Artículo de investigación

An algorithm for selecting the best tender and construction claims management by opportunistic bidding behavior approach

Un algoritmo para seleccionar la mejor oferta y gestión de reclamaciones de construcción mediante un enfoque de comportamiento de pujas oportunista

Um algoritmo para selecionar o melhor gerenciamento de reclamações de licitação e construção por abordagem de comportamento de licitação oportunista

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Abstract

Due to intense competition in tenders and increasing complexity of the documents, participants are looking to win the bidding and increase profits due to existing limitations. It is common solution among bidders to consider the price down in tender and retrieve profits during implementing projects in order to the weakness of the employer, ambiguities in the documents and administrative environment. Therefore, in this study due to lack of a complete solution, a new algorithm is provided with regard to profit maximization of contractor with three main stages that consist of pre-tender, tender and post-tender by providing a method based on Fuzzy Multi Criteria Decision Making and game theory. For evaluate the results, a case study in a construction project is used. The evaluation results showed that in the first stage the results of algorithm and case study was same, but in the second and third stages the algorithm had better results.

Keywords: claim management, opportunistic bidding behavior, Fuzzy AHP, Fuzzy TOPSIS, Game Theory.

Resumen

Debido a la intensa competencia en las licitaciones y la complejidad cada vez mayor de los documentos, los participantes buscan ganar la licitación y aumentar las ganancias debido a las limitaciones existentes. Es una solución común entre los licitantes considerar el precio bajo en licitación y recuperar ganancias durante la implementación de proyectos con el fin de la debilidad del empleador, las ambigüedades en los documentos y el entorno administrativo. Por lo tanto, en este estudio debido a la falta de una solución completa, se proporciona un nuevo algoritmo con respecto a la maximización de ganancias del contratista con tres etapas principales que consisten en pre-licitación, licitación y post-licitación al proporcionar un método basado en Fuzzy Multi Criteria Toma de decisiones y teoría de juegos. Para evaluar los resultados, se utiliza un estudio de caso en un proyecto de construcción. Los resultados de la evaluación mostraron que en la primera etapa los resultados del algoritmo y el estudio de caso fueron los mismos, pero en la segunda y tercera etapas el algoritmo tuvo mejores resultados.

Palabras clave: gestión de reclamaciones, comportamiento de pujas oportunistas, Fuzzy AHP, Fuzzy TOPSIS, Game Theory.

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Resumo

Devido à intensa concorrência nas licitações e ao aumento da complexidade dos documentos, os participantes procuram ganhar a licitação e aumentar os lucros devido a limitações existentes. É comum a solução entre os licitantes considerar o preço baixo na licitação e recuperar os lucros durante a implementação de projetos, a fim de fraqueza do empregador, ambigüidades nos documentos e ambiente administrativo. Portanto, neste estudo devido à falta de uma solução completa, é fornecido um novo algoritmo com relação à maximização do lucro do contratado com três etapas principais que consistem em pré-concurso, licitação e pós-oferta, fornecendo um método baseado em Multi Critérios Fuzzy. Tomada de Decisão e teoria dos jogos. Para avaliar os resultados, é utilizado um estudo de caso em um projeto de construção. Os resultados da avaliação mostraram que no primeiro estágio os resultados do algoritmo e estudo de caso foram os mesmos, mas no segundo e terceiro estágios o algoritmo obteve melhores resultados.

Palavras-chave: gestão de sinistros, comportamento de licitação oportunista, AHP Fuzzy, TOPSIS Fuzzy, Teoria dos Jogos

Introduction

Due to competitive economic environment, contractors are looking for ways to achieve greater profits within the organization's objectives. For this purpose, you must use the appropriate mechanism to select the economic projects according to relevant criteria (Powers, G., Ruwanpura, J. Y., Dolhan, G., & Chu, M. (2002).). In fact, project selection is process of evaluation and analysis of independent projects to achieving the goals of the organization. Choose the best projects is difficult because many factors such as project risk, the organization's objectives, and limited resources involved in this issue (fazli, s., & madani, s., 2010).). In most of the projects after project selection, the contractor should win in tender held by the employer. In availability of several tenders and possibility to participate in only one tender by contractor (according to the capacity of the contractor), he must select the best tender.

The importance of selecting the best tender is profit maximization for contractor according to the analysis of various criteria (including contractor's capabilities, access to credit, learning, particular conditions of employer, physical condition and etc.). After selecting the best tender, the contractor should be looking for a way for increase the chances of winning in the tender and profit-maximizing. It also must establish a comprehensive system to ensure the goals planned during the project (Viviana Ñañez Silva and Lucas Valdez, 2017). This paper presents an algorithm with a single Method in project phases including pre-tender, tender and post-tender to help contractors to achieve maximum efficiency by providing transparency and centralization. An algorithm that can increase the chances of winning the tender, accurate estimation of the resources required by the contractor before choosing a tender offer and manage the contractor's financial and legal claims during a project.

In the next section the theoretical background of the study will be discussed. In the third part, the research methodology used in the study described, in section four results have been presented with a case study and in the fifth part is discussed to the conclusions and recommendations.

Literature review

This section is divided into two parts: theoretical discussions and research literature.

Theoretical discussions

Fuzzy AHP.Analytical Hierarchy Process is essentially a measure of a general theory is based on some principles of psychology and mathematics based on the ability to solve complex issues in various fields is qualitatively and quantitatively (Pohekar, S., & Ramachandran, M. (2004).). AHP was developed initially by Satie as a means of influencing the decision to choose the best alternative based on multiple criteria sets (Buckley, J. J., Feuring, T., & Hayashi, Y. (2001).). But traditional AHP not correctly reflect the human thinking. Hence the FAHP developed by Satie to solve decision-making problems under uncertainty (Antón Chávez, 2017 and Saaty, T. L. (2008).).

Fuzzy TOPSIS. TOPSIS is one of multi-criteria decision-making methods that ranking M option according to N criteria. Since the production process is complex, to work with uncertain data or a range of data, special methods must be used (Li, X.-B., & Reeves, G. R. (1999).). Therefore, fuzzy logic can be used in various decision-making techniques. The main reason to use fuzzy decision-making techniques, the effectiveness of uncertainty associated with the human thought in decision Makings. TOPSIS have great popularity among multi-criteria decision making problems (Yong, D. (2006)., Dağdeviren, M., Yavuz, S., & Kılınç, N. (2009).).

Chang's Fuzzy Standard Numbers. Chang's Fuzzy Standard Numbers (Chang, D.-Y. (1996).) is used to perform pairwise comparisons. The reason for using these numbers is the universality, simplicity and standardization of them. The numbers are designed in a way that is also acceptable outcomes, are less likely to be incompatible matrix.

These numbers are shown in Table 1.

Table 1. Chang's fuzzy standard numbers

Linguistic variable	Fuzzy Number
Equal importance	(1 , 1 , 1)
A little Importance	$(\frac{1}{2}, 1, \frac{3}{2})$
Importance	$(1, \frac{3}{2}, 2)$
More importance	$(\frac{3}{2}, 2, \frac{5}{2})$
Quite important	$(2, \frac{5}{2}, 3)$

Fuzzy Numbers of Sun. Fuzzy numbers provided by the Sun (Sun, C.-C. (2010).) is another common linguistic variables fuzzy numbers. These numbers are due to the proper range, facilitate decision-making to the experts. To rank the tenders the linguistic variables of Sun is used. These numbers are shown in Table 2.

Table 1. Fuzzy Numbers of Sun

Linguistic variable	Fuzzy Number
Very Weak	3)،1،(0
Weak	5)،3،(1
Average	7)،5،(3
Great	9)،7،(5
Very much	10)،9،(7

Game Theory. Game theory is used for claims management of the project. This is a collection of players, moves or strategies for each combination of strategies. The chance is not the only effective thing to win the game. The ultimate goal is to find the optimal strategy for players.

Background of Research

So far, several studies in subject of the ranking of tenders, ways to victory in tender and claims management after tender are presented. Biruk et al. (2017) presented a method based on linear programming in order to get the optimal price to win the tender (Biruk, S., Jaśkowski, P., & Czarnigowska, A. (2017).). Cid-López et al. (2016) to increase the chances of winning the tender, offering innovative linguistic variables that facilitate decision-making (Keshtkar M.M. (2016).). Huang (2016) based on game theory presented an equation to evaluate the effectiveness of the parties involved in the tender according to the criteria of cost and other terms of the tender and the best decision will be taken (Huang, Z.-x. (2016).). The survey showed that the studies done so far either as separate or focused on specific areas (Ho, S. P., & Liu, L. Y.

(2004)., Luo, Y., Liu, Y., Yang, Q., Maksimov, V., & Hou, J. (2015), Roszkowska, E., Brzostowski, J., & Wachowicz, T. (2014).). Also criteria are general and without considering the conditions of opportunistic bidding behavior are presented (Nejad and, Keshtkar M.M. (2018)., Taylan, O., Bafail, A. O., Abdulaal, R. M., & Kabli, M. R. (2014).) and in the opportunistic bidding behavior, the models reported with the assumption that only one tender evaluated and presented (Keshtkar M. M. (2011).). Therefore it has been perceptible the lack of existence a comprehensive algorithm that can ensure contractor's profit and success from start to end of the project.

Methodology

According to the novelty of the proposed algorithm the research is based on objective as fundamental research. Considered data collection tool method is library research and from the perspective of research performance according to the analysis of a sample of the target population based on previous studies, the research is among the descriptive surveys. Considering that the study examines the relationships between variables is a Delphi method's study. Finally, to test the proposed algorithm, the case study method was used.

The statistical population based on the number of constituent members, restricted and by subject, contractors and employers construction and industrial projects and all organizations that are associated with the management of industrial and construction projects. The sample of projects in the oil and gas industries. The current research activities in the field of technical and engineering in general, and specialized in managing projects and topics as claims management and administration of construction contracts.

The validity and reliability of research

In order to determine the validity of opportunistic bidding behavior criteria, the Delphi method was used. For this purpose, due to previous studies and expertise of experts, several meetings were held with participation of 7 expert and finally 16 criteria in 3 groups were selected. In FAHP and FTOPSIS methods, information obtained by paired comparisons and surveys of experts, thus questionnaire has not been used. To determine reliability of the pairwise comparison matrices the method of Gogus and Boucher was used (Gogus, O., & Boucher, T. O. (1998).). If the values are less than 0.1, the matrix will be compatible.

Flowchart of research

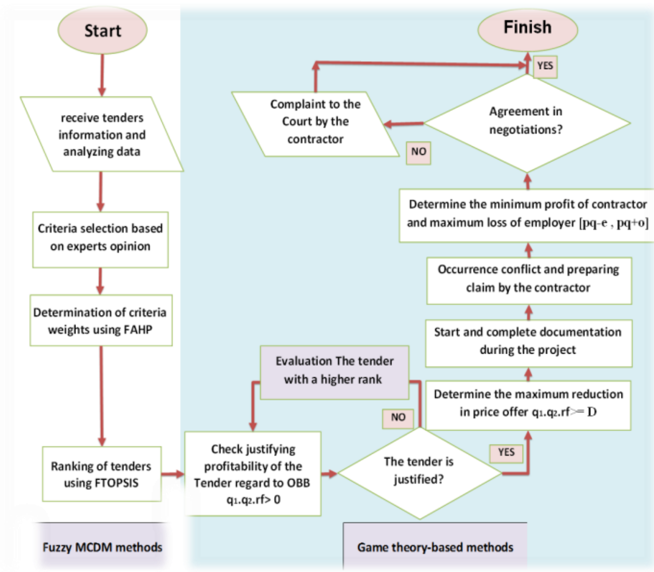

Fig.1. Flowchart of research

As shown in Fig. 1 the algorithm formed of two main parts based on fuzzy multi-criteria decision-making and Game theory. In the multi-criteria decision-making phase, the contractor after getting tenders information and criteria selection by experts, prepared the paired comparison matrix then using FAHP and

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FTOPSIS the tenders were ranked. After ranking of tenders, the maximum amount of reduction in tender determined with methods based on game theory. Also claim management that used after winning the tender is characterized by the use of game theory.
In this chapter the algorithm is presented step by step.

Receive tenders information and analyzing data. After initial studies, the contractor must identify the tenders that was available at a specified time and evaluate according to the criteria.

Criteria selection based on expert opinion. In order to determine the best tender, the criteria are identified and selected by previous studies and experts then using the articles and related content, at first Classify the criteria and after holding numerous meetings and analysis of data, the high ranked criteria are chosen with delphi method due to activity type and situation of country.

Determination of criteria weights using FAHP. After the criteria selection we should determine importance and influence to be presented logical analysis. Various tools used for ranking, but in this study for the following reasons FAHP method was used. 1-The number of criteria and sub-criteria and alternatives are within reasonable limits. 2- This is a specialized problem and require expert opinion. 3- The criteria has not weight and we want to gain weight and rank them. 4- Due to provide acceptable results in the face of verbal variables the FAHP used to determination of criteria weights.

Ranking tenders with FTOPSIS.TOPSIS have great popularity in multi-criteria decision making problems. To use this method weight of criteria should be given that derived by FAHP. For reasons that sub-discussed FTOPSIS method is used to rank the criteria. 1- With high or low number of criteria and alternatives can be done. 2- With the positive and negative criteria can be done. 3- By Qualitative and quantitative criteria can be done. 4- Criteria need to weigh. 5- Ranking of Options can be done. Considering the conditions and research needs, FTOPSIS method is the best method for ranking options for this study.
Justifiability of profitability tender regard to OBB. After ranking the tenders, contractor must check justifiability of profitability of them. For this purpose we used of OBB model that presented by Mohamed et al. (2011). The condition of justifiability of profitability is satisfying the following equation.

(1) $q_1.q_2.rf>0$

The concept of above equation is if the financial volume that contractor claimed and will accepted after negotiation is greater than zero, he can use opportunistic approach.

In above equation q1 is OBB criteria that evaluated by tender information. These criteria with relevant linguistic variables are presented in the Table 3 and linguistic variables to access q1 in Table 4.

Table 2. OBB criteria and sub criteria

	Criteria		Sub criteria
1	Potential change in documents	1-1	Additional work
		1-2	Omissions
		1-3	Corrections
2	Potential delays	2-1	Delays in the delivery site
		2-2	Limited access to the site
		2-3	Delays in decision making and providing work order
		2-4	Delays in the approval of materials and Drawings
		2-5	Delays in inspection and testing
		2-6	Delays in the supply of materials and machinery
		2-7	Interruption in operations
3	Potential claims	3-1	Differences in work quantity
		3-2	Differences in interpretation of contract and documents
		3-3	Difference due to acceleration and compression

3-4	Differences due to lack of tender documents

Table 3. linguistic variables to access q_1

Probability	Score
No chance	0.0
Very low	0.1
Low	0.2
Unlikely	0.3
With doubt	0.4
Almost possible	0.5
Possible	0.6
Likely	0.7
Good chance	0.8
Very good chance	0.9
Certain	1.0

q_2 acquired from evaluate the ability of the contractor's team due to claim management and proper estimation of criteria. Score range to evaluate the ability of the contractor's team presented in Table 5.

Table 4. Score range to evaluate the ability of the contractor's team

Level of ability	Score range
4	1 - 0.76
3	0.75 - 0.51
2	0.50 - 0.26
1	0.25 - 0.01
0	0.0

In order to estimate the amount of offered rate (r) we used criteria, weights and score range Table 6. It should be noted the value of f obtained with respect to the amount of fi/ci in the Table 6 and the value of c is obtained according to a review of bid documents.

Table 5. Criteria and weights to evaluation of r

Score range (r)	Weight of criteria	F	E	D	C	B	A	Description
0 - 0.15	0.15	invalid	Slightly valid	Partially valid	Moderately valid	Considerably valid	Valid	contract clauses About compensation
0 - 0.15	0.15	Turnkey	Design-Build	Lump sum	Negotiating	unit price, BOQ	Cost+%, cost + fee	Type of contract
0 - 0.15	0.15	against	Partially against	Slightly aside	Neutrally aside	Partially aside	Totally aside	perspective of employer about contractor's claim
0 - 0.15	0.15	After handover	Before Handover	Within final payment	End of construction	Lately during Construction	Early during Construction	Time of claim presenting

0 - 0.15	0.15	Insolvent	Unlikely Solvent	Doubtful solvent	Likely solvent	Possibly solvent	Solvent	financial reputation of the employer
0 - 0.25	0.25	>30%	24-30%	18-24%	12-18%	6-12%	<6%	volume of previous similar approved claim of contractor (f_i/c_i)
		0.15 - 0.0	0.32 - 0.16	0.49 - 0.33	0.66 - 0.50	0.83 - 0.67	1.0 - 0.84	Range of evaluation

To calculate r, we must multiply weights in score range and range of evaluation.

Determining justifiability of profitability of tender and amount of reduction in tender price. Justifiability and amount of reduction obtained after calculation r, q1, q2, amount of fi/ci and ci regard to tender documents, site conditions and other information available. Also this equation noted that amount of reduction in tender price (D) must be less than or equal to value that can be achieved after negotiate with employer.

Start and completion of documentation during the project. Contractor based on the schedule starts the project and checked status of progress on a weekly basis. In case of occur delay in scheduling, the cause of delays be monitored and record in the relevant file. If the delay is due to employer negligence, contractor must be documented these items by letter, technical query or any relevant document.

Occurrence conflict and preparing claim by the contractor. After a period of time the project and increasing conflict between contractor and employer, the contractor must preparing his claim due to contract, schedule plan, Documents collected, Laws and regulations.

Determine minimum profit of contractor and maximum loss of employer. Ho and Liu (2004) in order to facilitate decision-making and reduce disputes in the claim negotiations, proposed a model using game theory. In this model by decision tree and step backward method, check all conditions that could occur if claim offered. Nash equilibrium that used in this study is

(2) $(pq-e, pq + o)$

Following the variables will be discussed.

P variable is claim volume provided by the contractor that obtained from equation 3.
(3) $p= aC$

A is the rate of claim court that given by contractors experience in similar claim litigation. C is the total estimated price for the project before cutting the contractor opportunism. q is the chance of winning in court that have a reverse relationship with a. In fact as the amount of claim is greater, the chance of winning in court is less. e is the opportunity cost of the contractor in court lawsuit and o is the opportunity cost of the employer in court lawsuit. This means that the costs for participating in court imposed to the parties.

Left side of the equation 2 states that if finally end up in court contractor gains at least as much claim amount due to the contractor chance of winning in court (pq) that must reduce claims court costs (e) of this amount. Also In right side the maximum loss of employer is the volume of claim multiplied by the chance of winning in court (pq) which should added the cost of court claims (o) to the employer losses.

Results

To evaluation result of proposed algorithm a real case study in field of industrial projects is presented.

Determine criteria of best tender

Various investigations were conducted from experts and relevant sources and more than 12 criteria and 80 sub-criteria were identified in the first stage. After holding meetings to determine the final criteria, the experts have determined 3 criteria and 16 sub-criteria. Criteria and sub criteria of the study are presented in Fig. 2.

(A) The ability and expertise of employer

- (A1) Possibility of learning and conveying new knowledge
- (A2) Timely financial supply
- (A3) Reputation and credibility of employer
- (A4) The stability of the board and key persons of employer

(B) Based on conditions of the contract

- (B1) Type of contract
- (B2) Duration of project
- (B3) The central office nearby to the project site
- (B4) Located project in the industrial area

(C) Opportunistic Bidding Behavior

- (C1) The quality of contract
- (C2) Quality of technical documentation of project
- (C3) Expertise of management and planning team of employer
- (C4) Have enough time to Check the condition the project
- (C5) Employer Experience in a lawsuit against contractor
- (C6) Employer Experience in similar projects
- (C7) Competition in the tender
- (C8) Damage Project

Fig. 2. Criteria for selection of the best tender

Determination of weights by FAHP

Using FAHP regard to criteria set and matrix of paired comparisons, the weight of each criterion was calculated and shown in Fig. 3.

		Local weight factors	Total weight factor
W_A		0.2740	
	W_{A1}	0.2381	0.0652
	W_{A2}	0.3402	0.0932
	W_{A3}	0.2470	0.0677
	W_{A4}	0.1747	0.0479
W_B		0.3047	
	W_{B1}	0.2672	0.0814
	W_{B2}	0.2337	0.0712
	W_{B3}	0.2175	0.0663
	W_{B4}	0.2816	0.0858
W_C		0.4212	
	W_{C1}	0.1552	0.0654
	W_{C2}	0.1444	0.0608
	W_{C3}	0.1083	0.0456
	W_{C4}	0.1214	0.0511
	W_{C5}	0.1078	0.0454
	W_{C6}	0.0793	0.0334
	W_{C7}	0.1425	0.0600
	W_{C8}	0.1410	0.0594

Fig. 3. Weighted Criteria

Ranking tenders according to weighted criteria by FTOPSIS

In the Table 7, information of 4 tender are available in a specific period of time.

Table 6. Information of tenders

tender ID	location	Date of presentation the tender documents.	The deadline for delivery of tender documents
P1	Mahshahr	2015/06/18	2015/07/09
P2	Hamedan	2015/06/15	2015/07/16
P3	Kerman	2015/06/24	2015/07/08
P4	Asalloye	2015/07/05	2015/07/12

According to weighted criteria, 4 tender will be evaluated and ranked. Results are shown in Table 8.

Table 7. results of ranking

Mahshahr	Hamedan	Kerman	Asalloye
P_1	P_2	P_3	P_4
CC_i	CC_i	CC_i	CC_i
0.7489	0.2815	0.3990	0.6962
Rank	Rank	Rank	Rank
1	4	3	2

According to the Table 8, P1 has the highest score and is selected to participate in the tender.

Determining justifiability of profitability of tender and amount of reduction in tender price

After selecting the best tender and check tender documents, according to the equation 1, justifiably and maximum of price reduction has been determined. Results shown in Table 9.

Table 8. Calculation of maximum of price reduction

Criteria		Sub criteria		q_1	q_2	R	f_i/c_i	c_i	Fi
1	Potential change in documents	1-1	Additional work	0.91	0.98	0.75	0.18	3,344,000,000	412,369,317
		1-2	Omissions	0.84	0.98	0.75	0.18	352,000,000	40,016,102
		1-3	Corrections	0.84	0.98	0.75	0.18	704,000,000	80,032,203
2	Potential delays	2-1	Delays in the delivery site	0.79	0.92	0.72	0.28	528,000,000	75,893,180
		2-2	Limited access to the site	0.66	0.92	0.72	0.28	396,000,000	47,605,722
		2-3	Delays in decision making and providing work order	0.66	0.92	0.72	0.28	677,600,000	81,458,680
		2-4	Delays in the approval of materials and Drawings	0.70	0.92	0.72	0.28	1,980,000,000	253,552,214

		2-5	Delays in inspection and testing	0.53	0.92	0.72	0.28	308,000,000	29,782,324
		2-6	Delays in the supply of materials and machinery	0.54	0.92	0.72	0.28	484,000,000	48,065,681
		2-7	Interruption in operations	0.64	0.92	0.72	0.28	686,400,000	80,722,746
3	Potential claims	3-1	Differences in work quantity	0.94	0.96	0.74	0.17	4,118,400,000	460,743,064
		3-2	Differences in interpretation of contract and documents	0.87	0.96	0.74	0.17	739,200,000	76,432,513
		3-3	Difference due to acceleration and compression	0.86	0.96	0.74	0.17	1,073,600,000	109,189,304
		3-4	Differences due to lack of tender documents	0.77	0.96	0.74	0.17	352,000,000	32,219,795
Maximum reduction in pic price (D)								**1,828,082,843**	

Therefore, due to the positivity value of D, tender for investment is justified and contractor deposit the sum 1,828,082,843 Rials could reduce the proposed price to be able returned them by claim during the project.

Start and completion of documentation during the project. During the project, there are several cases that can cause disputes in the project. Therefore, according to calculations were performed in this section, the allowable delay of the contract was 157 days.

Calculate the final amount of real claim. Finally, according to information gathered, the relevant laws and practices, contractor claims was calculated as a financial statement. The total amount of financial compensation about 2,963,432,896 Rials was determined.

The proposed rate determination in the negotiations disputes using game theory. As previously mentioned p = aC and project contract amount is 6,587,332,900 Rials. To determine total estimated project cost (C) should the estimated cost of the project (taking into account the opportunism amount reduced) be considered. For this purpose must be aggregated contract amount with deductions for opportunism. Thus estimated total project cost (C) is equal to 8,415,415,743 Rials. To determine the optimal amount proposed in the negotiations we should determine the optimal rate of claim. In Table 10 subject checked and the corresponding calculation is done.

Table 9. Calculation of optimal rate of claim

Claim rate (a)	Amount of claim (p=aC)	Chance of winning in court (q)	Expected compensation (pq)
5%	420,770,787	99%	416,563,079
10%	841,541,574	93%	782,633,664
15%	1,262,312,361	87%	1,098,211,754
20%	1,683,083,149	80%	1,346,466,519
25%	2,103,853,936	63%	1,325,427,980
30%	2,524,624,723	45%	1,136,081,125

According to the results, the optimal rate of claim is equal to 20%. This means that if we proposed 20% of the amount C, the probability of winning in court equal to 80% and the amount of the expected compensation (pq) will be maximum.

With regard to that contractor at time of delay can participate in 3 tenders, and he had the possibility to win at least in 1 tender, with estimation of other indirect costs, opportunity cost of contractor (e), was estimated about 317,246,836 Rials.

For the opportunity cost of the employer, with gathering of information of employer qualified personnel and analyzing by the contractor team, the opportunity cost of the employer (o), was about 743,877,955 Rials.

Therefore, according to the information obtained, the minimum profit of contractor and maximum loss of employer while occurred court claim calculated as follows.

(pq-e, pq+o) = (1,069,105,127 2,130,229,918)

According to the results, in case of disagreement in the claim negotiations, the contractor gained at least 1,069,105,127 Rials, and the maximum losses of employer is 2,130,229,918 Rials.
Considering the amount of real claim in section 4.6, the contractor and the employer will have to decide whether to agree or do claim court.

Conclusions and Future work

In this study, by the absence of a comprehensive algorithm from the beginning of the process of selecting a project, up to last step that the contractor is involved, using methods based on fuzzy multi-criteria decision-making and game theory the contractor benefit is maximized. In order to do this using the studies were performed and experienced experts, criteria for ranking and selection of the best tender were presented due to opportunistic bidding behavior and based on the Delphi method. Then the select tenders available in a given time and after Expert Survey and using FAHP and FTOPSIS, weighting and ranking was done.

Next evaluated justifying of profitability of the tender with regard to opportunistic bidding behavior criteria, the ability of the contractor and the proposed claim rate (r) was discussed. After start of project and collecting the necessary documents, on increasing disputes, contractor prepared his claim and finally using a method based on game theory, minimum profit of contractor and maximum loss of employer was determined. This range in decision making for agreement or disagreement during negotiations will have great help.

In order to evaluate the algorithm and its results, a case study was presented. In the following an analysis of the main results, the advantages of research and recommendations is described.

Analysis of the results

It is assumed that q1, q2, r, d, q, p, a, e, o all non-negative numbers that of those q (a) is a decreasing function with respect to a. That is whatever the claim rate increases, the chances of winning the court lawsuit will be reduced. According to the discussions, the applied results of the proposed algorithm is presented as follows.

5.1.1. Determining the criteria should be done carefully, and presented the criteria using an appropriate method with regard to type and conditions of the study. It should be noted that all aspects of the project have been considered, and the expected results will be achieved. If do not use the appropriate method, loss of contractor in different dimensions seem likely.

5.1.2. If the expert's opinions are incorrect, those actions of contractor that related to these opinions is affected and may cause irreparable damage. This method have highly dependent on expert's opinions, so must be careful in the selection of experts.

5.1.3. According to equation 3-1, reduction in the tender has direct dependent to q1, q2 and r. considering that q1 is opportunities and gaps in documentation and weaknesses of the employer, contractor should have an expert team in technical department to be able to identify the differences and contradictions.
Also to increase the amount q2, contractor should have a strong team in project planning and management department.

5.1.4. R value associated with the previously judgment claims (fi / Ci). That mean if contractor whatever had the higher values of fi / Ci in past claims, r value is higher and therefore probability of winning and contractor's benefit will be more.

5.1.5. r depends on other five factors (except fi / Ci) specified in the Table 6. Therefore, contractor with analysis of the selected items before bidding, can expect better results.

5.1.6. If the compensation expected in court (q (a) p (a) -e) to be negative for the contractor, Then contractor, not incentive for opportunism in the tender.

5.1.7. if the compensation expected in court (q (a) p (a) -e) to be non-negative for the contractor, entrance price in the tender can be opportunistically reduced with the D amount. D will not be less than q (a) p (a) -e and more than q (a) p (a) + o. in result:

$d \in (q(a)p(a)-e \; , \; q(a)p(a)+o)$

5.1.8. If the compensation expected in court to the contractor q (a) p (a) -e is non-negative, Negotiation and bargaining will be the best outcome as compared to lawsuit to the employer and the contractor and the bargaining will be considered as z:

$z \in (q(a)p(a)-e \; , \; q(a)p(a)+o)$

5.1.9. Another important issue is that maximum possible loss for employer (q (a) p (a) + o) can predicted into consideration the worst-case scenario in this game.

The advantages of this study compared to other studies. In each of the areas included, selection of the best tender, set the maximum price reduction in the Tender to increase chance of victory and claim management after winning the tender several studies was conducted, but as separate. Considering the lack of comprehensive algorithm according to the conditions and the current climate of tenders, by previous studies and make changes in most of the steps, comprehensive algorithm was presented based on three methods of ranking and selection of tenders, determine the maximum amount of reduction in price offer and claim management. Also By making changes in these methods, new results were obtained. Other innovation of this study is to ranking the tenders regard to OBB. The strategy of cost reduction by OBB approach with the assumption that only one tender existing was formed (Mohamed et al., 2011), while in this study was to evaluate the cases of more than one tender.

Practical suggestions and future work. The contractor should be careful that indirect costs of participating in court claims is greater than direct cost. The contractor should be aware of the issue of indirect costs and consider all of them in his calculations.

5.3.2. The contractor and the employer always must be prepared for claims court and consequences. However, no contracts can cover all issues in the primary executive in the planning stage.

5.3.3. Odds of winning in court claims depends on the type and quality of the contract, appendices and attachments it.
5.3.4. When the contractor win the tender without opportunism, to win in claims is more difficult because the employer has not benefited.
5.3.5. Research to determine the necessary steps by employers to confront the opportunism of contractors.
5.3.6. Collecting a population included of type, number and causes of claims in the project.
5.3.7. Evaluate the benefits and problems of selection of second price offer in tenders.
5.3.8. Evaluate the more appropriate expressions instead of doing opportunism and claims.
5.3.9. Research on the effects of OBB criteria in contractor winning in the tender and increase profits.
5.3.10. A comprehensive survey of the consequences of referring cases to court litigation to resolve the dispute.

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