



## Developing a Framework for Prioritizing and Selection of Civil Projects Contractors at Tehran Municipality

Hamid Reza Ahadi\*<sup>1</sup>, Shafagh Alaei<sup>2</sup>, Sasan Amini<sup>3</sup>

<sup>1,2</sup>School of Railway Engineering, Iran University of Science and Technology

<sup>3</sup>School of Industrial Engineering, Sharif University of Technology

### ARTICLE INFO

### ABSTRACT

#### Article history:

Received: 24.02.2017

Accepted: 12.05.2017

Published: 17.06.2017

#### Keywords:

Civil projects

prioritizing criteria for contractors

AHP analysis

Multi-criteria decision making

Prioritizing and selection of contractors are significant in many civil projects. Contractors are the fundamental part of civil projects and they have significant role in turning existing resources into products and services. Therefore, implementation of projects requires an appropriate contractor thus organizations always use scientific approaches performance evaluation and selection of contractors. Usually contractors are selecting based on the lowest recommended cost. But there are other qualitative and quantitative criteria with different degree of significance that should be considered for selection of contractors. In this paper, in addition to identifying effective criteria for selecting contractors, the significance and priority of criteria is determined by applying a group AHP model for one of the big civil projects of Tehran Municipality.

## 1. Introduction

Proper decision making in every organization is a necessity. Currently, organizations, specifically civil companies, in order to privatize a part of their own affairs to contractors, hold bids. Then they try to choose the best one by using opinions and the attempts of technical and expert committees and ultimately by ranking contractors through pre-determined criteria. Since major part of civil budget is paid for executive operations, therefore execution of every project requires a proper contractor and related to the project to prevent increase of execution costs and finalize the project within the time period and forecasted resources. Therefore, incorrect decisions and neglecting scientific and proper technical methods for choosing contractors causes huge loss for organizations. For this reason, most of civil projects are facing with difficulties like cost increase, postponing execution time or decrease

of quality due to choosing improper contractor for the projects. Some of contractors cheat in order to win the bids, including high and illogical discounts in comparison with what is recommended by the employer that usually win the bids due to lack of proper regulations for determining the bid winner and they cause major difficulties during project execution [1]. Our purpose is to diagnose effective qualitative and quantitative criteria for choosing proper contractor at first, and then weighing and ranking above-mentioned criteria based on AHP technic for one of civil projects of Tehran municipality.

As mentioned earlier, a large number of various contractors are involved in a project. Lack of a systematic approach to their performance evaluation leads to longer project duration, low quality, high cost, and company loss. Hence, it is necessary to have accurate and efficient planning to prevent from resource loss and do assigned activities with high quality.

\*Corresponding author

Email address: ahadi@iust.ac.ir

<http://tlx.doi.org/.....>

Many authors have tried to evaluate contractors' performance using different indexes and methods; Authors [2] conducted a study to present a model in order to evaluate and select best contractors in Port Terminals Operation using multi-criteria decision-making technics (hierarchy analysis) that are related to subject of this study. Author [3] conducted a study in order to evaluate and rank contractors of civil projects using a fuzzy method; (Case Study: Mass Producers of Mehr Housing in Hashtgerd City, Iran) that is interconnected to the title of this study.

Rashvand et al [4] conducted a study to evaluate pre-competency of contractors and concluded that evaluation of contractor competency before implementation of a project can effect on quality and duration of a project. Therefore, some criteria such as management capability, technical abilities, financial capacity, health and safety are crucial factors in competency evaluation. Patil and Kant [5] conducted a study in this regards to examine the role of knowledge management in performance evaluation of supplier and contractors of supply chain using BSC and ANP approaches.

**2. Procedure**

In this paper, effective qualitative and quantitative criteria on competency of civil projects' contractors and the significance and the weight of each one of these criteria will be provided for assessment and choosing contractor. Decision making with multi-criteria

decision making is one of the most common methods for assessing the contractors. The base of such method is to assess contractors on every single of criteria and ranking based on every criterion for each contractor, at the end, the winner contractor will be determined by calculating the sum of scores regarding their weights. First, by review the previous studies in this field, some of the criteria have been identified, [6], [7], [8] and [9].

In order to make sure about the impact of identified criteria, a questionnaire has been prepared and distributed among experts of Tehran municipality Technical and civil organization, then chosen experts are a group of engineers who are experienced for several years within different related jobs. In next step, in order to determine the significance of each criteria, the questionnaire of paired comparisons among criteria has been designed. By collecting the experts' opinions and using hierarchical group process, the relative weight of each criteria has been determined. In order to determine effective criteria, we have used reference [5]; then 6 below criteria have been chosen by suing organization experts' opinions;

1. Technical criteria: technical criteria means a general planning system and project controlling, obeying safety and environmental instructions, standards application and technical specification exist in previous projects.

2. Financial criteria: price offered by Contractor and items such as insurance of equipment and personnel for possible events is important here.

Table 1. Pairwise comparison

	Skill	Facilities	Finance	Commitment	Personnel	Quality
Skill	1	2.3	1.3	2.1	0.91	1.3
Facilities	0.43	1	0.56	0.83	0.37	0.56
Finance	0.77	1.8	1	1.2	0.45	1
Commitment	0.48	1.2	0.83	1	0.42	0.63
Personnel	1.1	2.7	2.2	2.4	1	1.5
Quality	0.77	1.8	1	1.6	0.67	1

Table 2. Preference rating

Preference	Skill	Facilities	Finance	Commitment	Personnel	Quality
Weight	0.15	0.15	0.25	0.20	0.10	0.15

Table 3. Criteria ranks

	Skill	Facilities	Finance	Commitment	Personnel	Quality
Khatam.Rajaei	10	10	10	10	7	9
Khatam.Sepasad	5	10	10	10	10	8
Iranshahr	10	10	10	10	10	10
Dey	10	8	7	6	8	10
Sabir	10	10	9	9	10	10

3. Implementation quality indicators: quality of work by the contractor and check the quality of similar projects carried out by the contractor in the past is considered.

4. Professional personnel: efficient management, level of experience and education are the key elements of the experts' team and employees' continues training.

5. Equipment

6. Commitment to the time planning

In Tables 1 and 2, paired comparisons of criteria and the significance of decision criteria are shown based upon experts' opinions. In addition, Table 3, conclusion of criteria ranks is shown.

### 3.Evaluating and Prioritizing Contractors

Regarding rational limitation that each human is facing with it the only way to achieve a logical, disciplined, comprehensive and complete decision is collaboration. The process of hierarchical analysis is one of the profound multi-criteria decision making technics created by Iraqi Thomas in 1970s for the first time. This method can be used when we face with some competitive options and decision criterion. Mentioned criteria can be qualitative and

quantitative [6]. The basic of this method is upon paired comparison decision making. Decision making begins with providing the tree of decision hierarchy. Decision hierarchy tree indicates the comparable factors and competitor options. Then a series of paired comparisons is done. Such comparisons determine the weight of each one of factors in comparison with competitor options. Ultimately, the logic of hierarchical analysis combines matrixes resulted from paired comparisons in a way that the optimum decision will be the result.

#### 3.1 The hierarchical decision tree process

Hierarchical decision-making process tree includes 3 main purposes, criteria and options. High level indicates the main purpose of decision making process. Second level indicates major and fundamental criteria that may break into secondary criteria in the next level. Final level provides the decision options. Figure 1, indicates decision making tree of choosing contractors within the projects of constructing *Bagheri highway junctions*. Tables 4 to 9, indicate paired comparisons of alternatives according to each criterion.

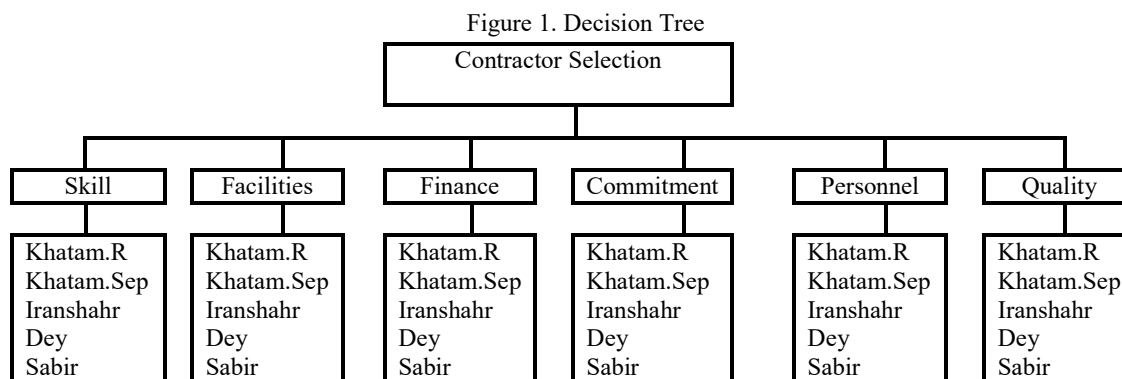


Table 4. Pairwise comparisons of alternatives according to technical criteria

Skill	Khatam.Rajaei	Khatam.Sepasad	Iranshahr	Dey	Sabir
Khatam.Rajaei	1	2	1	1	1
Khatam.Sepasad	0.5	1	0.5	0.5	0.5
Iranshahr	1	2	1	1	1
Dey	1	2	1	1	1
Sabir	1	2	1	1	1

Table 5. Pairwise comparisons of alternatives according to facilities criteria

Facilities	Khatam.Rajaei	Khatam.Sepasad	Iranshahr	Dey	Sabir
Khatam.Rajaei	1	1	1	1.25	1
Khatam.Sepasad	1	1	1	1.25	1
Iranshahr	1	1	1	1.25	1
Dey	0.8	0.8	0.8	1	0.8
Sabir	1	1	1	1.25	1

Table 6. Pairwise comparisons of alternatives according to economic criteria

Finance	Khatam.Rajaei	Khatam.Sepasad	Iranshahr	Dey	Sabir
Khatam.Rajaei	1	1	1	1.25	1
Khatam.Sepasad	1	1	1	1.25	1
Iranshahr	1	1	1	1.25	1
Dey	0.7	0.7	0.7	1	0.78
Sabir	0.9	1	1	1.25	1

Table 7. Pairwise comparisons of alternatives according to commitment criteria

Commitment	Khatam.Rajaei	Khatam.Sepasad	Iranshahr	Dey	Sabir
Khatam.Rajaei	1	1	1	1.66	1.11
Khatam.Sepasad	1	1	1	1.66	1.11
Iranshahr	1	1	1	1.66	1.11
Dey	0.6	0.6	0.6	1	0.67
Sabir	0.9	0.9	0.9	1.5	1.00

Table 8. Pairwise comparisons of alternatives according to personnel criteria

Personnel	Khatam.Rajaei	Khatam.Sepasad	Iranshahr	Dey	Sabir
Khatam.Rajaei	1.00	0.70	0.70	0.88	0.70
Khatam.Sepasad	1.43	1.00	1.00	1.00	1.00
Iranshahr	1.43	1.00	1.00	1.00	1.00
Dey	1.14	0.80	0.80	0.80	0.80
Sabir	1.43	1.00	1.00	1.00	1.00

Table 9. Pairwise comparisons of alternatives according to criteria of implementation quality

Quality	Khatam.Rajaei	Khatam.Sepasad	Iranshahr	Dey	Sabir
Khatam.Rajaei	1.00	1.13	0.90	1.00	1.00
Khatam.Sepasad	0.89	1.00	0.80	0.80	0.80
Iranshahr	1.11	1.25	1.00	1.00	1.00
Dey	1.11	1.25	1.00	1.00	1.00
Sabir	1.11	1.25	1.00	1.00	1.00

#### 4. Implementation of the Problem and Results

Regarding paired comparisons of criteria and alternatives presented in previous parts, the matrix of group weights are given as entry to Expert Choice® software to the necessary output for decision making. Regarding to the Figures 2-6, it is clear that the best choice for Shahid Bagheri project is Iranshahr Company.

Next options, according to their priority were Sepasad technical group, Sabir Company, Gharargahe KhatamAl-anbia, Shahid Rajaei specialist group and Dey Company. As it is

indicated in Figure 4, we can determine the best choice to the worst one according to each criteria by using this figure. For technical criteria, Sepasad Group of Khatam Al-anbia is the first priority. For machineries and equipment criteria, four Companies of Shahid Rajaei group of

Khatam Al-anbia, and Sepasad, Sabir and Iranshahr are having equal priority at highest level. For economic criteria, Iranshahr is the highest priority. For the criteria of commitment to the pre-determined time length, Iranshahr and Khatam Al-Anbia Companies are having the highest priority. For Personnel criteria, Iranshahr

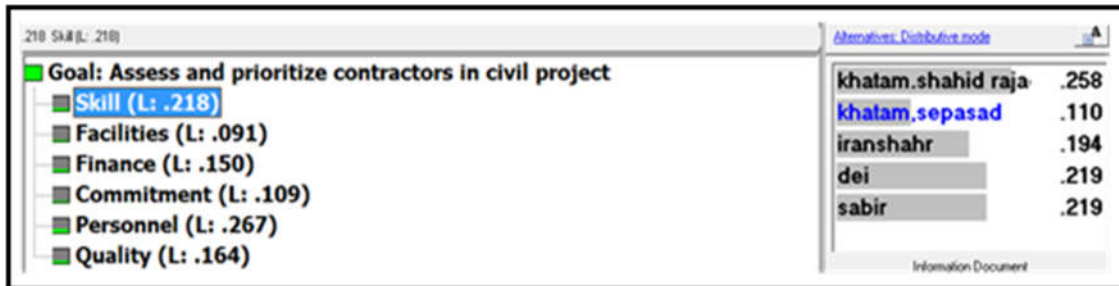


Figure 2. Priority of each criteria

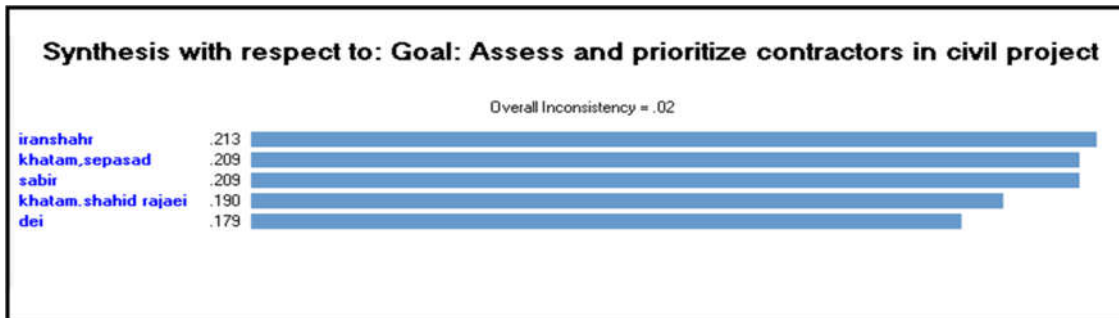


Figure 3. Priority of each alternative for project

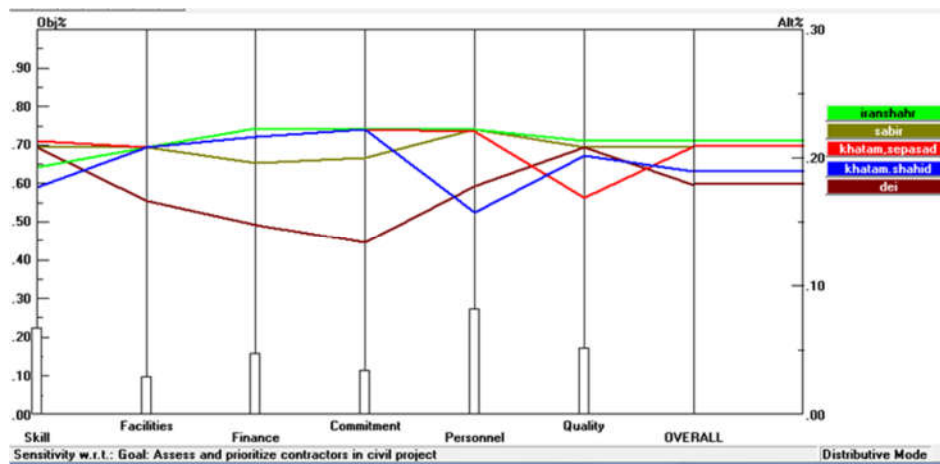


Figure 4. Performance sensitivity-graph

municipality, proper selection of contractor can

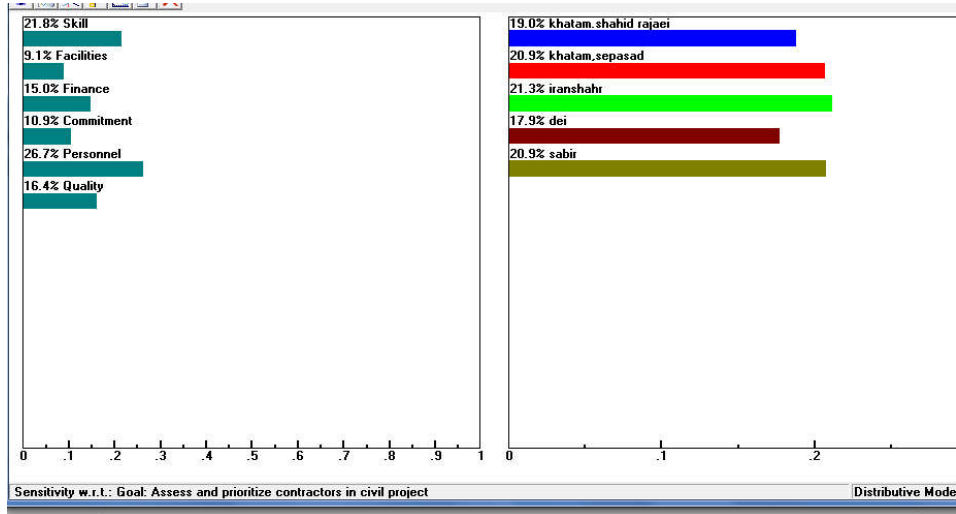


Figure 5. Dynamic sensitivity-graph

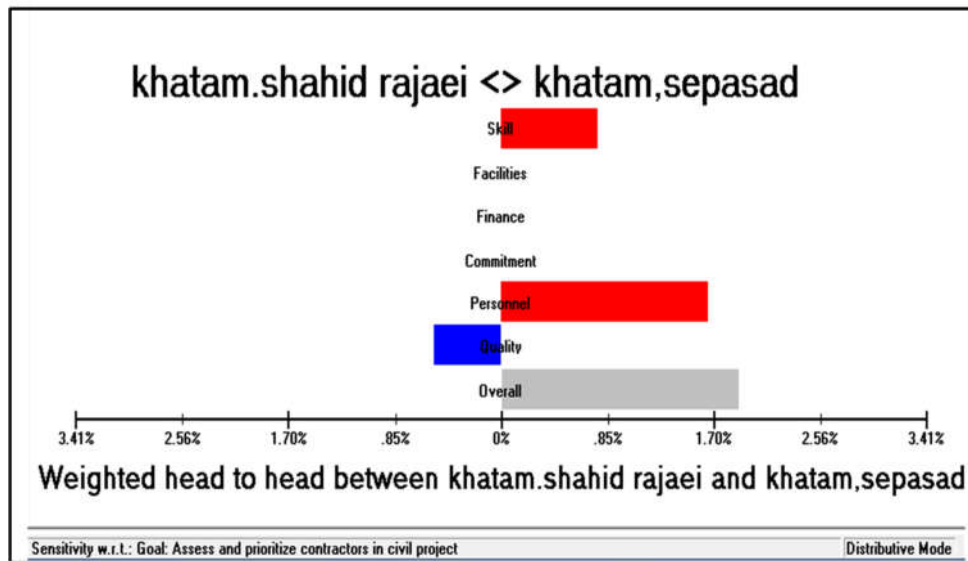


Figure 6. Head-to-head sensitivity-graph

Company and Khatam Al-anbia Companies are having highest priority.

For the criteria of implementation quality, Iranshahr is having the highest priority.

### 5. Conclusion

Proper assessment and selection of contractors can be considered as a first step and a key to success for construction of civil projects. Due to financial resource limitations in Tehran

guarantee the success of project. Traditional methods for selecting contractors based on lowest price is no longer applicable for big civil projects and recent studies indicates that neglecting other factors for selecting contractors will cause additional costs to projects. In this paper, in addition to identifying effective criteria for prioritizing and selecting civil projects contractors, the significance of related criteria are determined through AHP model within a group decision making technique for one of the important civil project of Tehran municipality.

The results indicate that “Iranshahr Company” has the highest priority as a contractor for the “Shahid Bagheri” project and is best possible choice for this project. This selection framework can be used for similar construction projects in other municipalities of big cities in Iran.

## References

- [1] Amir Lotfi, Principles of managing civil projects of Tehran, Simaye-Danesh Publications, 2002.
- [2] M. Mohammad Zadeh, A. Yazdanpanah, A. Akbari, A model for evaluating and selecting the best contractor of operating port terminals using multi-criteria decision-making techniques, Maritime Transport Industry, Issue 2, (2016), p.48-53
- [3] M. Nasrollahi, F-PROMETHEE application for evaluation and ranking of contractors of civil projects (case study: mass producers of Mehr housing in Hashtgerd City, Iran), Industrial Management, Vol. 7, Issue 1, (2015), p.175-188
- [4] P. Rashvand, M. Abd, J. Pinto, Contractor management performance evaluation model at prequalification stage, Expert Systems with Applications, (2016), p.1-15
- [5] S. Patila, R. Kant, Evaluating the impact of knowledge management adoption on supply chain performance by BSC-FANP approach: An empirical case study, TÉKHNE - Review of Applied Management Studies, (2016), p.1-23
- [6] Behnam Jadidi, High voltage substations contractor selection with neural AHP technique, Sharif University of Technology, 1996.
- [7] Abbas Bidi, Seminar on evaluation of contractor selection, Iran University of Science and Technology, 2002.
- [8] Consultant and contractors' office, Bylaw of identifying contractors' competency, Budget and planning organization, 1988.
- [9] Ezat-allah Asgharizadeh, Mehdi Nasr-allahi, Identifying and evaluating of contractor selection criteria in civil projects, Journal of Management Research, Vol.2, (2008), p.105-122
- [10] Adel Azar, Aziz-allah Memariani, AHP, A new technique for group-decision making, Journal of Management science, Vols.27-28, (1998), p.22-32