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Identifying and Prioritizing Arising Claim's Factors by the Combined Approach of DEMATEL and ANP Method (Case Study: Urban Development and Civil Organization of Shiraz Municipality Projects)

Amir Akbari[1], Ardalan Feili[2*], Mohsen Dashtipour[3]

1. Master of Construction Management, Management Department, Apadana Institute, Shiraz, Iran
2. Assistant Professor, Management Department, Apadana Institute, Shiraz, Iran
3. Master Student of Business Administration, Management Department, Apadana Institute, Shiraz, Iran

Corresponding author: *feili@apadana.ac.ir*

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ABSTRACT

Claim management describes the process required to eliminate or prevent construction claims from arising and for the expedition handling of claims when they do occur. The present study aimed to identify the factors affecting the claimed design and their ranking. This research is applied and descriptive. The effective factors have been identified by reviewing the claims filed by the contractors of Shiraz Municipality during one year and have been classified according to their nature in the four main areas of the Claims (scope, time, quality and cost). To collect data, questionnaires based on the multi-adjective decision-making method used in this study were used, which were completed by experts of civil engineering projects in Shiraz Municipality. Data were analyzed using a combined approach of Decision-making Trial and Evaluation Laboratory (DEMATEL) and Analytic Network Process (ANP). According to the results, 3 factors: Deviation from the project schedule plan, Changes in the technical specifications of and the resources of tasks and Not controlling the actual values on-site before execution with the initial estimate of the contract have the most effect and factors: Not to prepare a joint mapping with the presence of the consultant and the contractor at the beginning and Contractor financial loss due to bidding a lower price offer than the market have the least effect on claim. In general, factors related to time and quality areas have a greater effect on claim than factors related to scope and cost areas.

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1. Introduction

These days, the main part of the country's economy, especially developing ones, belongs to its infrastructure and construction projects. Achievement in the implementation of these projects is one of the key factors of economic growth in societies. Stagnation and lack of progress in the implementation of construction projects, cause the lack of sustainable urban management and create claims. This indicates the fundamental problems and obstacles in the implementation of valuable development projects. This issue, which is called a crisis of civil projects seriously threatens economic reconstruction and development. The main problem that most great projects are faced with, is the delay in different phases of the project and the completion time [1–3]. In this area; delays in the implementation of the country’s projects have become one of the inherent features [4]. These delays are due to the three vertices of the executive triangle: the employer, the consultant, and the contractor [5]. In recent years, the increasing demand for construction projects, which has occurred for various reasons, has led to the creation of some policies for their optimal implementation. These policies have goals such as cost, time, and quality. One of the important factors that can affect these goals is litigation [6]. Claim means to request and demand, and in contracting, it refers to cases that are not given enough attention in the contract or there are different interpretations of it. The purpose of making a claim is to persuade the other party to the contract to pay or repay the extra funds to the claimant. Any factor that disrupts the obligations under the contract is likely to be claimed by the contractor and the employer [7]. In fact, a claim is a tool to prove the right to reimburse costs or time imposed outside the contract and to prove ownership of time and money. The ignorance of some of the lines and issues of the contract, the type of contract, and the employer's view versus the contractor's view of the nature of the work, is itself the source of claims and disputes between the parties to the contract [8].

According to researches, each manager typically spends about 25 percent of their time resolving tensions and disputes, and many project stakeholders make claims and dispute one of the most destructive events in construction projects [9].

Since 2000, claim management, as an important field in project management knowledge, was added to the Construction Extension guide book of PMBOK. In general, this field of the project management body of knowledge describes a set of methods used to eliminate, prevent and manage claims when they occur [10]. Claim management describes the process required to eliminate or prevent construction claims from arising and for the expeditious handling of claims if they do occur [4]. In this regard, the claim management process in the PMBOK standard can be divided into the following steps [10]:

Step 1: Claim Identification; this step is the first and perhaps most important step in the entire claim management process [11].

Regardless of the origin of the claim, the claim identification process should be done with specialized knowledge of different areas of work and their relationship with each other and accuracy in contractual terms [12]. Identifying the claim requires a correct interpretation of the contract text with sufficient information about the scope of the project and the contractual

requirements that can be achieved by those who dominate the project contract and its area. Sometimes during the implementation of the project, based on this knowledge and understanding of the status of the project based on its performance and contractual issues, potential claims can be identified [13]. Claim identification begins with a clear definition of the contract and the area of the project and includes a written description of the claim, time and cost effects, payment time, ability analysis, expert judgment, documentation, and under review claim file [14].

The inputs to the claim identification process are [15,16]:

- Project scope: includes everything that is mentioned in the contract, including plans and specifications.
- Contract: Includes various terms and conditions related to the work. Paragraphs related to changed conditions, programming and time schedule, etc.
- Claim Description: A description of things that may occur outside the contract
- Project scheduling plan: The project scheduling plan is one of the key documents used to describe the effect of the claim on the project.

Step 2: Claim Quantification: After examining the importance of a claim and deciding to pursue it, the next step is to quantify in terms of additional compensation or a time extension to the contract completion or other milestones date. Therefore, a proper evaluation of the achievements of the stakeholders and the positive and negative points resulting from the presentation of the claim should be done [16]. Examining the quantitative characteristics of fact-based contractual claims, it can be seen that the root of many disputes arising from disagreements over the financial consequences of events even when the obligations relating to these claims do not differ. Therefore, it is essential to explain the processes, principles, and standards of claims analysis and introduce effective analytical methods to minimize the impact of claims.

The next step after identifying potential claims; is that these claims should be evaluated in terms of cost and time, by the main stakeholders, and compensatory costs and extra time to complete the contract should be determined [13,16].

It is better to refer to the parts and materials of the contract that are the basis of the quantitative evaluation of the claim. In this process, the cause-and-effect approach can be used to determine the causes and effects of the claim [13]. Claim quantification inputs include the claim protocol and the project schedule plan.

Step 3: claim Prevention: It is impossible to control the conditions of project; because construction activities occur in a complex and highly sensitive manner with many environmental changes. The best way to prevent the claim is to have no claims although we know that it's impossible [16]. For this reason, there is an emphasis on avoiding or preventing the occurrence of claims. In a project in which the scope of work is well defined, the risk allocation is done correctly and is implemented in the best way, we will definitely face fewer claims. To prevent claims from occurring, transparency should be provided when preparing the tender documents for various aspects of the contract.

For contracts, a complete and accurate description of the requirement should be prepared in which the scope of work is carefully and transparently regulated, and to ensure the feasibility of the plans, by holding meetings to review the feasibility, the claim occurrence should be prevented as much as possible. [17].

Step 4: Claim Resolution: Claim resolution is a process of determining the amount of compensation, or time requested is correct or not and the like. This process should be as quick as possible in order not to increase the expenses. This process begins with negotiations at various levels and continues through mediation. Likewise, these processes will lead a claim to be approved or disapproved, in the event of confirmation. A contract must provide the necessary mechanisms for the time delay compensation, or payment compensation.

Scope claims:

These claims are due to the difference in the project scope. Claims related to working conditions and its area are those in which the employer or contractor claims to increase or decrease the scope and agenda of the project due to disagreement about the actual scope and conditions of the project and its difference with the agreed scope at the time of concluding the contract. This increase or decrease in the scope of work, willingly or unwillingly, leads to an increase or decrease in project time and cost. Claims of these changes may arise after the time of soil testing and drilling, excavation, leveling, or construction of buildings and facilities [18,19].

Time claims:

Time claims are claims in which the employer or contractor, depending on the encountered circumstances, requests a revise during the term of the contract and so-called seeks to extend the contract time. This type of claim can be made by both parties of the contract, whether the employer or the contractor. It means that the contractor did not fulfill its commitments at the specified time and thus delayed the project or the employer did not respond to the contractor's requests on time and increased the contract time and contractor costs.

Cost claims:

Cost claims are claims in which the employer or contractor suffers due to a malfunction of the other party or is forced to pay compensation due to a change in environmental conditions. In other words, the contractor claims that due to foreign sanctions, they have not been able to provide part of the equipment required for the project at the projected price, and therefore demands an increase in the planned costs, or the employer claims that due to the lack of Certain goods and equipment in the market, the contractor has used cheaper ones, which the difference in project costs must be calculated [19,20].

Qualitative claims:

Qualitative claims are claims in which one party protests the quality of the other party's performance. As it is expected from the name of this type of claim, they are not measurable and there are different opinions about them, for example, the employer claims that the quality and specifications of the work done by the contractor aren’t equal to the contract specifications, Or

the contractor claims that the facilities and equipment provided by the employer do not have the quality and efficiency agreed in the contract. Making and dealing with this type of claim also requires financially, and time costs [18,21–23].

Table 1
lists the latest article in claim management and its methodologies.

no.	Objective	Method	conclusion	Reference
1	Negotiation and resolution of conflict	Analytic Hierarchy Process	Budget transfer according to progress of project is the most important criteria found for evaluating costs and benefits.	[24]
2	Dispute avoidance and resolution a literature review	literature review	The most important recurring success for these projects were found to be client leadership and trusting relationships.	[25]
3	Investigating and analyzing the reasons of creating contract claims	The average importance index	"A large change in the price of foreign currencies "and "Non-payment of status and prepayments of the employer were identified as the most important factors.	[26]
4	Claim management	A theoretical framework	Identifying of commonly used method for assessing delay claims	[27]
5	A process reference model for claims management	Review study	Improve the claims management process	[28]
6	Identifying of construction claims management problems	Analytical Hierarchy Process	critical problems were: the lack of site staff awareness, inaccessibility or unavailability of relevant documents, and conflicts which arises during owner/contractor negotiation	[29]
7	Investigating of Conciliation	Questionnaire survey	Importance of inherent communication skills and understanding of the theoretical skills	[30]
9	Development of Multi-party Risk and Uncertainty Management Process	Risk Analysis Model	The consequence of misallocation of risk in contract could adversely affect all involved parties.	[31]
11	Identifying of influencing factors on the causes of construction claims	statistical method	Contract aspects, land handovers and late completion of work by contractors were identified as the most influenced factors.	[32]
12	Considerations for Filing Global Construction Claims	Case study	Separate the consequence of events that are not the responsibility of the employer and consequently do not entitle it to an extension of time.	[33]
13	Fundamentals of alternative dispute resolution processes in construction	AHP and ADR Process.	The most important ranked attributes are voluntariness, enforceability, creative agreement, knowledge of construction, consensus agreement, confidentiality, neutrality and fairness, speed, cost and prevention of relationships.	[34]
14	Construction project dispute resolution	AHP and ADR processes.	The top-ranked attributes identified as critical include, among others, preservation of relationships, enforceability, neutrality, and consensus.	[35]

Based on the research conducted in previous studies, the interrelationships of the factors affecting the claim were examined. In the present study, these relationships have been identified using the DEMATEL technique, so the results presented based on the ANP technique are closer to reality. In addition, no similar research has been conducted in Iran so far. Therefore, the present study can help future researchers and managers in this field in terms of considering the environmental conditions of Iran.

2. Research methodology

This study in terms of functional goal and method seeks to identify and prioritize the factors affecting the claim in the contracts of sub-contractors of the Civil Organization and Recreation of Urban Spaces of Shiraz Municipality. It is descriptive and multi-Adjective decision making (MADM). Similar results can be achieved by modeling the standard of Project Management Body of Knowledge (PMBOK) and its construction extension and adapting the claims management steps to the internal laws ruling contracts and the general terms of the contract. MADM methods have been used in previous civil engineering studies [36]. The methods selected for this research are DEMATEL and ANP. The information collecting method is mixed. Observation is completed on claim cases that have been proposed by sub-contractors at the technical office (Table 2) and the Delphi method is utilized to receive expert's choices on the information observed.

Table 2
Sample of claims managed in PMO of Urban Development and Civil Organization of Shiraz Municipality out of 35 cases.

No.	The contract subject	The claimant	The claimed subject	Applying for	Claim Origin
1	Preparation of materials and execution of stone walls	Contractor	Excavation volume	payment over the initial maps	Not to prepare a joint mapping with the presence of the consultant and the contractor at the beginning
2	Pre-cast beam construction	Contractor	Changing the a pre-made method to pre-made and on-site combination	Changing the maps and changing the prices	Not controlling the actual values on-site before execution with the initial estimate of the contract
3	Implement ICF Structures	Contractor	Confirmation of changes in the initial map of the structure for temporary delivery	Temporary work delivery	Map changes during execution compared to original maps
4	Execution of body and floor stone in the pedestrian gallery	Contractor	Working in night shifts	Additional pay for Working while the night shifts.	Work shifts to expedite tasks that change the project schedule
5	Procurement & execution of stone walls	Contractor	Cost Compensation	Integrated change to the contract	Contractor financial loss due to bidding a lower price offer than the market
6	Procurement & execution of Surface water piping	Contractor	Cost Compensation	Incorrect Calculation of the grade of concrete in the contract	Incorrect primitive estimation and conditions of the contract

The experts' group typically consists of 7 to 15 people [37]. Experts group represent all individuals with at least one common trait and in this research, the experts' group are the Urban Development and Civil Organization of Shiraz Municipality managers who have 10 years of work experience and with a minimum degree of bachelor in civil engineering. By the results derive from Table 2 claim identification in 13 categories of claim origins and 4 claim types are done (Table 3).

Table 3
Claim factors identified based on the results of technical office cases observations.

No.	The party whom causes the claim	Claim origin	Claim type	Symbol
1	Contractor	Not to prepare a joint mapping with the presence of the consultant and the contractor at the beginning	Scope	S1
2	Contractor	Not controlling the actual values on-site before execution with the initial estimate of the contract	Scope	S2
3	consultant engineer	Map changes during execution compared to original maps	Scope	S3
4	Employer	The exact scope of the contract is not specified by the employer	Scope	S4
5	consultant engineer	Incorrect primitive estimation and conditions of the contract	Scope	S5
6	Contractor	Insufficient knowledge of the terms of the contract	Scope	S6
7	Contractor	Contractor financial loss due to bidding a lower price offer than the market	Cost	C1
8	Contractor	Bid price in the tender without analysis and study the contract documents	Cost	C2
9	Employer	Work shifts to expedite tasks that changes the project schedule	Time	T1
10	Contractor	Deviation from the project schedule plan	Quality	T2
11	Contractor	Insufficient expertise of the contractor to perform the activity	Quality	Q1
12	consultant engineer	Changes in the technical specifications of and the resources of tasks	Quality	Q2
13	Contractor	Improper supply of resources to carry out tasks of the contract	Quality	Q3

The first questionnaire is used to collect experts' opinions about the effectiveness of the identified factors of claim origins in the form of DEMATEL. Analysis of data by using this method leads to Network Relation Map. The next step is using this map to rank the factors, so a pairwise comparative questionnaire of the Network Analysis Method is used. To test the pairwise comparison reliability, the incompatibility rate for each of the pairwise matrixes was calculated. This rate shows how informed the opinions of the reader, have been based on logic and alignment. To test the paired comparison questionnaire reliability, the incompatibility rate of each comparison matrix was calculated. This rate indicates that how logical and integrated each expert responded to the questions. Generally, this rate should be less than 0.1 [37]. The number of the incompatibility rate for this research is less than 0.1 which indicates the reliability of the results. Figure.1 presents the summary of the research process in this article.

3. DEMATEL method

The DEMATEL technique was one of a variety of multi-criteria solving techniques, based on graph theory, proposed by Fontal and Gabus to solve complex problems such as famine, energy, and environmental protection in a simple way between 1972 and 1926 [38]. The ultimate product of this technique is to present network relations between the elements of the problem and their division into causal and causal groups. Therefore, with the help of this method, the factors affecting a disabled person can be determined from the resulting extraction stage is structured based on information from the judgment of experts in a systematic manner so that direct and indirect connections between them are shown [39].

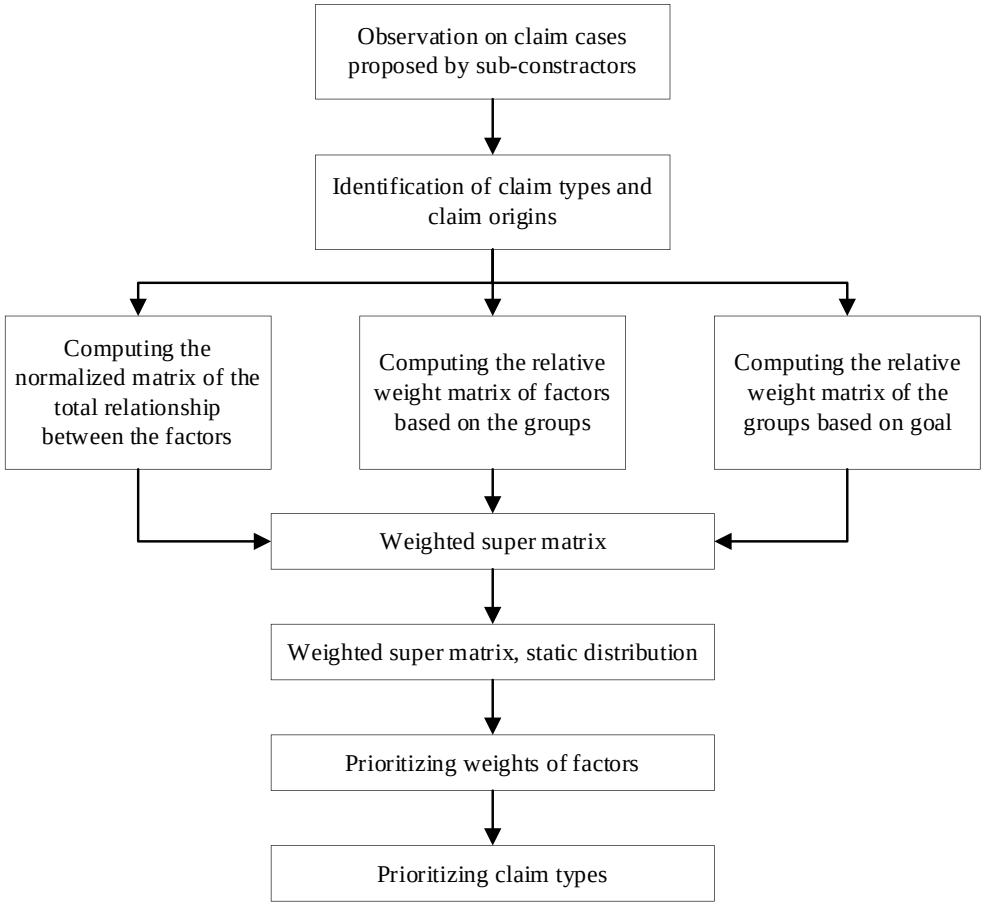

Fig. 1. Summary of the research process.

Step 1: Generating the direct relation matrix: In this step, experts make sets of pairwise comparisons in terms of influence and direction between criteria. Then, the initial data is calculated as the direct-relation matrix as the result of these evaluations, which is a n*n matrix A, in which a_{ij} is shown as the degree to which the criterion i affects the criterion j.

Step 2: Normalizing the direct relation matrix. This matrix (X), can be obtained through formulas on the base of the direct relation matrix A:

$$X = k.A \tag{Eq.1}$$

$$k = \frac{1}{\max\limits_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}}, \quad i, j = 1, 2, ..., n \tag{Eq.2}$$

Step 3: Computing the total-relation matrix: This matrix (T) can be acquired by using the below formula, in which the I is denoted as the identity matrix:

$$T = X\,(1 - X)^{-1} \tag{Eq.3}$$

Step 4: Producing a causal diagram: The total sum of rows and the total sum of columns are separately denoted as vector D and vector R calculated by the below formulas. Then, the

horizontal axis vector (D + R) named ‘‘Prominence’’ is made by adding D to R, which reveals how much importance the criterion has. The vertical axis (D - R) named ‘‘Relation’’ is made by subtracting D from R, which divides criteria into a cause group and an effect group. Generally, the criterion belongs to the cause group, when (D - R) is positive. Otherwise, the criterion belongs to the effect group if the (D - R) is negative. Therefore, the causal diagram can be acquired by mapping the dataset of the (D + R, D - R), providing valuable insight for making decisions.

$$T = \left[t_{ij} \right]_{n\times n}, \quad i, j = 1, 2, ..., n \tag{Eq.4}$$

$$D = \left[\sum_{j=1}^{n} t_{ij} \right]_{n\times 1} = \left[t_{i.} \right]_{n\times 1} \tag{Eq.5}$$

$$R = \left[\sum_{i=1}^{n} t_{ij} \right]_{1\times n} = \left[t_{.j} \right]_{1\times n} \tag{Eq.6}$$

4. ANP method

The total-influenced matrix $T_c = \left[t_{ij} \right]_{n\times n}$ is obtained by criteria and $T_D = \left[t_{ij}^{D} \right]_{m\times m}$ is obtained by dimensions (clusters) fromT_C. Then, normalize super matrix T_C which represents the ANP weights of dimensions (clusters) by using influence matrix T_D [40] is computed.

Step5: Establishing the unweighted Super matrix: The total-influence matrix will be obtained from DEMATEL. In order of normalizing, the sum of each column is calculated. After normalizing the total-influence matrix T_C by dimensions (clusters), a new matrix T_C^{α} is obtained. In addition, an explanation for the normalization $T_C^{\alpha 11}$ is shown in the below Equations.

$$d_{Ci}^{11} = \sum_{j=1}^{m1} T_{ij}^{11}, \ \mathrm{i} = 1, 2, ..., \mathrm{m}_1 \tag{Eq.7}$$

$$\boldsymbol{T}_c^{\alpha 11} = \begin{bmatrix} t_{c11}^{11}/d_{c1}^{11} & \cdots & t_{c1j}^{11}/d_{c1}^{11} & \cdots & t_{c1m_1}^{11}/d_{c1}^{11} \\ \vdots & & \vdots & & \vdots \\ t_{ci1}^{11}/d_{ci}^{11} & \cdots & t_{cij}^{11}/d_{ci}^{11} & \cdots & t_{cim_1}^{11}/d_{ci}^{11} \\ \vdots & & \vdots & & \vdots \\ t_{cm_1 1}^{11}/d_{cm_1}^{11} & \cdots & t_{cm_1 j}^{11}/d_{cm_1}^{11} & \cdots & t_{cm_1 m_1}^{11}/d_{cm_1}^{11} \end{bmatrix} = \begin{bmatrix} t_{c11}^{\alpha 11} & \cdots & t_{c1j}^{\alpha 11} & \cdots & t_{c1m_1}^{\alpha 11} \\ \vdots & & \vdots & & \vdots \\ t_{ci1}^{\alpha 11} & \cdots & t_{cij}^{\alpha 11} & \cdots & t_{cim_1}^{\alpha 11} \\ \vdots & & \vdots & & \vdots \\ t_{cm_1 1}^{\alpha 11} & \cdots & t_{cm_1 j}^{\alpha 11} & \cdots & t_{cm_1 m_1}^{\alpha 11} \end{bmatrix} \tag{Eq.8}$$

Let total-influence matrix match and fill into the interdependence clusters. It is called unweighted super matrix and is shown the below Equation which is based on transpose the normalized influence matrix T_C^{α} by dimensions (clusters), i.e., $W = (T_C^{\alpha})'$.

$$W = (T_c^{\alpha})' = \begin{array}{c} \\ D_1 \\ \\ \vdots \\ D_j \\ \\ \vdots \\ D_n \\ \end{array} \begin{array}{c} \begin{array}{cccccc} D_1 & & D_i & & D_n \\ c_{11}\cdots c_{1m_1} & & c_{i1}\cdots c_{im_i} & \cdots & c_{n1}\cdots c_{nm_n} \end{array} \\ \begin{bmatrix} W^{11} & \cdots & W^{i1} & \cdots & W^{n1} \\ \vdots & & \vdots & & \vdots \\ W^{1j} & \cdots & W^{ij} & \cdots & W^{nj} \\ \vdots & & \vdots & & \vdots \\ W^{1n} & \cdots & W^{in} & \cdots & W^{nn} \end{bmatrix} \end{array} \begin{array}{l} c_{11} \\ c_{12} \\ \vdots \\ c_{1m_1} \\ \vdots \\ c_{j1} \\ c_{j2} \\ \vdots \\ c_{jm_j} \\ \vdots \\ c_{n1} \\ c_{n2} \\ \vdots \\ c_{nm_n} \end{array} \quad \text{(Eq.9)}$$

If the matrix W^{11} is blank or 0, it means that the matrix between the clusters or criteria is independent and with no interdependent, and the other W^{nn} are as above.

Step 6: For obtaining the weighted Super matrix, each column will sum in order of normalizing. We normalized the total-influence matrixT_d, and obtained a new matrix T_d^{α} (where $T_d^{\alpha ij} = T_D^{\alpha ij} / d_i$). Let the normalized total-influence matrix T_D^{α} fill into the unweighted super matrix to obtain the weighted super matrix.

$$W^{\alpha} = T_D^{\alpha} W = \begin{bmatrix} t_D^{\alpha 11} \times W^{11} & \cdots & t_D^{\alpha i1} \times W^{1j} & \cdots & t_D^{\alpha n1} \times W^{1n} \\ \vdots & & \vdots & & \vdots \\ t_D^{\alpha 1j} \times W^{i1} & \cdots & t_D^{\alpha ij} \times W^{ij} & \cdots & t_D^{\alpha nj} \times W^{in} \\ \vdots & & \vdots & & \vdots \\ t_D^{\alpha 1n} \times W^{n1} & \cdots & t_D^{\alpha in} \times W^{nj} & \cdots & t_D^{\alpha nn} \times W^{nn} \end{bmatrix} \quad \text{(Eq.10)}$$

Step 7: Limit the weighted super matrix: Limit the weighted super matrix by raising it to a sufficiently large power k, until the super matrix has converged and become a long term stable super matrix to get the global priority vectors, called ANP weights, such as $\lim_{h\to\infty}(W^{\alpha})^h$.

5. Data analysis and results

The identifying process of the origin claims and claim types is made in three general principles as follows:

1) Reviewing the documents of requests made by sub-contractors
2) Studying and matching the claims with the contract and its accessories, especially What is mentioned as standards or technical documents
3) Reviewing and reconciling the claim with the agreement, general terms and conditions of the contract
4) A detailed studying of the result announced by the technical office

Table 3 is a very important result of this process that defines the factors of claim origin in the 13 main axes and categorizes them in to 4 types of claims. These 13 factors are plotted in three clusters: contractor, consultant and employer, and Options are split into types of claims.

The DEMATEL diagram shows the direction of factors effect on each other. In designing the network, only relationships are considered which has a threshold larger than or equal to 0.15 (Figure.2).

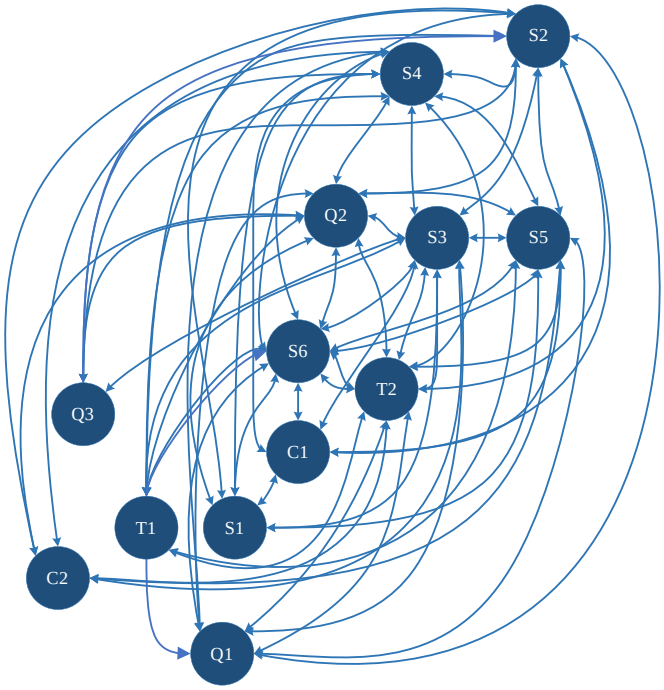

Fig. 2. The DEMATEL diagram.

The results of DEMATEL method is shown in the Table 4.

Table 4
Results of data analysis based on the DEMATEL method.

Factor	Elements	R	C	R+C	R-C	Type of variable
Scope	S1- Not to prepare a joint mapping with the presence of the consultant and the contractor at the beginning	2.10	1.65	3.76	-0.45	Effect
	S2- Not controlling the actual values on-site before execution with the initial estimate of the contract	1.97	2.97	4.94	0.99	Cause
	S3- Map changes during execution compared to original maps	2.05	2.45	4.50	0.39	Cause
	S4- The exact scope of the contract is not specified by the employer	1.76	2.65	4.42	0.89	Cause
	S5-Incorrect primitive estimation and conditions of the contract	2.27	2.65	4.93	0.38	Cause
	S6-Insufficient knowledge of the terms of the contract	2.032	1.94	3.97	-0.08	Effect
Cost	C1-Contractor financial loss due to bidding a lower price offer than the market	2.07	1.73	-0.35	3.80	Effect
	C2-Bid price in the tender without analysis and study the contract documents	1.85	1.25	-0.61	3.10	Effect
Time	T1-Work shifts to expedite tasks that changes the project schedule	1.96	1.43	3.39	-0.52	Effect
	T2-Deviation from the project schedule plan	2.15	2.07	4.22	-0.08	Effect
Quality	Q1-Insufficient expertise of the contractor to perform the activity	2.29	1.44	3.72	-0.85	Effect
	Q2-Changes in the technical specifications of and the resources of tasks	1.84	2.30	4.13	0.46	Cause
	Q3-Improper supply of resources to carry out tasks of the contract	1.66	1.48	3.14	-0.19	Effect

This table indicates the most causes factor on the others in the claims is C1 and the most Effective factor from the others is Q1.

The results of ANP method is shown in the Table 5.

Table 5
Results of data analysis based on ANP method.

Total ranking	Total weight	Cluster ranking	Cluster weight	Criterion
13	0.004839	6	0.01018	S1
3	0.125255	1	0.26356	S2
5	0.108615	3	0.22855	S3
6	0.096762	4	0.20360	S4
4	0.120326	2	0.25319	S5
9	0.019447	5	0.04092	S6
12	0.005176	2	0.44134	C1
11	0.006552	1	0.55866	C2
10	0.007916	2	0.03667	T1
1	0.207938	1	0.96333	T2
7	0.072817	2	0.24503	Q1
2	0.199384	1	0.67093	Q2
8	0.024973	3	0.08403	Q3

6. Discussion

In the last 10 years, due to the increase in construction projects in the city of Shiraz, Iran, and the implementation of urban megaprojects by Urban Development and Civil Organization of Shiraz Municipality. Managing and supervising the planning and execution of a project ensures that the overall goals of the project and its subsequent tasks and milestones are all in line with the organization's strategy.

Project managers know that the time schedule is one of the three major project constraints: Time, scope and cost, therefor deviation from the project schedule plan will become a critical aspect of a project. When a project is behind schedule or at risk of a critical delay, it is possible to turn it to an agile approach, which is a good way to accelerate the timeline. At the beginning, analyze the scope that is at risk and divide it into smaller, tangible parts. Set a very short daily meeting or call with the key leaders of the delivery team to closely monitor progress. It is recommended that tracking progress by using a dashboard which identifies the state of each part of the scope or each life cycle phase of the deliverables: not initialized, in progress or completed.

Specifications are the documents that specifies the work of a project in a contract. When technical specifications increase the chances, service, satisfaction of stakeholders involved are with. It decreases the chances of something going horribly wrong during implementation and even after you've launched your product. Technical specifications have immense benefits to anyone involved in a project: the engineers, the teams that use them, even the projects that are designed off of them. The changes in technical specifications should be managed as soon as possible, if not, it may cause damages. Changes must be agreed upon by the parties to the

contract in the project, otherwise these changes will be the basis of financial disputes in the project. Changing the percentage that you allocate resources to tasks may change the schedule duration and cost. Changes in time and cost in the project can increase the allocation of time and cost risks. Resources used in the execution of a task in a construction project, i.e. skilled human resources, appropriate machinery and quality materials, as well as accurate and complete plans and technical specifications are the most important factors that determine the final quality of the task, therefore, these factors can allocate qualitative risk and at the same time, can increase the chance of qualitative claims.

The number of executive operations of each activity on site can be reduced or increased by a maximum of 25% compared to the initial amounts in the contract therefor controlling the actual values on-site before execution with the initial estimate of the contract is very important. If these values are not controlled and compared by the engineers before the start of the executive operation, they can lead to a scope claim. Arising such claims can even affect the contract itself and turn it into a dispute. One of the most important aspects of plan execution in construction is the control of changes to the project. Changes may occur for a variety of reasons and from different participating areas of the project. It is the task of integrated change control to identify possible changes, review them for the effect on project scope, cost and schedule, see that they are approved or not and that a proper project record is made of the disposition of the change.

7. Conclusion

Obviously claim factors can affect a contract, and cause delay or disrupt of the work [41]. Increasing claims by sub-contractors in an organization with multiple projects can lead to problems such as non-completion of the project, and increased time and cost. For this purpose, in order to prevent claims, creating a knowledge sharing base and applying the experiences of the similar contracts, with an appropriate mechanism for preventing claims, is essential. Determining the responsibilities of each party to the contract clearly is an enormous importance, too. For this purpose, the contract scope should be clear to all the contract sides. This must be documented in a way that not only be a part of the past database for this project, but also be a useful database for other future executive projects. This database can be the basis of contract knowledge management of the organization. Mainly a large part of indirect causes of claim origins occurs before the bidding and the direct causes of the claim origins occurs at the time of the execution.

The most important finding of this research is the most effective factor of claim origins made by sub-contractors" Deviation from the project schedule plan" which is a time claim, " Changes in the technical specifications of and the resources of tasks" which is a quality claim and " Not controlling the actual values on-site before execution with the initial estimate of the contract" which is a scope claim. Based on previous studies, the most effective factors identified in the project claim management have been scope claim factors, especially those that are related to contract management. Therefor this study tries to find the effective factors in other areas of claim by studying the real cases in Civil Organization of Shiraz Municipality. The result of this effort has been the achievement of influential factors, not only in the field of scope, but also in the fields of time, quality and cost, which can be a basis for future research.

The present study, like all other studies, has the limitations that are mentioned here. The combination of the proposed DEMATEL and ANP is a complex approach that requires the production of familiarity with the concepts and mental models of the research development of claims management. In this study, the weight of experts taken from them in different levels of studies was considered the same without the differences, while it is different due to the knowledge and experience of experts and the allocation weight to them is necessary. The present study was implemented in Shiraz Municipality and was according to the period of time. In order to achieve more accurate results, future researchers should consider that in similar studies, they should identify the professional characteristics of experts according to the subject of the study and by assigning appropriate weight to them, examine internal relations using techniques decision making such as analysis network process. The combined model of the present study deals only with mental uncertainty. Therefore, it is suggested that the present model to help simultaneously respond to possible mental uncertainties (e.g., randomness) by combining the proposed method with the system dynamics method can help to predict the effects of managers' policies.

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Appendix 1: DEMATEL Tables

The merged direct-relation matrix:

	S1	S2	S3	T1	S4	C1	Q1	S5	Q2	S6	Q3	T2	C2
S1	0	1.5	1.6667	0.3333	2	0.8333	1	2	1.5	1.1667	0.6667	1.1667	0.5
S2	2	0	2.3333	0.8333	2.8333	3.3333	2.1667	2.8333	2.1667	2.1667	2.1667	2.8333	2.5
S3	2.5	2.1667	0	2.1667	1.8333	2.3333	1.5	2.1667	2.3333	1.6667	1.5	1.5	1.3333
T1	1.6667	1.5	2.1667	0	0.8333	0.6667	1.6667	1.1667	0.5	0.6667	0.3333	0.8333	1
S4	2.6667	2.5	1.8333	1.1667	0	2.5	1.6667	2.5	2.1667	2.3333	2.5	1.6667	1.5
C1	2	1.6667	1.5	1.5	1	0	1.3333	1.1667	0.6667	2.3333	1.5	0.6667	0.8333
Q1	0.5	1	1.3333	0.6667	0.3333	1.1667	0	1.3333	1.3333	1.6667	0.5	2.5	0.6667
S5	2.1667	2.6667	2.3333	2.3333	1.8333	2.3333	2.5	0	1.5	2.1667	0.8333	2.1667	2.5
Q2	2.6667	1.5	2	2	1	0.8333	1.8333	2.1667	0	1.8333	2.3333	1.6667	2.3333
S6	2.1667	1.1667	1.3333	1.8333	1.8333	1	2	1	1.1667	0	1.6667	1.8333	1.6667
Q3	0.3333	1.5	0.8333	1.3333	1	1	1.5	1.1667	1.3333	1.1667	0	1.5	0.8333
T2	0.8333	1	1.5	2	1.6667	1.1667	2.6667	2.8333	1.5	1.3333	1.3333	0	1.6667
C2	0.3333	0.3333	0.3333	2.1667	0.1667	2.3333	1.6667	1.1667	1	0.5	0.3333	1.8333	0

Normalized matrix

	S1	S2	S3	T1	S4	C1	Q1	S5	Q2	S6	Q3	T2	C2
S1	0.000	0.053	0.059	0.012	0.071	0.030	0.036	0.071	0.053	0.041	0.024	0.041	0.018
S2	0.071	0.000	0.083	0.030	0.101	0.118	0.077	0.101	0.077	0.077	0.077	0.101	0.089
S3	0.089	0.077	0.000	0.077	0.065	0.083	0.053	0.077	0.083	0.059	0.053	0.053	0.047
T1	0.059	0.053	0.077	0.000	0.030	0.024	0.059	0.041	0.018	0.024	0.012	0.030	0.036
S4	0.095	0.089	0.065	0.041	0.000	0.089	0.059	0.089	0.077	0.083	0.089	0.059	0.053
C1	0.071	0.059	0.053	0.053	0.036	0.000	0.047	0.041	0.024	0.083	0.053	0.024	0.030
Q1	0.018	0.036	0.047	0.024	0.012	0.041	0.000	0.047	0.047	0.059	0.018	0.089	0.024
S5	0.077	0.095	0.083	0.083	0.065	0.083	0.089	0.000	0.053	0.077	0.030	0.077	0.089
Q2	0.095	0.053	0.071	0.071	0.036	0.030	0.065	0.077	0.000	0.065	0.083	0.059	0.083
S6	0.077	0.041	0.047	0.065	0.065	0.036	0.071	0.036	0.041	0.000	0.059	0.065	0.059
Q3	0.012	0.053	0.030	0.047	0.036	0.036	0.053	0.041	0.047	0.041	0.000	0.053	0.030
T2	0.030	0.036	0.053	0.071	0.059	0.041	0.095	0.101	0.053	0.047	0.047	0.000	0.059
C2	0.012	0.012	0.012	0.077	0.006	0.083	0.059	0.041	0.036	0.018	0.012	0.065	0.000

Computing the total-relation matrix

	S1	S2	S3	T1	S4	C1	Q1	S5	Q2	S6	Q3	T2	C2
S1	0.0959	0.1398	0.1474	0.0983	0.1467	0.1222	0.1349	0.1686	0.1335	0.1314	0.0991	0.1351	0.1017
S2	0.2315	0.1553	0.2363	0.1837	0.2305	0.2723	0.2507	0.271	0.2157	0.233	0.2032	0.2606	0.2278
S3	0.221	0.2007	0.1345	0.1969	0.1766	0.2105	0.1974	0.2191	0.1955	0.1881	0.1585	0.1884	0.1653
T1	0.136	0.1257	0.1504	0.0725	0.0969	0.1037	0.1413	0.1268	0.089	0.1003	0.0738	0.111	0.1036
S4	0.2362	0.2216	0.2053	0.1757	0.1259	0.2277	0.2153	0.2416	0.2009	0.2209	0.2003	0.2066	0.1809
C1	0.1631	0.1459	0.1441	0.1375	0.1167	0.0935	0.1479	0.142	0.1071	0.1696	0.1258	0.1214	0.112
Q1	0.0981	0.1083	0.1232	0.0999	0.0805	0.1173	0.0889	0.1325	0.1146	0.1334	0.0814	0.1649	0.0956
S5	0.2192	0.2245	0.2209	0.2131	0.1849	0.2237	0.242	0.1596	0.1788	0.2137	0.1442	0.2226	0.2118
Q2	0.2123	0.1688	0.1894	0.1846	0.1407	0.153	0.1987	0.2081	0.1105	0.1811	0.1743	0.186	0.1883
S6	0.1775	0.1398	0.1494	0.1596	0.1505	0.1388	0.1827	0.1511	0.1336	0.1023	0.1394	0.1709	0.1487
Q3	0.0941	0.1268	0.1093	0.1215	0.1026	0.1148	0.1406	0.1285	0.1163	0.1191	0.0651	0.1352	0.1022
T2	0.143	0.1428	0.1629	0.1743	0.1496	0.1528	0.2134	0.2156	0.1498	0.156	0.1331	0.1185	0.1576
C2	0.0797	0.0757	0.0804	0.1375	0.0614	0.1425	0.1316	0.1122	0.0905	0.0839	0.0635	0.1297	0.0594

Causal diagram

	R	D	D+R	D-R
S1	2.1076	1.6545	3.7621	-0.453
S2	1.9757	2.9715	4.9472	0.9958
S3	2.0534	2.4524	4.5058	0.399
T1	1.9551	1.4309	3.3859	-0.524
S4	1.7633	2.6588	4.4221	0.8955
C1	2.0728	1.7266	3.7994	-0.346
Q1	2.2854	1.4384	3.7237	-0.847
S5	2.2766	2.6589	4.9355	0.3823
Q2	1.8359	2.2959	4.1318	0.46
S6	2.0328	1.9442	3.977	-0.089
Q3	1.6615	1.4762	3.1377	-0.185
T2	2.1507	2.0695	4.2202	-0.081
C2	1.8549	1.248	3.1029	-0.607

Appendix 2: ANP Results

Weighted super matrix

clusters	nodes	C1	C2	Claim	Q1	Q2	Q3	S1	S2	S3	S4	S5	S6	T1	T2
cost	C1	0.000	0.000	0.072	0.000	0.000	0.000	0.610	0.000	0.000	0.000	0.000	0.114	0.000	0.000
	C2	0.000	0.000	0.359	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.337	0.000	0.000
goal	Claim	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
quality	Q1	0.000	0.000	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.350
	Q2	0.000	0.400	0.019	0.311	0.000	0.614	0.229	0.108	0.308	0.000	0.308	0.169	0.349	0.325
	Q3	0.000	0.000	0.138	0.000	0.000	0.000	0.000	0.199	0.000	0.000	0.000	0.000	0.000	0.000
scope	S1	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.000	0.000	0.000
	S2	0.283	0.046	0.017	0.030	0.272	0.068	0.033	0.000	0.064	0.356	0.065	0.031	0.029	0.073
	S3	0.219	0.033	0.034	0.048	0.247	0.063	0.032	0.067	0.000	0.272	0.052	0.025	0.031	0.053
	S4	0.237	0.037	0.017	0.039	0.254	0.256	0.034	0.074	0.055	0.000	0.060	0.029	0.028	0.058
	S5	0.260	0.084	0.017	0.043	0.227	0.000	0.032	0.075	0.098	0.372	0.000	0.033	0.034	0.062
	S6	0.000	0.000	0.034	0.036	0.000	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.046	0.079
time	T1	0.000	0.000	0.041	0.109	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	T2	0.000	0.400	0.205	0.385	0.000	0.000	0.000	0.475	0.475	0.000	0.475	0.261	0.484	0.000

Limited super matrix

clusters	nodes	C1	C2	Claim	Q1	Q2	Q3	S1	S2	S3	S4	S5	S6	T1	T2
cost	C1	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052
	C2	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066
goal	Claim	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
quality	Q1	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728	0.0728
	Q2	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994	0.1994
	Q3	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250
scope	S1	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
	S2	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253	0.1253
	S3	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086	0.1086
	S4	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968
	S5	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203	0.1203
	S6	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194	0.0194
time	T1	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079
	T2	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079	0.2079

Prioritize

Name	Normalized By Cluster	Limiting
C1	0.44134	0.005176
C2	0.55866	0.006552
Claim	0	0
Q1	0.24503	0.072817
Q2	0.67093	0.199384
Q3	0.08403	0.024973
S1	0.01018	0.004839
S2	0.26356	0.125255
S3	0.22855	0.108615
S4	0.2036	0.096762
S5	0.25319	0.120326
S6	0.04092	0.019447
T1	0.03667	0.007916
T2	0.96333	0.207938