention between clients and contractors, project control methods, such as continuous schedule monitoring, are used to identify deviations from timelines. Restoring the original schedule often incurs high costs for contractors, while prolonged delays harm clients(Javadinejad et al., 2019, 2020).

Thus, identifying root causes of delays and proposing practical solutions are essential for engineering projects. To mitigate delays, their causes must be systematically analyzed (Yarmohammadian et al., 2018; Javadinejad et al., 2019, 2020).

Government-led civil projects frequently face repeated halts, prolonging timelines and sometimes leading to complete abandonment. Extended project durations increase costs and risks(Javadinejad[(12)]et al. 2020) and (Javadinejad et al., 2019). Delays have become so normalized that unfinished projects within stipulated timelines are perceived as an unwritten norm in Iran's budgeting and execution systems. According to the Monitoring and Evaluation Office of the Management and Planning Organization, insufficient funding is the primary cause of delays in civil projects. Persistent financial shortages in recent years indicate that delays or even project suspensions will remain widespread (Dastgerdi et al., 2023; Javadinejad et al., 2018, 2019).

Just as diagnosing a disease is the first step in its treatment, identifying the factors contributing to delays is a crucial step in improving project execution and preventing delays in future projects (Javadinejad et al., 2018, 2019, 2020). Since prior studies have not examined the causes and impacts of executive delays in civil engineering projects in Isfahan Province, this research aims to statistically analyze these factors and propose mitigation strategies for projects in Isfahan. The methodology involves identifying delay factors through a review of existing literature, selecting relevant factors for civil engineering projects, analyzing them via questionnaires, prioritizing the factors, and finally providing actionable recommendations to contractors, clients, engineers, and other stakeholders to reduce project delays.

One of the central challenges societies face is achieving development, and civil engineering projects play a vital role in this process. Delays in commissioning such projects equate to delays in national development, leading to significant losses, including increased project costs, capital stagnation, loss of relevance, reduced budget flexibility, diminished quality, and public dissatisfaction (Shamei et al., 2021; Javadinejad et al., 2011, 2020).

A hallmark of a nation's industrial and economic growth is the successful execution of civil engineering projects. Key indicators of success include timely and high-quality delivery, as prolonged project timelines not only inflate costs due to factors like inflation and price hikes but also delay the utilization of completed projects. Delays in civil projects remain a critical weakness in the global construction industry, and studies show that despite modern technology, most projects still exceed their deadlines. Addressing delays and preventing their recurrence in future projects requires identifying their causes and attributing responsibility among stakeholders, a complex task due to the unique nature of each project (Asadi, 2017; Javadinejad et al., 2020).

Delays in civil projects are a major point of contention between clients and contractors. Project control methods, such as continuous schedule monitoring, are typically used to detect deviations from timelines. Restoring the original schedule often imposes high costs on contractors, while prolonged delays harm clients, creating a conflict of interest. Timely completion and delivery of civil projects are critical for stakeholders, underscoring the need for this study's statistical analysis of delay causes and impacts in Isfahan Province, along with proposed mitigation strategies. Data from this study will be analyzed using SPSS software.

2 Research Methodology

Given that this study is intended for use by policymakers, planners, managers, and engineers in civil engineering projects in Isfahan Province, it is applied research in nature. In terms of analytical approach, since it statistically analyzes the causes and impacts of executive delays in civil projects and proposes mitigation strategies for Isfahan Province, the study is descriptive-

analytical. As data collection relies on questionnaires, it is also classified as survey-based research. (Figure 1)

(1) Procedure

Identification of Causes: First, the causes and impacts of executive delays in civil projects are identified.

Indicator Extraction: Relevant indicators for each factor are extracted from existing literature.

Questionnaire Design: A questionnaire is designed based on these indicators.

(2) Validation and Reliability

Validity: Ensured by incorporating feedback from experts.

Reliability: Assessed using Cronbach's alpha coefficient in SPSS software. Adjustments to the questionnaire are made to optimize fit.

(3) Data Analysis: Collected data from the questionnaires are analyzed.

(4) Recommendations: Final results and actionable recommendations are provided to policy-makers, planners, managers, and engineers involved in civil projects in Isfahan Municipality.

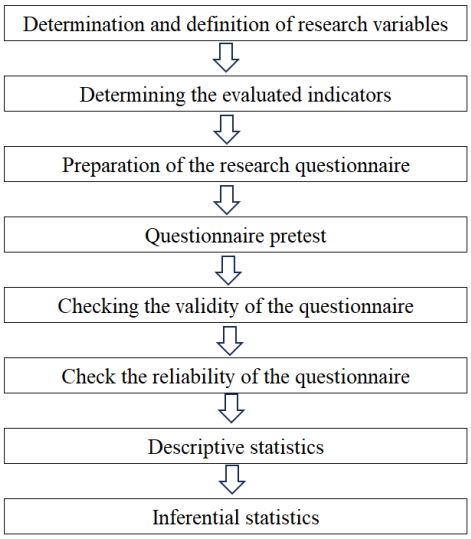

Figure 1 Research work-flow

2.1 Research Scope

(1) Thematic Scope: The study focuses on delays in project execution, causes of delays in civil engineering projects, and strategies to mitigate delays for future research.

Spatial Scope: The geographical scope of this research is civil engineering projects in Isfahan Province, Iran.

(2) Temporal Scope

Cross-Sectional Studies: Some studies collect data at a single point in time (*e.g.*, over days, weeks, or months) to address research questions. These are termed "cross-sectional" or "snapshot" studies, focusing on a specific period.

Longitudinal Studies: In contrast, longitudinal studies collect data on variables at multiple time points to analyze changes over time.

This research employs cross-sectional data, collected during the period February 2024 to June 2024 (Bahman 1402 to Khordad 1403 in the Persian calendar).

2.2 Conceptual Model

The causes of delays in projects have been widely studied. Researchers categorize delays into two types:

Justified Delays: Typically caused by unpredictable natural factors.

Unjustified Delays: Stem from structural, managerial, or operational shortcomings.

Studies indicate that in developed countries, delays are primarily unjustified (management-related), while in developing countries, justified delays (natural or external factors) dominate. (Figure 2)

To develop the conceptual framework for this study, the following steps were undertaken:
(1) A review of existing literature, related models, and field research precedents.
(2) Identification of five main components based on the research title and case study context.

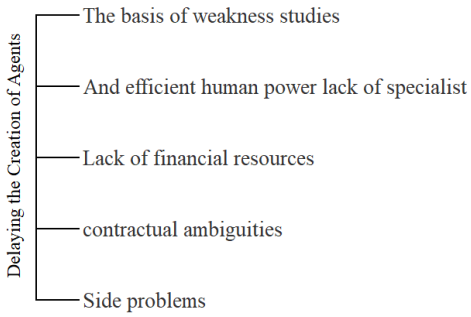

Figure 2 Conceptual research model

2.3 Questionnaire

Since questionnaires are the most common data collection tool in survey research, this study employs a researcher-designed questionnaire (see appendix for the sample). The questionnaire comprises two sections:

(1) Demographic Information: 5 questions assessing respondents' gender, role, field of expertise, educational background, and work experience in the Maskan Mehr housing projects in Fooladshahr.

(2) Specialized Questions: 52 questions evaluating the impact of executive delays on various criteria in Isfahan Province.

2.3.1 Validity

The questionnaire's face validity, content validity, and construct validity were confirmed through alignment with prior studies and expert reviews.

2.3.2 Reliability

Reliability was assessed using Cronbach's alpha, a measure of internal consistency. The questionnaire was distributed to 30 experts, and the resulting Cronbach's alpha coefficient (0.807) confirmed high reliability. Values closer to 1 indicate stronger internal consistency. (Table 1)

Table 1 Reliability coefficients of the research questionnaire

Reliability Coefficient	Number of Questions	Dimensions	Reliability Coefficient	Total Number of Questions
0.784	12	Weakness of basic studies	0.807	52
0.842	11	Lack of efficient and specialized human resources		
0.702	7	Lack of timely financial resources		
0.698	14	Contractual ambiguities		
0.812	8	Side problems		

2.4 Data Analysis Methods

This study employs descriptive statistics, inferential statistics, and SPSS software for data analysis.

2.4.1 Normality Test (Kolmogorov-Smirnov Test)

As shown in Table 2, the significance level (p-value) for all variables, assessing the impact of executive delays in the Maskan Mehr housing projects in Fooladshahr on various criteria, is greater than 0.05. This confirms that the data distribution is normal.

2.4.2 One-Sample T-test

A one-sample t-test evaluates whether the population mean of a variable differs from a specified value. In this study, the test compares the sample mean to 3 (the midpoint of the Likert scale used in the questionnaire) at a 95% confidence level to determine if this value is

Table 2 Variable analysis test for impact assessment

Scale	Reliability Coefficient	Error rate
Weakness of basic studies	0.2	0.83
Lack of efficient and specialized human resources	0.2	0.123
Lack of timely financial resources	0.2	0.074
Contractual ambiguities	0.124	0.152
Side problems	0.2	0.102

statistically acceptable for the research components or if values significantly higher/lower than 3 should be considered.

Null Hypothesis (H_0): The population mean equals 3.
Alternative Hypothesis (H_1): The population mean differs from 3.

2.4.3 Interpretation of Results in SPSS

A. Sig $>$ 0.05 with mixed confidence interval bounds (upper positive, lower negative): The mean is not significantly different from 3.

B. Sig $<$ 0.05 with both confidence interval bounds positive: The mean is significantly greater than 3.

C. Sig $<$ 0.05 with both confidence interval bounds negative: The mean is significantly less than 3.

Table 3 presents the results of the t-test, demonstrating the significant impact of executive delays in the Maskan Mehr housing projects in Fooladshahr on various criteria.

Table 3 T-test Results for Variable Significance and Dimensions

No.	Scale	Test Value = 3				
		T value	Reliability Coefficient	Average Difference	Confidence Interval of Differences 95%	
					Lower limit	Upper limit
1	Weakness of basic studies	24.92	0.000	2.85	2.6140	3.0860
2	Lack of efficient and specialized human resources	25.57	0.000	3	2.7683	3.2512
3	Lack of timely financial resources	25.37	0.000	3.317	3.0481	3.5868
4	Contractual ambiguities	31.65	0.000	3.09	2.8895	3.2918
5	Side problems	29.25	0.000	3.375	3.1386	3.6114

2.4.4 Ranking Research Components Using the Friedman Test

To prioritize the main research components and evaluate the relative importance of variables affecting executive delays in civil engineering projects in Isfahan Province, the Friedman test was applied. The results are summarized in Table 4. The following hypotheses were formulated:

Null Hypothesis (H_0): The priority rankings of components assessing the impact of executive delays on various criteria are equal.

Alternative Hypothesis (H_1): The priority rankings of components assessing the impact of executive delays on various criteria are not equal.

Table 4 Ranking of Components Assessing the Impact of Executive Delays in Isfahan Civil Projects on Various Criteria

Dimensions	Significance of Coefficient	Degree of freedom	Average rank	Component Rank
Weakness of basic studies	0	51	2.07	5
Lack of efficient and specialized HR			3.61	2
Lack of timely financial resources			3.57	3
Contractual ambiguities			3.02	4
Side problems			3.73	1

According to Table 4, the significance coefficient (p-value) is less than 0.05; thus, the null hypothesis is rejected at a 95% confidence level. Consequently, the rankings of the components assessing the impact of causes for delays in executive civil projects in Isfahan Province across various criteria are not uniform. The variables are ranked as follows: *peripheral issues* in first

place, *lack of skilled and specialized human resources* in second place, and *untimely provision of financial resources* in third place.

Figure 3 shows the rank and degree of importance of the components of the study of the impact of the reasons for the implementation delays of construction projects in Isfahan province on various criteria.

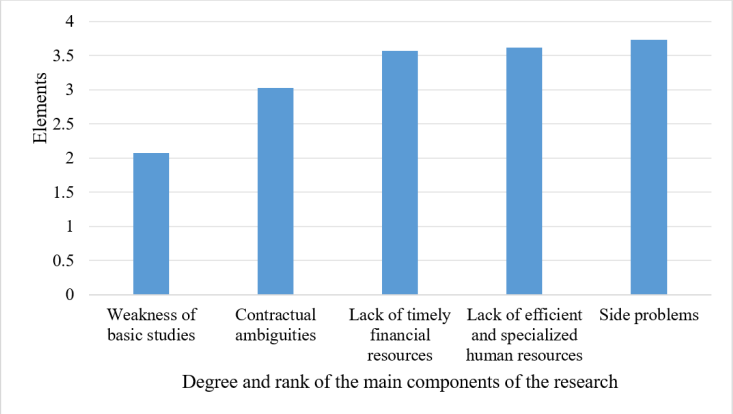

Figure 3 Rank and degree of importance of the components

3 Results

In analyzing the data obtained from expert questionnaires and identifying the most important factors, as well as their importance and impact on delays in construction projects in Isfahan province, in examining these factors on various criteria, the following were identified as important, which are summarized in Table 5.

3.1 Practical research suggestions

For solutions to reduce implementation delays in Mehr Foladshahr housing projects, future studies are presented.

3.1.1 Suggestions to prevent delays caused by weak basic studies

(1) The goals, strategies, and implementation requirements of projects and their stakeholders should be clear and transparent;

(2) All project management processes and procedures should be identified and operationalized;

(3) The planning, implementation, and control tools and techniques should be consistent with the goals, strategies, and requirements of the project.

(4) Using the sharing and application of project management knowledge and the scientific approach to project control in the design and implementation process of projects

(5) Creating an appropriate project implementation structure, including managing the procurement of goods and services, ensuring the quality of implementation, time management, etc.;

(6) Relying on the highest common project management standards in the construction industry, regardless of existing facilities;

(7) Improving the adequacy of clear laws, regulations, and executive instructions regarding project execution and monitoring systems;

(8) Separating project implementation stages to the level of recognizing activities and relationships between them;

(9) Accurate and specific definition of project measurement and control indicators;

(10) Correct use of previous case records and their application;

(11) Appropriate localization of studies on foreign optimal models, in order to use and apply them in domestic projects;

(12) Accurate and rational identification of project risks.

Table 6 shows the results of scores for each question of the delay component due to weak basic studies based on questionnaire responses.

Figure 4 shows the comparative graph of each question for the delay component due to weak basic studies.

Table 5 Causes of delays in construction projects in Isfahan province

Elements	Ranking of causes of delays in construction projects in Isfahan province
Weakness of basic studies	1. Failure to separate project implementation stages to the level of recognizing activities and relationships between them 2. Little use of sharing and applying project management knowledge and the scientific approach to project control in the process of designing and implementing projects 3. Failure to identify and operationalize all project management processes and procedures 4. Incompatibility of planning, implementation and control tools and techniques with project objectives, strategies and requirements 5. Lack of clarity and clarity of project objectives, strategies and implementation requirements and their stakeholders 6. Inadequacy of clear laws, regulations and executive instructions in relation to project implementation and monitoring systems 7. Failure to accurately and logically identify project risks 8. Reliance on the highest common project management standards in the construction industry, without considering existing facilities 9. Failure to accurately and clearly define project measurement and control indicators 10. Failure to properly localize studies on external optimal models for use and application in domestic projects 11. Lack of appropriate project implementation structure, including management of goods and services procurement, quality assurance of implementation, time management, etc. 12. Failure to properly use From the records of previous cases and applying them to a case
Lack of efficient and specialized HR	1. The employer uses the lowest price as the criterion for the winner of the tender 2. Inaccuracy in estimating the tender documents (volume of operations, costs and project time) 3. Deficiency in research capacities in the field of studying the preliminary stages, implementation and monitoring of projects 4. Reliance on ad hoc successes resulting from the capabilities of individuals or environmental factors, without considering the systematic nature of successes and beneficial results from previous projects 5. Weakness in evaluating and estimating project implementation costs by the employer 6. Underdevelopment of management consultant capacities 7. Lack of attention to teamwork and participatory management in project management processes 8. Insufficient mastery of the employer's personnel in the legal aspect of contracts 9. Lack of systematization in increasing the capacity and quality of project management training 10. Lack of comprehensive technical evaluation of consultants and contractors by the employer's personnel 11. Lack of specialized and skilled human resources in the contractor's organization
Lack of timely financial resources	1. Problems related to project funding by the employer 2. Weakness in the actual cost estimation of projects 3. Financial weakness of project contractors 4. Failure to pay invoices of contractors and consultants on time due to liquidity problems by the employer 5. Prolonged account opening and activation of documentary credits in the supply of goods 6. Lack of attention to the principle of management based on merit in compensation for services, bonuses and other motivational issues 7. Lack of equipping the contracting department with appropriate equipment and facilities and modern technologies to reduce costs
Contractual ambiguities	1. Lack of necessary coordination between the project consultant and contractor and its not being included in the contract provisions 2. Lack of attention to the results of the technical evaluation and the performance of consultants in the consultant selection tenders 3. Failure to observe a reasonable and appropriate mechanism for selecting contractors and concluding contracts with them 4. Contractual ambiguities regarding legal deductions in the contract 5. Announcement of frequent changes in the framework of the initial needs of the projects by the employer's applicant units and requests for amendments 6. Making executive changes in the project's work description, exceeding the legal limits stated in the contracts 7. Providing unconventional and low rates with the aim of winning the tender by the contractor 8. Lack of transparency of the tender conditions and the lengthy process of selecting the contractor 9. Limiting the supply of goods from a few manufacturers, based on the authorized list stated in the contract 10. Lack of information, management and coherence of the various areas of project implementation, in the event of changes in part of the project implementation process 11. Flexibility and ability to change insignificantly in the contract according to the conditions and requirements of the variable environment 12. Inaccuracy in defining and determining Basics of price changes in contracts and claims from contractors 13. Informal influence and bargaining power over contractors in carrying out project activities 14. Lack of transparency and interpretability of contract documents
Side problems	1. The occurrence of serious unforeseen complications such as seasonal rainfall and dust, etc. 2. Floating exchange rates of various currencies 3. Lack of proper growth and development of project management culture 4. Unconventional increase in the price of goods and services 5. Political problems such as economic and political sanctions in the supply of goods and services required by the project 6. Problems of opponents 7. Problems in the supply of goods and services due to changes in the conditions of foreign manufacturers 8. Problems in customs clearance

Table 6 Results of scores for each question of the delay component

Number of the Questions	Average	Standard Deviation	Variance	Minimum	Maximum
1	2/9655	1/20957	1/463	1/00	5/00
2	3/0333	/96431	/930	1/00	5/00
3	3/0333	1/24522	1/551	1/00	5/00
4	3/1000	1/26899	1/610	1/00	5/00
5	2/6333	1/09807	1/206	1/00	5/00
6	2/8214	1/18801	1/411	1/00	5/00
7	2/9643	/92224	/851	1/00	4/00
8	3/1852	1/07550	1/157	1/00	5/00
9	2/7857	1/10075	1/212	1/00	5/00
10	2/4815	1/15593	1/336	1/00	4/00
11	2/7500	1/10972	1/231	1/00	5/00
12	2/9286	1/05158	1/106	1/00	5/00

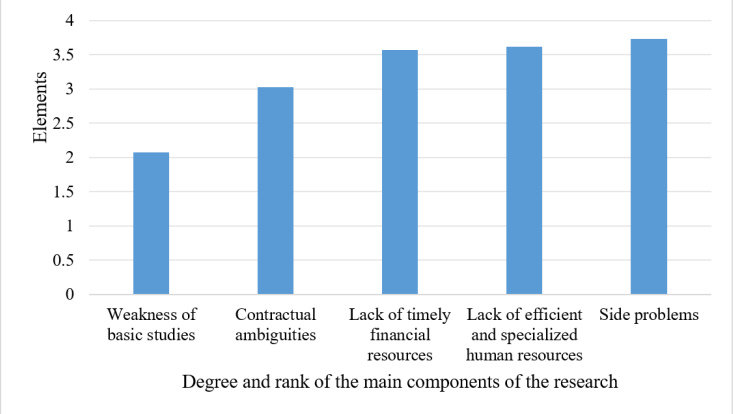

Figure 4 Comparative graph of each question for the delay component

3.1.2 Suggestions to prevent delays due to lack of efficient and specialized human resources

(13) Eliminating deficiencies in research capacities in the field of studying the preliminary stages, implementing and monitoring projects;

(14) Comprehensive technical evaluation of consultants and contractors by the employer's personnel;

(15) Providing the required specialized and skilled human resources in the contractor's organization;

(16) Sufficient mastery of the employer's personnel in the legal aspect of contracts;

(17) Accurate evaluation and estimation of project implementation costs by the employer;

(18) Developing management consultant capacities;

(19) Systematizing in increasing the capacity and quality of project management training;

(20) Accuracy in estimating tender documents (volume of operations, costs and project time);

(21) Attention to teamwork and participatory management in project management processes;

(22) Relying on ad hoc successes resulting from individual capabilities or environmental factors, while taking into account the systematic nature of successes and beneficial results from previous projects;

(23) Not using the lowest price as the criterion for the winner of the tender by the employer.

Table 7 shows the results of the scores for each question of the delay component due to the lack of efficient and specialized human resources.

Figure 5 shows the comparative graph of each question for the delay component due to lack of specialized and efficient human resources.

3.1.3 Suggestions to prevent delays due to failure to provide timely financial resources

(24) Resolving problems related to project funding by the employer;

(25) Reducing the time for opening an account and activating documentary credits in the

Table 7 Results of the scores for each question of the delay component

Number of the Questions	Average	Standard Deviation	Variance	Minimum	Maximum
13	3/1071	1/16553	1/358	1/00	5/00
14	2/8571	1/20844	1/460	1/00	5/00
15	2/7143	1/32936	1/767	1/00	5/00
16	2/8621	1/05979	1/123	1/00	5/00
17	3/0690	1/25160	1/567	1/00	5/00
18	3/0345	/94426	/892	1/00	4/00
19	2/8621	1/05979	1/123	1/00	5/00
20	3/1724	1/25553	1/576	1/00	5/00
21	3/0345	1/11748	1/249	1/00	5/00
22	3/1034	1/04693	1/096	1/00	5/00
23	3/3448	1/11085	1/234	1/00	5/00

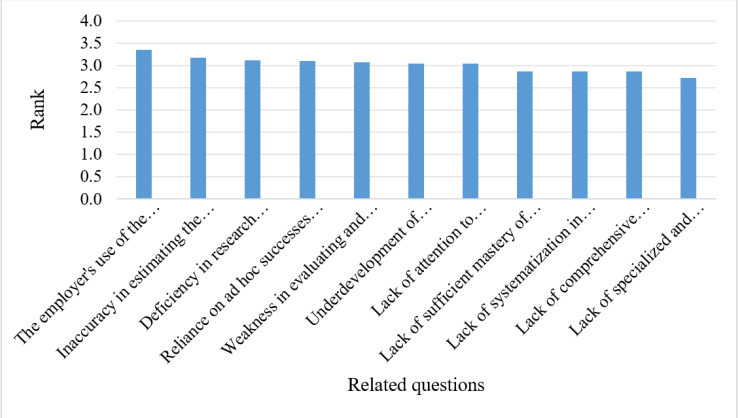

Figure 5 Comparative graph of each question for the delay component

supply of goods;

(26) Realistic estimation of project costs;

(27) Empowering the financial sector of project contractors;

(28) Paying invoices to contractors and consultants on time, due to liquidity problems by the employer;

(29) Equipping the contracting department with appropriate equipment and facilities and modern technologies to reduce costs;

(30) Paying attention to the principle of management based on merit in compensation for services, rewards, and other motivational issues.

Table 8 shows the results of the scores for each question of the component of delay caused by timely provision of financial resources.

Table 8 Results of scores for each question of the component of delay

Number of the Questions	Average	Standard Deviation	Variance	Minimum	Maximum
24	3/7931	1/14578	1/313	1/00	5/00
25	3/1034	1/26335	1/596	1/00	5/00
26	3/6071	/99403	/988	2/00	5/00
27	3/3214	1/12393	1/263	1/00	5/00
28	3/2963	1/35348	1/832	1/00	5/00
29	2/8929	1/13331	1/284	1/00	5/00
30	3/0714	1/05158	1/106	2/00	5/00

Figure 6 shows the comparative graph of each question for the component of delay due to timely provision of financial resources.

3.1.4 Suggestions to prevent delay due to contractual ambiguities

(31) Adhering to a reasonable and appropriate mechanism for selecting contractors and concluding contracts with them;

(32) Clarifying the conditions for holding tenders and reducing the time of the contractor

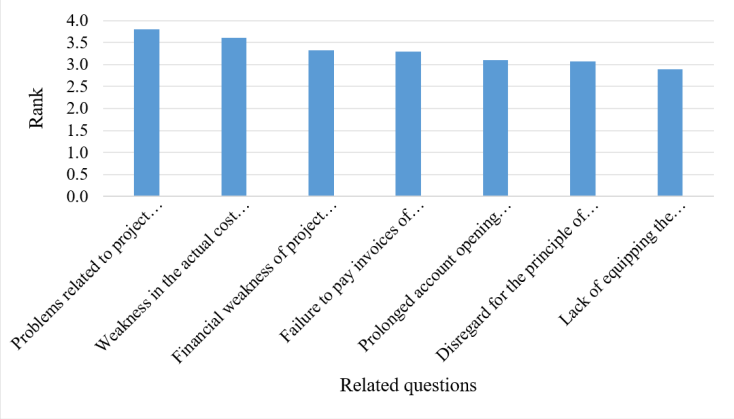

Figure 6 Comparative graph of each question for the component of delay

selection process;

(33) Providing reasonable and low rates with the aim of winning the tender by the contractor;

(34) Failure to announce frequent changes in the framework of the initial requirements of the projects by the employer's applicant units and requesting amendments;

(35) Lack of flexibility and the ability to make insignificant changes in the contract according to the conditions and requirements of the changing environment;

(36) Procurement of goods from different manufacturers, based on the authorized list included in the contract;

(37) Clarifying and interpreting contract documents;

(38) Failure to make executive changes in the project work descriptions, exceeding the legal limits included in the contracts;

(39) Accuracy in defining and determining the bases related to the price of changes in contracts and the occurrence of claims from contractors;

(40) Absence of informal influence and bargaining power over contractors in carrying out project activities;

(41) Informing, managing and integrating different areas of project implementation, in the event of changes in part of the project implementation process;

(42) Reducing contractual ambiguities in relation to legal deductions of the contract;

(43) Establishing the necessary coordination between the consultant and the project contractor and not including it in the provisions of the contract;

(44) Paying attention to the results of the technical evaluation and the performance of consultants in the consultant selection tenders.

Table 9 shows the results of scores for each question of the delay component due to contractual ambiguities.

Table 9 Results of scores for each question of the delay component

31	3/2963	1/13730	1/293	2/00	5/00
32	3/0000	1/36083	1/852	1/00	5/00
33	3/1429	1/11270	1/238	1/00	5/00
34	3/1786	/94491	/893	2/00	5/00
35	2/8667	1/00801	1/016	1/00	5/00
36	3/0000	/90972	/828	2/00	5/00
37	2/5667	1/13512	1/289	1/00	5/00
38	3/1724	/88918	/791	1/00	5/00
39	2/7000	/98786	/976	1/00	4/00
40	2/6333	1/06620	1/137	1/00	5/00
41	2/9333	1/33735	1/789	1/00	5/00
42	3/2667	1/14269	1/306	1/00	5/00
43	3/4828	1/15328	1/330	1/00	5/00
44	3/4000	/96847	/938	2/00	5/00

Figure 7 shows the comparative graph of each question for the delay component due to contractual ambiguities.

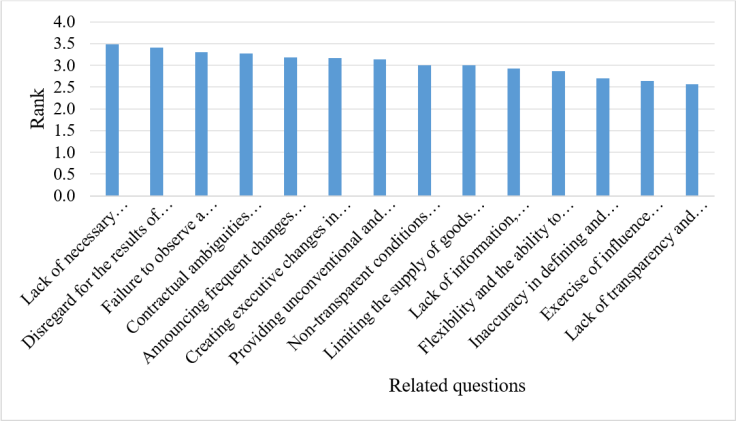

Figure 7 Comparative graph of each question for the delay component

3.1.5 Suggestions to prevent delays due to side problems

(45) Resolving political problems such as economic and political sanctions in the supply of goods and services required by the project;
(46) Resolving customs clearance problems;
(47) Resolving problems in the supply of goods and services due to changes in the conditions of foreign manufacturers;
(48) Reducing the unconventional increase in the price of goods and services;
(49) Reducing the floating exchange rate of various currencies;
(50) Reducing serious unpredictable complications such as seasonal rainfall and dust, etc.;
(51) Reducing the problems of opponents;
(52) Appropriate growth and development of project management culture.

Table 10 shows the results of scores for each question of the delay component due to side problems.

Table 10 Results of scores for each question of the delay component

45	3/3000	1/36836	1/872	1/00	5/00
46	2/9000	1/18467	1/403	1/00	5/00
47	3/0667	1/04826	1/099	1/00	5/00
48	3/4333	1/19434	1/426	1/00	5/00
49	3/5172	1/08958	1/187	1/00	5/00
50	3/6000	1/22051	1/490	1/00	5/00
51	3/2000	/99655	/993	1/00	5/00
52	3/5000	1/13715	1/293	1/00	5/00

Figure 8 shows the comparative graph of each question for the delay component due to side problems.

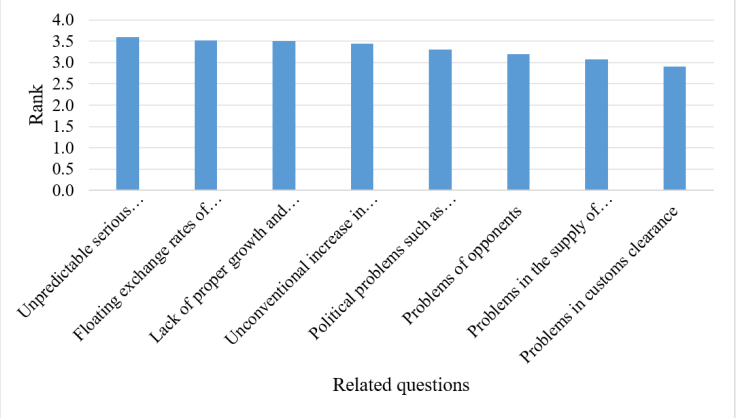

Figure 8 Comparative graph of each question for the delay component

3.2 Results from statistical analysis of data and information

Regarding the main research question "What are the parameters affecting the occurrence of delays in construction projects? And what solutions do you suggest to reduce them in Isfahan province?" According to the ranking of the importance of the factors, the side problems parameter has the highest priority from the respondents' perspective, with the occurrence of serious unpredictable complications such as seasonal rainfall, etc. having the greatest impact and customs clearance problems having the least impact.

The lack of efficient and specialized human resources is ranked second, with the lack of specialized and skilled human resources required in the contractor organization having the least impact, and the ability to place the lowest price as the winner of the tender by the employer being the most influential factor among the factors of this parameter.

The lack of timely provision of financial resources is ranked third. Problems related to project funding by the employer have the greatest impact, and the least impact is related to the lack of equipment and facilities for the contracting department and modern technologies to reduce costs.

Contractual ambiguities are ranked fourth in the priority list, with the lack of clarity and uninterpretability of contract documents having the least impact, and the lack of necessary coordination between the consultant and the project contractor and its not being included in the contract provisions having the greatest impact.

And finally, the weakness of basic studies is ranked fifth. The greatest impact is the lack of separation of project implementation stages to the level of recognizing activities and relationships between them, and the least impact is the lack of proper use of previous case records and the application of a case study.

The findings obtained show that there was a positive and significant relationship between the research variables. Also, employers, contractors, consultants and other engineers of Mehr Foladshahr housing projects in Isfahan should accept that project delays are inevitable, but to reduce them, they should focus on identifying the factors that caused delays in past projects. They can prevent delays in projects to a great extent by trying to introduce the importance of "time" in projects through culture building, timely provision of resources by the employer, and creating a logical match between the contract amount and the approved credits so that the time distribution of the credit is consistent with the project schedule, guiding contractors to be careful in calculating the cost price and justifying them for giving the right price in tenders, studying and creating appropriate indicators in selecting the contractor and implementing it by the employer, and using graduates of industrial engineering and industrial management in project control and familiarizing managers, consultants and contractors with project planning and control management and forcing them to do so instead of using traditional and beginner methods.

4 Conclusion

The present study was conducted with the aim of statistically analyzing the causes and effects of execution delays in Mehr Foladshahr housing projects and providing solutions to reduce them in Isfahan province in the year (1403) using a descriptive survey method. The statistical population of this study includes employers, consultants, contractors, and people in charge and familiar with the research topic. The sampling method of the above research is the census sampling method, which is 30 samples that include a completed questionnaire. This method is such that due to the small size of the population, the questionnaire is distributed among all the people in the community and the number of responses received constitutes the number of the population. The questionnaires used in this study, the face, content, and construct validity of the questionnaires have been conducted and approved using previous research. The reliability coefficient of the questionnaire was estimated using Cronbach's alpha coefficient (0.807). Data analysis was performed in SPSS software.

In order to analyze the data, descriptive statistics including frequency, percentage, mean and standard deviation and inferential statistics including averaging the scores of the research variables, Kolomoirov-Smirnov test, analysis of variance, one-sample t-test, Friedman test were used. The findings indicate that all the variables affecting the reasons for the implementation delays of Mehr Foladshahr housing projects are available. The significance level of all research variables is less than 0.05, so the distribution of scores is normal. None of the groups show a significant difference, which indicates the equality of the means in the education level variable.

None of the groups show a significant difference, which indicates the equality of the means in the field of study variable. All dimensions of the study of the impact of the reasons for the implementation delays of Mehr Foladshahr housing projects on different criteria are not the same, and the variables of side problems are in the first place, the lack of efficient and specialized human resources in the second place, and the lack of timely financial resources in the third place.

In order to conduct the present study, the researcher faced the following limitations:

(1) The study population in this study is the employers, contractors, consultants and other engineers of Mehr Foladshahr housing projects in Isfahan city, therefore, considering the structural, cultural and individual differences of other organizations, generalization to other organizations is probably not easily possible or, in case of similarities, generalization should be done with caution.

(2) The questions were tested based on the research model and other relationships between variables were not considered in the model.

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Conflicts of interest

The authors declare that they have no competing interests.

Data availability

Some or all data, models, or code used during the study were provided by a third party. Direct requests for these materials may be made to the provider as indicated in the Acknowledgements. The data include: Minimum temperature, maximum temperature, precipitation, sunny day, wind speed, dew point temperature, and pressure was obtained from the Esfahan Regional Water Authority, Meteorological Organization and the Ministry of Energy.

Authors' contributions

Safieh Javadinejad designed the research, wrote the paper, collected the necessary data, and conducted the data analysis. The other co-authors, including Rebwar Dara, Stefan Krause, Majid Riyahi, and Abdoreza Mohammadi, participated in drafting the manuscript. They contributed to data collection, data interpretation, and edited the paper format according to the manuscript style.

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