

Identifying and Prioritizing of Contractors' Claims in Three-Factor Contracts Based on Financial Criteria Case Study: Civil Project of Shiraz Municipality

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ABSTRACT

Today, the claim is an integral part of civil projects in the country. These claims have caused irreparable damage to the country's economy. This study aims to identify and prioritize the claims of contractors in three-factor contracts based on financial criteria (Case study: Civil Project of Shiraz Municipality). The present study is applied in terms of purpose and descriptive-survey in terms of methodology. The statistical population consisted of 10 contractors, employers, and consultants of Shiraz Municipality. In this study, 4 main criteria and 18 sub-criteria were identified using the research background and the experts' opinion, and then a questionnaire was prepared. This questionnaire was evaluated by ANP and DEMATEL combined methods. According to the results, most of the claims were made in the bid and conclusion of the contract. So that the top three priorities were related to the sub-criteria of bid and conclusion of the contract. Employers should pay more attention to the text of the contract or even edit the terms of the contract using legal advisors. Also, contractors should focus more time on the content of the contract and study the content and technical drawings of the contract well before a bid. To prevent the recurrence of claims in the project, some solutions including 1- Accuracy in forecasting and cost and time of project implementation 2- Selecting the best method of project implementation. 3- Predicting the delay in the contract 4- Preparing the mechanism for evaluating the changes in terms of direct and indirect costs and profits 5- sufficient and appropriate time for the contractors to evaluate the bid documents have been proposed.

Keywords: Contractors' Claims, Three-Factor Contracts, Financial Criteria

Introduction

The structure of civil projects and the management of contract claims are affected by various components such as economic conditions, geographical location, access to materials, local skilled labor, executive management, local culture in accelerating or delays the project. Therefore, there are some influencing factors in each region for a project delay. Recognizing and determining these factors can help us to provide an appropriate enforcement solution to prevent claims and reduce costs (Jahangiri and Qomi Oveili, 2017). Claims in civil projects in all parts of the world are due to changes or delays or financial problems.

According to the reports of the Strategic Vice President and the Research Center of the Islamic Consultative Assembly, a large number of projects are affected by financial problems every year. These cannot be finished either or delayed or spends more than the predetermined cost. According to the statistics of the Management and Planning Organization of the country, the costs of 90% of civil projects have increased. Also, according to World Bank studies, 30 to 40 percent of projects in all countries face increased costs. The publication of the agreement and the general terms of the contract is the primary criterion for judgment and strategic instruction between employers and contractors; shortcomings and ambiguities in the formulation of these criteria increase the time required for implementation and delay in operation, increase costs and reduce project efficiency, cause conflicts of interest and differences between the parties and ultimately lead to damages to resources and national interests (Noor et al. 2017).

During the progress and planning of the project, some disputes that occur increase the claims in the project. Because the claim is unpredictable, efforts are needed to identify and manage the claim. Most project requirements relate to time and cost in the project which affects not only the job of individuals but also the whole project and may shut down the whole project. Therefore, it is necessary to identify the reasons for the claim and take the necessary measures when necessary (Hayati et al., 2019).

Identifying the claims in the contract reduces project costs significantly (Hashem et al. 2018). These claims cause the project to deviate from its goals, so the analysis of this claim helps to solve and manage these problems (Dastyar et al., 2018). Common claims that are made during the execution of a project will vary depending on the claimant (contractor or employer). They do not have much time and quality to file the claim. In the common claim related to the employer, the first rank is the time claim and in the second rank is the qualitative claim (Jahangiri and Qomi Oveili, 2017).

In most projects, there is a possibility of a claim by the contractor and other project agents. Contractors' claims are usually financial. Therefore, any factor that causes the contractor to face a problem from his goal, i.e. profit, is formed. Certainly identifying and preventing a claim is easier and less costly than resolving it. But once a claim is made, it will take a long time to resolve it. And due to the passage of time and the obsolescence of problems, various aspects will be added to it. As a result, it imposes more costs on the project. If the causes of the claim are known, the ways to prevent it will be known. And in many cases, by taking simpler measures, major claims can be prevented. Therefore, in this study, all the factors of financial claims in the project are identified, and then using the combined method of DEMATEL and ENP, the causes of the differences will be compared with each other and finally, the claims will be prioritized to find appropriate solutions for to prevent and prevent claims in contracts.

Theoretical Foundations of Research

1.1. Contractors Claim

In each contract, the contractor obliges to complete the main subject of the contract with a predetermined quality, according to a predetermined schedule, and with a specific budget. Now, if one of the main components of the treaty is changed, a dispute or the claim will be made. The Management and Planning Organization of the country defines the claim as follows (Sotoudeh Bahreini and Mohammadizadeh, 2018):

A: Claiming the contractor to pay an additional amount, claiming damages for breach of contract, the extension of project implementation time, or other request or claims that he believes he is entitled to under the contract.

B: The request is usually made by the contractor to increase the receipt, or to extend the execution time. Common claims in the project are the result of a breach by one of the parties to the terms of the contract.

In some cases, the reason for the claim is different interpretations of the contractor and the employer about some clauses of the contract, and in other cases, changes in the terms and requirements. Today, claims are an integral part of contracts and financial claims are one of the most common cases. Because financial claims in most cases lead to the closure of the project. Now, if this claim is accepted by the employer and the employer is forced to pay damages to the contractor, this will cause a change in the project schedule (Zanganeh, 2012). Claims in which the contractor is harmed by the employer's misconduct or forcibly due to a change in environmental conditions and seeks compensation are called

financial claims, for example, the contractor claims that is not able to provide the equipment needed for the project at the estimated price and wants to increase the contract amount due to sanctions, (Sotoudeh Bahreini and Mohammadzadeh, 2018).

1.2. Three-factor contract (DBB) Design / Bid / Build Method

The design, bid, and build method is one of the most common contracts. At first, an architect is selected to design, compile, and estimate the project during a competitive process. In the next step, when the designer is selected, and the documents collected by the employer are studied, the design is sent to the contractor. After assessing the items by contractors, the contractors send an estimate of the initial cost and time required to the employer. And the contractor will be selected after the employers' approval, and then the contractor starts hiring subcontractors.

This is the same as the traditional (three-part) method for implementing civil projects. In this method, the employer selects the design team according to the formalities and employs a consulting company related to the project field, to perform all the design steps, then selects a contractor to perform the work. Currently, most projects in the country are done in this way. In this method, the employer executes the project through separate contracts, with the designer or consultant and the builder or contractor.

In this method, first, the design is completed and then it is awarded to one or more contracting companies through a bid. In this method, the responsibility for coordination and the risk of non-coordination between design and construction and commissioning of the project is the responsibility of the employer. In the contractual method, entrusting part or all of the work to others is through a contract. In this method, the employer entrusts all or part of the operation to the completion of the project to others by concluding contracts that guarantee the correct execution of the work and securing his interests. (Atefi-Fard et al., 2016). Disadvantages of the three-factor method are listed below (Atefi-Fard et al., 2016):

1. Construction cannot be started before the design
2. A specific person or group is not responsible for the whole project.
3. The employer alone may not make the necessary arrangements between the consultants and the contractors.
4. The start of construction operations depends on the design department, which prolongs the project.
5. Most of the executive issues are not well seen in the plan.
6. Correction and revision require a lot of time and money.

To identify the causes of claims in construction projects, valid articles as well as expert opinions were used. The reasons for making the claims are given in Table (1). Finally, among these claims, the final claims are determined according to the experts.

Table 1: Reasons for Making a Claim

Row	Reasons For Making a Claim	Kind of Claim	Reference
1	Selecting a contractor based on a lower price, discarding and technical ability and competence	Bid and contract	<i>KamalOuda , 2014) (Bassioni, 2012)</i>
2	Changes in workloads and additional work	Changing	(Nor azmi, 2015) (History, 2014) (Abdoulateef, 2014) (KamalOuda, 2014) (Bassioni, 2012) (acharya, 2006) (Zaneldin, 2006) (samantha, 2002) (Suleiman, 2014)
3	Delays in payments and fulfillment of financial obligations by the employer and financial problems of the contractor	Financial	(Parikh, 2014) (Suleiman, 2014) (moura 2007 (abdoulateef, 2014) (Bison, 2012) (zaneldin, 2006)
4	Ambiguity and inconsistency in the documents or content of the contract	Bid and contract	(Bonaventura, 2015) (Parikh, 2014) (Suleiman, 2014) (Shah&bhatt, 2014)
5	Lack of timely notification of plans, changes and instructions	Time	(Shah&bhatt, 2014) (Hitania, 2013) (Bassioni, 2012) (Zaneldin, 2006)
6	Delay in the supply of equipment, materials and other resources by the employer	Time	(Abdullah Hatef, 2014) (Suleiman, 2014) (Chaitanya, 2013) (zaneldin, 2006) (Samantha, 2002)
7	Sudden and unexpected changes in exchange rates, bank interest rates	Financial	(Nor azmi, 2015) (Bassioni, 2012) (zaneldin, 2006)
8	Wrong planning by the employer	Time	(Abdullah Hatef, 2014) (zaneldin, 2006) (Samantha, 2002)
9	Low contract price due to high competition	Bid and contract	(hesham, 2012) (Zaneldin, 2006)
10	Change maps and scope of work	Changing	Nor Azmi, 2015) (bonaventura, 2015) (Suleiman, 2014) Chaitanya, 2013) (Zaneldin, 2006)

11	Change in the quality level of the contract content	Changing	(Mohammed al mohsin, 2012)
12	Suspension of the project by administrative, legal and legislative organizations outside the project	Time	(Shah and Behta, 2014) (Nedlin, 2006)
13	Delay in delivery of the workshop or project site	Time	(Parikh, 2014) (Abdullah Hatef, 2014) (Shah&bhatt, 2014) (Chaitanya, 2013)
14	Wrong design and technical drawings	Changing	(Nor azmi, 2015) (KamalOuda, 2014) (Shah, 2014) (Zandlin, 2006)
15	Job suspension	Time	(KamalOuda, 2014) (Zaneldin, 2006)
16	Verbal orders about change by the employer	Changing	(Zaneldin, 2006) (Bassioni, 2012)
17	Lack of complete familiarity with the terms and conditions of the contract	Bid and contract	(alaryan, 2014) (ruqaishi, 2013) (Zaneldin, 2006)
18	Improper distribution of risks, obligations and responsibilities	Bid and contract	(ketki, 2013)
19	Interference of different contractors	Time	(Zaneldin, 2006)
20	Wrong execution by the contractor	Time	(Shah&bhatt, 2014) (KamalOuda, 2014) (Zaneldin, 2006)
21	Changes in laws and standards (tax laws, value-added rates, etc.)	Changing	(KamalOuda, 2014) (Zaneldin, 2006)
22	Late approval of the schedule	Time	(Abdullah Hatef, 2014) (Al-mohsin, 2012)
23	Lack of accurate identification of all project stakeholders	Bid and contract	(Bassioni, 2012) (KamalOuda, 2014)
24	Improper selection of the type of contract by the employer	Bid and contract	(KamalOuda, 2014)
25	Rely on people instead of documents and on oral communication instead of letters	Bid and contract	(Zandlin, 2006) (Bonaventura, 2015) (Al-Mohsin, 2012)
26	Existence of objections in land delivery	Time	(Parikh, 2014)
27	Poor communication between the parties involved in the project	Time	(Zaneldin, 2006) (Samantha, 2002)
28	Wrong schedule	Time	(Al-Mohsin, 2012) (Bassioni, 2012) (KamalOuda, 2014) (Zandlin, 2006)
29	Complexity in project implementation	Time	(KamalOuda, 2014)
30	Majors (unavoidable events such as floods, earthquakes, etc.)	Time	(Bonaventura, 2015) (KamalOuda, 2014) (Moura, 2007)
31	Poor organizing by contractor	Time	(Abdullah Hatef, 2014) (Al-Mohsin, 2012) (Zandlin, 2006)
32	Changing workshop conditions	Changing	(Bonaventura, 2015) (Parikh, 2014) (Shah, 2014) (Oda, 2014) (Nedlin, 2006)
33	Unfavorable weather conditions	Time	(Shah&bhatt, 2014) (Chaitanya, 2013) (Samantha, 2002) (Semple, 1994)
34	Limited access to the workshop	Time	(Bassioni, 2012) (Semple, 2014)

Research Methodology

This is an applied study in terms of purpose and descriptive in terms of method. In this study, the questionnaire, interview, and review of library documents have been used to collect information. The population consisted of 10 contractors, employers, and consultants of Shiraz Municipality. They have at least the experience of participating in more than 10 civil projects in Shiraz Municipality. In this study, two questionnaires were prepared. The first questionnaire is to identify the relationships between the criteria. To determine the relationship between the criteria, the DEMATEL method was used. Finally, the information collected in the DEMATEL method was analyzed with Excel software. The second questionnaire was used to prioritize the criteria, which was done by prioritizing the criteria by (ENP) method. Finally, the collected information is analyzed by the (ENP) method with software (Super Decision). To identify the reasons for making claims in civil projects, a review of valid articles as well as expert opinions was used. After identifying the reasons for making claims in the contract, a questionnaire was designed. Among the introduced criteria, according to the opinions of experts, 4 main criteria and 18 sub-criteria were identified.

Findings

The relationship between the criteria is identified at first with the DEMATEL method; this relationship between the criteria will be used as software input (ENP) and the criteria will be prioritized. Therefore, the criteria and sub-criteria are introduced. This research includes four main criteria and eighteen sub-criteria. The criteria and sub-criteria are given in Table (2) as follows.

Table 2: Criteria and sub-criteria and their symbols

Symbol	Sub-criteria	Criteria	Symbol
C1	Lack of timely notification of plans	Time	C11
C2	Delay in supplying equipment		
C3	Wrong scheduling		
C4	Delay in delivery workshop		
C5	Job suspension		
C6	Force Majors		
C7	Delay in payment	Cost	C12
C8	Sudden and unexpected changes in exchange rates, bank interest rates		
C9	Overtime working		
C10	Increasing material cost		
C11	Channing in work volume	Changing	C13
C12	Changing the plan and work area		
C13	Making mistake in design and technical drawings		
C14	Verbal orders about change by the employer		
C15	Changing workshop conditions		
C16	Choosing a contractor discarding technical ability	Bid and contract	C14
C17	Ambiguity and inconsistency in the documents or content of the contract		
C18	Low contract price due to high competition		

In this study, to identify and prioritize contractors' claims in three-factor contracts based on financial criteria, 18 criteria have been used, the names of which are given in Table (3).

Table 3: Names of Criteria

No	Title	Symbol
1	Lack of timely notification of plans	C ₁
2	Delay in supplying equipment	C ₂
3	Wrong scheduling	C ₃
4	Delay in the delivery workshop	C ₄
5	Job suspension	C ₅
6	Force Majors	C ₆
7	Delay in payment	C ₇
8	Sudden and unexpected changes in exchange rates, bank interest rates	C ₈
9	Overtime working	C ₉
10	Increasing material cost	C ₁₀
11	Channing in work volume	C ₁₁
12	Changing the plan and work area	C ₁₂
13	Making mistake in design and technical drawings	C ₁₃
14	Verbal orders about change by the employer	C ₁₄
15	Changing workshop conditions	C ₁₅
16	Choosing a contractor discarding technical ability	C ₁₆
17	Ambiguity and inconsistency in the documents or content of the contract	C ₁₇
18	Low contract price due to high competition	C ₁₈

Also, in order to compare the criteria with each other, 5 values have been used, the names of these values are shown in Table (4).

Table 4: Used Values and Their Equivalent Names

Name	Value
No effect	0.00
Low effect	1.00
Medium effect	2.00
high effect	3.00
High effect	4.00

Next, 10 experts are used to examine the criteria, which table (5) shows the pairwise comparison of each expert, in these matrices, x_{ij} is the opinion of each expert, and $x_{ii} = (i = 1,2,3, \dots, n)$ is equal to zero. (The original diameter is zero).

Table 5: Average Pairwise Comparisons of All Experts

Average opinion of all experts	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉	C ₁₀	C ₁₁	C ₁₂	C ₁₃	C ₁₄	C ₁₅	C ₁₆	C ₁₇	C ₁₈
C ₁	0.00	2.50	2.20	2.10	2.70	0.80	0.90	0.90	2.10	0.80	2.20	1.90	1.90	1.60	1.50	1.50	1.40	0.50
C ₂	1.30	0.00	2.10	2.60	2.80	0.90	1.30	1.10	2.20	0.90	1.40	1.50	1.50	1.80	1.50	0.90	1.40	0.70
C ₃	1.90	2.60	0.00	2.60	2.80	0.70	1.80	1.00	2.40	0.60	2.10	2.40	2.00	1.50	1.20	1.00	1.40	0.40
C ₄	1.50	2.00	1.80	0.00	2.80	0.30	1.40	0.50	1.50	0.50	2.10	1.30	1.60	1.10	1.80	0.80	1.00	0.60
C ₅	2.20	2.40	1.80	2.00	0.00	0.70	1.60	0.80	1.50	1.00	1.80	1.70	0.90	1.70	1.60	0.60	1.20	0.70
C ₆	2.30	2.40	1.80	2.70	3.40	0.00	1.60	0.90	3.00	2.10	3.10	2.80	1.50	1.50	2.20	0.90	1.10	0.80
C ₇	2.40	2.60	1.60	2.10	2.40	0.70	0.00	0.50	1.80	1.10	1.60	1.40	1.30	1.50	1.60	1.40	1.60	0.90
C ₈	2.80	3.40	2.30	2.50	2.90	0.50	3.00	0.00	2.20	2.30	2.50	2.50	1.20	1.60	2.30	1.80	2.40	1.30
C ₉	1.00	0.80	1.70	1.10	1.00	0.50	1.10	0.20	0.00	0.80	2.30	1.10	0.60	1.70	1.40	1.10	1.30	1.10
C ₁₀	2.10	3.00	2.00	2.10	3.00	0.80	2.30	0.90	1.60	0.00	2.20	2.60	1.60	1.60	2.00	1.00	2.40	0.90
C ₁₁	1.50	2.00	2.20	1.10	2.10	1.00	1.50	1.20	2.00	1.40	0.00	1.70	1.50	1.60	1.80	1.20	1.20	0.70
C ₁₂	2.30	2.00	1.90	1.70	2.10	0.80	1.40	0.70	1.70	1.10	2.50	0.00	1.70	1.70	1.50	1.30	1.40	0.80
C ₁₃	2.50	2.00	2.20	1.90	2.40	0.50	1.20	1.00	1.40	1.00	1.90	1.50	0.00	1.40	2.00	1.40	1.40	1.00
C ₁₄	2.20	1.90	2.50	2.20	2.00	0.50	1.70	0.40	1.80	0.70	2.50	2.00	1.60	0.00	2.00	1.50	2.00	0.60
C ₁₅	2.00	1.70	1.40	1.90	1.40	0.40	1.10	0.70	1.30	1.10	2.00	1.90	1.50	1.80	0.00	1.00	1.00	0.40
C ₁₆	2.10	1.70	2.10	1.70	1.80	0.80	1.80	0.70	1.90	1.50	2.70	1.90	1.40	2.00	1.70	0.00	2.30	1.90
C ₁₇	2.40	1.80	2.10	1.80	2.20	0.80	2.00	0.90	2.00	1.10	2.80	2.20	2.10	2.20	1.70	1.80	0.00	1.10
C ₁₈	0.80	1.00	1.40	1.00	1.20	0.70	0.70	0.80	1.30	0.80	1.10	1.20	1.50	1.30	1.20	1.60	1.80	0.00

Next, we use Equations (1) and (2) to normalize the resulting matrix.

$$H_{ij} = \frac{z_{ij}}{r} \tag{1}$$

r is obtained from the following Equations:

$$r = \max_{1 \leq i \leq n} \left(\sum_{j=1}^n z_{ij} \right) \tag{2}$$

Table 6: Normalized Matrix

Normalized Matrix	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉	C ₁₀	C ₁₁	C ₁₂	C ₁₃	C ₁₄	C ₁₅
C ₁	0.00	0.07	0.06	0.06	0.07	0.02	0.02	0.02	0.06	0.02	0.06	0.05	0.05	0.04	0.04
C ₂	0.03	0.00	0.06	0.07	0.07	0.02	0.03	0.03	0.06	0.02	0.04	0.04	0.04	0.05	0.04
C ₃	0.05	0.07	0.00	0.07	0.07	0.02	0.05	0.03	0.06	0.02	0.06	0.06	0.05	0.04	0.03
C ₄	0.04	0.05	0.05	0.00	0.07	0.01	0.04	0.01	0.04	0.01	0.06	0.03	0.04	0.03	0.05
C ₅	0.06	0.06	0.05	0.05	0.00	0.02	0.04	0.02	0.04	0.03	0.05	0.05	0.02	0.05	0.04
C ₆	0.06	0.06	0.05	0.07	0.09	0.00	0.04	0.02	0.08	0.06	0.08	0.07	0.04	0.04	0.06
C ₇	0.06	0.07	0.04	0.06	0.06	0.02	0.00	0.01	0.05	0.03	0.04	0.04	0.03	0.04	0.04
C ₈	0.07	0.09	0.06	0.07	0.08	0.01	0.08	0.00	0.06	0.06	0.07	0.07	0.03	0.04	0.06
C ₉	0.03	0.02	0.05	0.03	0.03	0.01	0.03	0.01	0.00	0.02	0.06	0.03	0.02	0.05	0.04
C ₁₀	0.06	0.08	0.05	0.06	0.08	0.02	0.06	0.02	0.04	0.00	0.06	0.07	0.04	0.04	0.05
C ₁₁	0.04	0.05	0.06	0.03	0.06	0.03	0.04	0.03	0.05	0.04	0.00	0.05	0.04	0.04	0.05
C ₁₂	0.06	0.05	0.05	0.05	0.06	0.02	0.04	0.02	0.05	0.03	0.07	0.00	0.05	0.05	0.04
C ₁₃	0.07	0.05	0.06	0.05	0.06	0.01	0.03	0.03	0.04	0.03	0.05	0.04	0.00	0.04	0.05
C ₁₄	0.06	0.05	0.07	0.06	0.05	0.01	0.05	0.01	0.05	0.02	0.07	0.05	0.04	0.00	0.05
C ₁₅	0.05	0.05	0.04	0.05	0.04	0.01	0.03	0.02	0.03	0.03	0.05	0.05	0.04	0.05	0.00

After calculating the above matrices, the matrix of fuzzy total relations is obtained according to Equation (3).

$$T = \lim_{k \rightarrow +\infty} (H^1 + H^2 + \dots + H^k) = H \times (I - H)^{-1} \tag{3}$$

Table 7: Total Relations Matrix

	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉	C ₁₀	C ₁₁	C ₁₂	C ₁₃	C ₁₄	C ₁₅	C ₁₆	C ₁₇	C ₁₈
C ₁	0.12	0.19	0.18	0.17	0.21	0.06	0.12	0.07	0.17	0.09	0.19	0.16	0.14	0.14	0.14	0.11	0.13	0.07
C ₂	0.15	0.12	0.17	0.18	0.20	0.06	0.12	0.08	0.16	0.09	0.16	0.14	0.13	0.14	0.14	0.09	0.12	0.07
C ₃	0.17	0.20	0.13	0.19	0.22	0.06	0.14	0.08	0.18	0.08	0.19	0.18	0.15	0.14	0.14	0.10	0.13	0.06
C ₄	0.14	0.16	0.15	0.10	0.19	0.04	0.11	0.05	0.13	0.07	0.16	0.13	0.12	0.11	0.13	0.08	0.10	0.06
C ₅	0.16	0.18	0.15	0.16	0.13	0.06	0.12	0.07	0.14	0.08	0.16	0.14	0.11	0.13	0.13	0.08	0.11	0.06
C ₆	0.21	0.22	0.20	0.22	0.26	0.05	0.16	0.08	0.22	0.13	0.24	0.21	0.15	0.16	0.18	0.12	0.14	0.08
C ₇	0.18	0.19	0.16	0.17	0.20	0.06	0.09	0.06	0.16	0.09	0.17	0.14	0.12	0.14	0.14	0.11	0.13	0.07
C ₈	0.23	0.26	0.22	0.23	0.26	0.07	0.21	0.07	0.21	0.15	0.24	0.22	0.16	0.18	0.20	0.15	0.19	0.10
C ₉	0.11	0.11	0.13	0.11	0.12	0.04	0.09	0.04	0.08	0.07	0.15	0.11	0.08	0.11	0.11	0.08	0.10	0.06
C ₁₀	0.19	0.23	0.19	0.20	0.24	0.07	0.17	0.08	0.18	0.08	0.21	0.20	0.15	0.16	0.17	0.11	0.17	0.08
C ₁₁	0.15	0.17	0.17	0.14	0.19	0.07	0.13	0.08	0.16	0.10	0.13	0.15	0.13	0.14	0.15	0.10	0.12	0.07
C ₁₂	0.18	0.18	0.17	0.16	0.19	0.06	0.13	0.07	0.16	0.09	0.19	0.11	0.14	0.14	0.14	0.11	0.13	0.07
C ₁₃	0.18	0.18	0.18	0.17	0.20	0.06	0.12	0.08	0.15	0.09	0.18	0.15	0.09	0.14	0.15	0.11	0.13	0.08
C ₁₄	0.18	0.18	0.19	0.18	0.19	0.06	0.14	0.06	0.16	0.08	0.20	0.17	0.14	0.11	0.16	0.12	0.15	0.07
C ₁₅	0.15	0.15	0.14	0.15	0.15	0.05	0.11	0.06	0.13	0.08	0.16	0.14	0.12	0.13	0.09	0.09	0.10	0.05
C ₁₆	0.18	0.18	0.19	0.17	0.20	0.07	0.15	0.07	0.17	0.11	0.21	0.17	0.14	0.16	0.16	0.08	0.16	0.11
C ₁₇	0.20	0.19	0.19	0.18	0.21	0.07	0.16	0.08	0.18	0.10	0.22	0.18	0.16	0.17	0.16	0.13	0.11	0.09
C ₁₈	0.11	0.12	0.12	0.11	0.13	0.05	0.09	0.06	0.12	0.07	0.13	0.11	0.11	0.11	0.11	0.10	0.11	0.04

The next step is to get the sum of the rows and columns of the T matrix. The sum of rows and columns is obtained according to Equations 4 and 5.

$$(D)_{n \times 1} = \left[\sum_{j=1}^n T_{ij} \right]_{n \times 1} \quad (4)$$

$$(R)_{1 \times n} = \left[\sum_{i=1}^n T_{ij} \right]_{1 \times n} \quad (5)$$

The next step is to determine the importance of the indicators $D_i + R_i$ and the relationship between the criteria $D_i - R_i$. If $D_i - R_i > 0$, the relevant criterion is effective and if $D_i - R_i < 0$, the relevant criterion is impracticable. Table 7 shows $D_i + R_i$ and $D_i - R_i$.

Table 8: Importance and Effectiveness of Criteria

Main Criteria	criterion	R-D	R+D	R	D
Lack of timely notification of plans	Criterion 1	-0.51	5.46	2.478726	2.987326
Delay in supplying equipment	Criterion 2	-0.88	5.55	2.334549	3.21499
Wrong scheduling	Criterion 3	-0.48	5.56	2.542941	3.020352
Delay in delivery workshop	Criterion 4	-0.96	5.02	2.029345	2.994108
Job suspension	Criterion 5	-1.3	5.68	2.194533	3.491755
Force Majors	Criterion 6	1.96	4.11	3.03677	1.084289
Delay in payment	Criterion 7	0.02	4.75	2.384168	2.366155
Sudden and unexpected changes in exchange rates, bank interest rates	Criterion 8	2.12	4.6	3.36576	1.240225
Overtime working	Criterion 9	-1.15	4.58	1.713887	2.865027
Increasing material cost	Criterion 10	1.24	4.54	2.890486	1.659227
changing in work volume	Criterion 11	-0.94	5.63	2.345789	3.289446
Changing the plan and work area	Criterion 12	-0.4	5.22	2.407798	2.812953
Making mistake in design and technical drawings	Criterion 13	0.08	4.75	2.420046	2.336152
Verbal orders about change by the employer	Criterion 14	-0.02	5.06	2.522958	2.538821
Changing workshop conditions	Criterion 15	-0.55	4.67	2.060381	2.609783
Choosing a contractor discarding technical ability	Criterion 16	0.82	4.58	2.700462	1.882117
Ambiguity and inconsistency in the documents or content of the contract	Criterion 17	0.46	5.12	2.790616	2.334816
	Criterion 18	0.5	3.08	1.800264	1.29194

Table (9) shows the importance, effectiveness and impracticable of the criteria.

Table 9: Effectiveness and impracticable of the main criteria

Main Criteria	R-D	R+D	R	D
Time	-0.60378	11.09951	5.247863	5.851644
Cost	0.526382	12.551	6.538689	6.012307
Quality	-0.33839	12.17563	5.918623	6.257008
Bid and Contract	0.415784	10.32023	5.368008	4.952224

Finally, the mean of the matrix T is taken to determine the relationships of each criterion. This average is called the threshold value, and finally we set values smaller than the threshold value to zero and values greater than the threshold value to one. Table (10) shows the relationships between the criteria. Threshold value = 0.135863

Table 10: Relationships between Criteria

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18
C1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0
C5	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
C6	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1
C7	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
C8	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1
C9	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1
C10	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	1	1
C11	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
C12	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
C13	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
C14	1	1	0	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
C15	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
C16	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
C17	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
C18	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1

Table 11: Relationships between Criteria

Relationship	Symbol
c2,c3,c4,c5,c6,c7,c8,c9,c10,c11,c12,c13,c14,c15,c16,c17,c18	C1
C1,c2,c3,c4,c5,c6,c7,c8,c9,c10,c11,c12,c13,c14,c15,c16,c17,c18	C2
C1,c2,c3,c4,c5,c6,c7,c8,c9,c10,c11,c12,c13,c14,c15,c16,c17,c18	C3
c13,c14,c15	C4
c14,c15	C5
c14,c15, c16,c17,c18	C6
c13,c14,c15,c16,c17,c18	C7
C1,c2,c3,c4,c5,c6, c10,c11,c12,c13,c14,c15,c16,c17,c18	C8
C1,c2,c3,c4,c5,c6,c9,c10,c11,c12,c13,c14,c15,c16,c17,c18	C9
C1,c2,c3,c4,c5,c6,c9,c13,c14,c15,c16,c17,c18	C10
C1,c2,c3,c4,c5,c6,c13,c14,c15,c16,c17,c18	C11
C1,c2, c13,c14,c15,c16,c17,c18	C12
C1,c2, c13,c14,c15,c16,c17,c18	C13
C1,c2,c4,c5,c6, c13,c14,c15,c16,c17,c18	C14
C1,c2,c3,c4,c5,c6, c13,c14,c15,c16,c17,c18	C15
C1,c2,c3,c4,c5,c6, c13,c14,c15,c16,c17,c18	C16
C1,c2,c3,c4,c5,c6, c13,c14,c15,c16,c17,c18	C17
C1,c2,c3,c4,c5,c6, c13,c14,c15,c16,c17,c18	C18

Later; Using super decision software, the criteria prioritization is solved by ANP method.

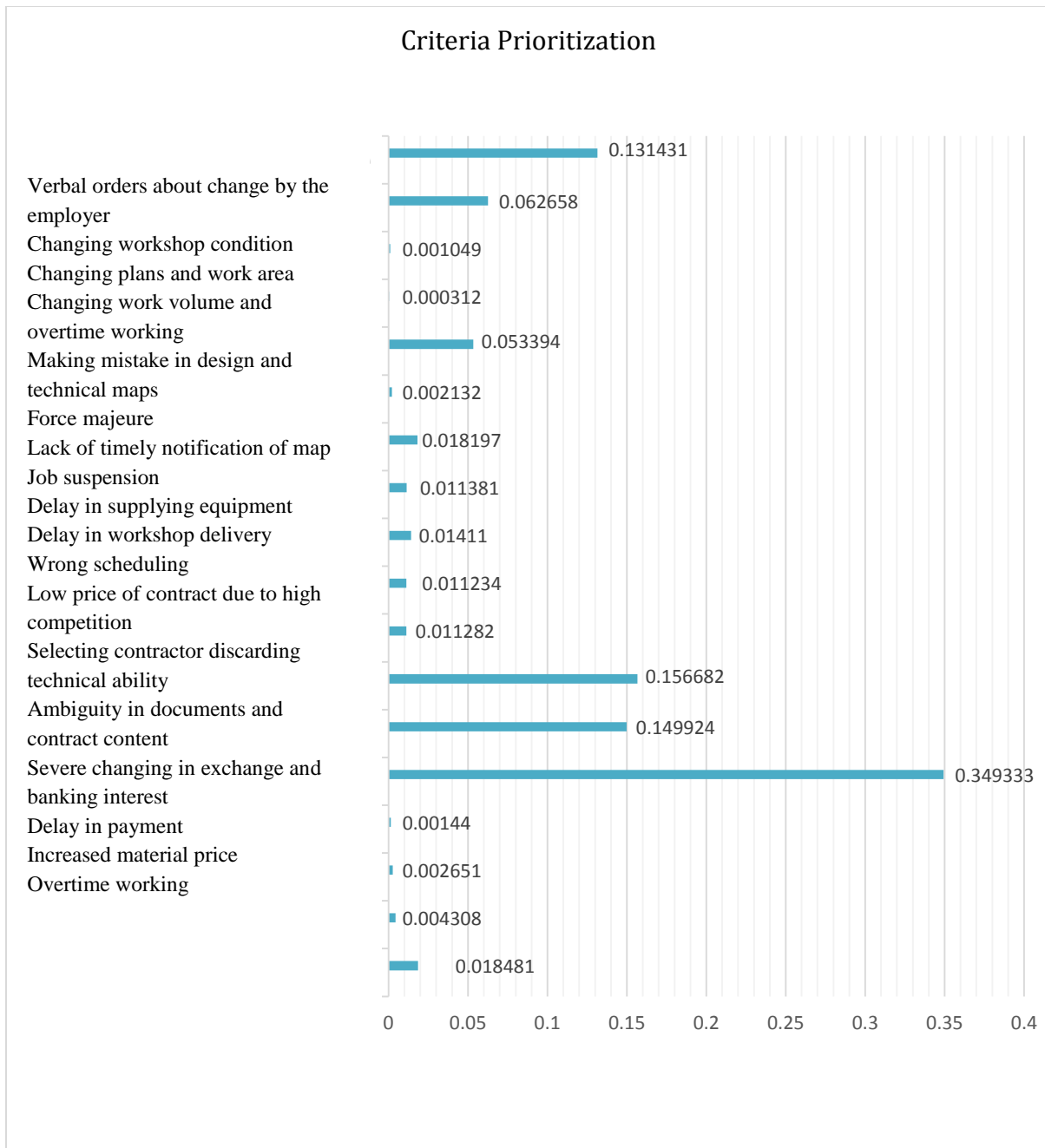


Figure 1: Prioritization of Criteria

After prioritizing the criterion; top 5 criteria are presented listed in the table below according to experts to prevent claims. These solutions are based on the meetings held with the experts.

Table 12: Strategies to prevent claims

Row	Claim	solutions to prevent a claim in the contract
1	ambiguity in the documents or content of the contract	Use of legal experts and specialists to review and edit the content of the contract
2	Low contract price due to high competition	Care in announcing the winner of the tender and selecting the contractor, taking into account experience, facilities, technical and executive ability, and not just based on the lowest bid price
3	Choosing a contractor discarding technical ability	Carefully select the contractor according to work experience and the number of successful projects.
4	Verbal orders about change by the employer	Holding meetings for coordination between the employer and the contractor
5	Changing workshop conditions	Mention the workshop conditions as well as the preparation of a contract or agreement for any change in the workshop conditions

Conclusion

This study aims to identify and prioritize the claims of contractors in three-factor contracts based on financial criteria (Case study: Civil Project of Shiraz Municipality). The required information was collected using a questionnaire and analyzed using software (EXCEL and SUPER DESITION).

Calculations were performed using DEMATEL method on the criteria (time, cost, quality, bid and contract), which showed that the quality criterion is the most effective. The cost criterion has a great deal of impact. The criteria are the cost of the most interaction with other factors studied. Also, in these criteria (cost, bid and contract) the cause variable and the criteria (quality and time) are disabled. According to the studies on sub-criteria, job suspension and changing the work volume and overtime working and making mistake in scheduling) are the most effective. Sub-criteria (unexpected changes in exchange rates, bank interest rates and force majeure) are highly impressible. Sub-criteria (job suspension and changes in workloads and doing extra work) have the most interaction with other studied factors. Also in these sub-criteria (force majeure and delays in payments and drastic and unexpected changes in exchange rates, bank interest and rising material prices and mistakes in design and technical drawings and the selection of the contractor without considering the technical ability, ambiguity and inconsistency in the documents or content of the contract and the low price of the contract due to high competition) are variable causes and sub-criteria (failure to timely notify plans and delays in equipment preparation and errors in planning and delays in workshop delivery and suspension of work and overtime and change in work volumes and additional work and change in plans and scope of work and orders for oral change by the employer and change of workshop conditions) are inactive. After evaluating each of the criteria by super decision software, the criteria prioritization showed that ambiguity and inconsistency in the documents or content of the contract, low contract price due to high competition and selection of a contractor discarding the technical ability are in the first to third priority. According to the results, it is recommended to be careful in forecasting, cost and time of project implementation, choosing the best project implementation method, visiting the site and project implementation area during the bid by the contractor, giving sufficient and appropriate time to contractors to evaluate the document of bid, identify and track the needs of project stakeholders, anticipate contract delays, provide a clear description of the payment process, deadlines for payment of funds and penalties for delays in the contract, coordinate and schedule payments in financial arrangements The employer should contact the contractor and prepare a mechanism to evaluate the changes in terms of direct and indirect costs and lost profits commensurate with each of the changes.

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