Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2015/03/jls.htm
2015 Vol. 5 (S3), pp. 2410-2416/Morzangoushi et al.
Research Article

IDENTIFYING AND RANKING THE CONTRACTORS SELECTION CRITERIA

Ali Morzangoushi[1], *Mohammad Mehdi Khabiri [2] and Saeid Ebrahimi Dehshiri[1]
[1]Departmentof Civil Engineering, Bafgh Branch, Islamic Azad University, Bafgh, Iran
[2]Departmentof Civil Engineering, Yazd University, Yazd, Iran
**Author for Correspondence*

ABSTRACT
The size of construction activities is considered as the indices of principal growth and development. Annually thousands milliards Rials of our country national capitals are sent directly and indirectly for construction and fundamental plants in government and private sectors. In a construction project, the most value of investment is performed in accomplishment of the project. One of the main reason of losing the financial resources and failure of construction projects is the incorrect choice of the contractors in the projects. In this regard, the introduction and correct selection of the contractors in the construction projects are considered as the principal solution to prevent from lose of the national resources. In this research, at first, the indices affecting on selection of the contractor was determined using research literature and then, a questionnaire was provided in order to evaluate the contractors. The mentioned questionnaire was fulfilled by the statistical community included the reporters and exports of Yazd city housing cooperative and was analyzed using FTOPSIS method and finally the managers' executive and technical ability and experience has obtained the highest rank and holding the management degree obtained the lowest rank.

Keywords: *Contractors, Evaluation, FTOPISI*

INTRODUCTION
The size of construction activities is considered as the indices of principal growth and development. Annually thousands milliards Rials of our country national capitals are sent directly and indirectly for construction and fundamental plants in government and private sections. In a construction project, the most value of investment is performed in accomplishment of the project (Abbasniya *et al.*, 2005). One of the main reason of losing the financial resources and failure of construction projects is the incorrect choice of the contractors in the projects. In this regard, the introduction and correct selection of the contractors in the construction projects are considered as the principal solution to prevent from lose of the national resources. Much quantity and quality factors are used to evaluate the contractors' competency. Considering the mentioned subjects and regarding this point that contractor's valuation and selection management to allocate construction projects is among the principal section of construction process, this research deals with finding the dimensions and factors affecting on selecting the contractor and prioritizing and selecting the most advisable contractor using TOPSIS method in construction general office of Yazd province.

Problem Analysis
The performed studies indicate that delay in construction projects is inevitable affair because of their special complexities. Most big construction projects in the world are faced to about 50% increase in time. Because of the direct relationship between time and cost, prolongation of project enforcement leads to increase in costs. Delay in implementation of projects will result in increase in costs, decrease in efficiency, low quality of work, and subsequently spending budget, paying the adjustments and differentials to compensate the damages caused by the delay. Moreover, customers' dissatisfaction, lack of timely use of project funds, lack of timely capital return due to becoming the project non-economic, increase in project costs and making it inefficient and finally creation of social and political tensions in the region such as the consequences of delays in implementation. Each organization, considering the internal properties and the managers' leadership and management style is managed in a particular way.

And the organization may use different methods to perform its tasks. Outsourcing and/or using consultants in the various stages are also among these methods. But in the conditions that there are considerable academic researchers in using outsourcing in construction activities, unfortunately the scientific studies which were carried out in outsourcing the construction projects are limit. But it should be investigated that what is the relationship between outsourcing and management consulting as well as in what extent and what issues of project management is allocated to the suppliers by contractors.

The present research deals with this subject that how the employers can select their contractors in a way that reduce the mentioned problems. So this research is seeking to answer this question that what are the contractor's selection criteria? And how are their rankings?

Research Literature

Aghabagheri *et al.,* have used grey theory from development of fuzzy MADM methods for ranking and selecting the contractors. This method is very suitable for the unknown situations and uncertainty and it includes many advantages in comparison with mathematical analysis. Grey theory is a new mathematical theories based on the combination of system theoretical concepts and space- theory (Aghabagheri *et al.,* 2010).

Keramati and Vakili have introduced a new technique based on multi-criteria titled as the contractor's superiority & inferiority ranking (SIR) meanwhile a comprehensive review about raking techniques and criteria and selecting the contractor.

In this model, by weighting criteria, forming lead matrix (S) and infrared (I) and obtaining the superiority and inferiority values using SAW and TOPSIS techniques, ranking the contractors is done in several stages and eventually the best option is concluded (Keramati & Vakili, 2010).

Sadeghi *et al.,* have done an integrated fuzzy approach to assess and select the contractors in EPC projects. In their approach, different concept of Delphi technique, fuzzy sets theory and multi-criteria decision techniques have been combined together to reduce the uncertainty and complexity of the issues in decision making problems and identifying the appropriate criteria and ranking the contractors (Sadeghi *et al.,* 2009). Arvin and his colleagues emphasized the importance of choosing subcontractors in the construction projects have presented an AHP technique based model to determine the suitable subcontractors (Arvin *et al.,* 2008).

Abbasniya *et al.,* (2005) divided the contractor selection process into two parts of tender winner's prequalification and determination of the tender winner and they provided a mathematical model to determine competency, then they began to determine their qualification, considering the criteria and sub-criteria of decision-making and also the weight of these criteria from viewpoint of the tender administrative board and evaluation of each criteria for the expensive tender.

They have investigated two preferential and elimination approaches together. So that defining two veto and threshold extents, an overlap has been done on both elimination and preferential approaches and they used TOPSIS technique and presented a new model to evaluate the contractors' pre-qualification (Abbasniya *et al.,* 2005).

Rezvan *et al.,* have presented a fuzzy approach based on the concept of ELECTRE to evaluate and select the contractors. The advantage of this approach is application of the linguistic variables to assess the priorities and weights of criteria. This primacy of language can be stated in the form of triangular and trapezoidal fuzzy numbers (Rezvan *et al.,* 2006).

Taheri and Rezvanian have offered a model to select the method of outsourcing approach of work packages based on the Simple assembly weighting approach (SAW) from multi-criteria decision making approaches, and they have illustrated this model to select outsourcing stations approach in the Tehran Metro 7th line project (Taheri & Rezvanian, 2008).

Rajai and Hazrati (2008) have offered the result of their investigations under both multi-criteria decision Fuzzy SAW and Fuzzy TOPSIS methods to evaluate the qualifications and selection of contractors and their results were compared with each other. They believe that, considering this matter that many criteria for qualification of the contractors are qualitative, so the fuzzy theory can be used as a suitable tool for pre-qualification and selection of the contractors. In their research, they have used both Fuzzy Saw and

Fuzzy Topsis multi-criteria decision-making approaches to confirm pre-qualification and selection of the contractors. By comparing the results of both approaches they have found that Fuzzy Saw is a conservative approach, but Fuzzy Tops is approach is better for the risked decision-making (Rajai and Hazrati, 2008).

Darvish *et al.,* (2009), in an article titled "Application of graph theory and matrix approaches in order to rank the contractor" have indicated that how graph theory and matrix approaches can be used as an analytical decision making tool to select the contractor, so that the project administrators can apply this method as a decision support system to identify the qualified contractor in order to conclude the contract.

MATERIALS AND METHODS

Research Methodology

Type of the present research is based on the applicable aim, and how to obtain the required data. This is descriptive research and is considered as measurement branch.

Since the evaluation indices of each system, depending on the development of its main objectives and key tasks which expected from the system as well as affective factors and costs will be different, therefore, in order to identify the effective indices in selection of the contractors for construction projects the following steps are carried out.

First, referring to the history of performed studies in this area, many criteria are identified and to ensure the effectiveness of the identified indices in the contractor selection process, a questionnaire was prepared and distributed among the experts. All indices affecting selection of the contractor are identified. In the next step, the paired comparisons questionnaire between indices is designed in order to determine importance rate of each indices. The relative weight of each index is determined. Finally, the preferred contractor is selected, collecting the experts' ideas and via TOPSIS approach.

Statistical Community of the Research

Senior executives of Yazd city housing cooperatives with the following characteristics:

1. Over 5 years experience
2. Holder of bachelor and higher degree of statistical sample

The sample is a subset of the statistical community that the researcher is able to generalize the results to the entire statistical community by studying it (Skaran, 2011).

Data Analysis

To analyze the data, since the criteria have been defined as the criteria and sub-criteria, for weighting the criteria, the Chang's hierarchical analysis approach from equations (1) and (2) has been used, and to weigh the sub-criteria, after data collection, using a questionnaire and decision matrix was formed and sub-criteria was stated quantitatively using triangular fuzzy numbers, the positive and negative ideal distance was calculated using equations (3-6) after normalizing the data.

Fuzzy triangular numbers have been used as (l, m, u) in the fuzzy hierarchical analysis.

Very good	Relatively good	Good	Average	Good	Relatively weak	Very weak
(10, 9, 7)	(9, 7, 5)	(9, 7, 5)	(3,5,7)	(1,3,5)	(3, 1, 0)	(1, 0, 0)

Equation (1)

$S_k=\sum^n M_{kj} * \{\sum\sum M_{ij}\}^{-1}$

Equation (2)

if: $s_i \geq s_j V(s_i \geq s_j)\{v(s_i \geq s_j)=1$

Otherwise: $V(s_i \geq s_j)=(U_i-L_j)/(U_i-L_j)+(m_j-m_i)$

Thus, all experts' idea was collected in a general matrix, in this matrix, the experts' ideas rate, data without scaled matrix and average experts' ideas in offering an idea in raking the contractor's selection criteria have been shown. Briefly, considering the uncertain and vague or fuzzy data in the process of group decision-making, the linguistic variables are used to assess the weights and criteria of each option.

In this approach, the decision-making matrix is turned into the fuzzy matrix. Then the normal weighty is created collecting decision-makers' ratings fuzzy.
Here, positive and negative fuzzy ideal solutions are identified. Vector method is used in order to determine the distance between two triangular fuzzy rank and distance of each option from both positive and negative ideal solutions. Finally, a proximity coefficient is identified for each option by which ranking the options is determined. Whatever this proximity coefficient is higher for an option, this option is in closer distance to the positive ideal solution and is in more distance to the positive ideal solution.
Considering the parameter k for the number of decision-makers, the ranks of each option and the weights of each factor can be calculated by the following formula:
Equation (3)

$$X_{ij} = \frac{1}{k}[\, x_{ij}^{1} + x_{ij}^{2} + \ldots + x_{ij}^{k} \,]$$

Equation (4)

$$W_{j} = \frac{1}{k}[\, w_{j}^{1} + w_{j}^{2} + \ldots + w_{j}^{k} \,]$$

Therefore, after making fuzzy the matrix tables of experts' responses, the matrix data was normalized using a linear scale.
Equation (5)

$$R = [\, r_{ij} \,]_{m \times n}$$

After normalization, the fuzzy data for each factor should be inserted in the range [1, o].
After normalization, data for each operating phase should be in the range [1, 0. Then, the positive ideal solution both and the negative ideal solution are calculated.
The following formula has been used to calculate.
Equation (6)

$$d^{+} = \sqrt{\sum_{1}^{23} \frac{(a1+2a2+a3)-4)2}{4}}$$

$$d^{-} = \sqrt{\sum_{1}^{23} \frac{(a1+2a2+a3)2}{4}}$$

After calculating the distances, the final weight of each financing method was calculated, considering the ranked criteria in the previous step. It is obvious that the method which earns more rank will be put in priority.
The weights will be calculated using the following formula:
Equation (7)

$$cc = \frac{(d+)}{(d+)+(d-)}$$

Considering the agreed, presented and identified criteria from the texts, the under studying approaches, each approach have been compared as the above table and have been prioritized for selection, consideringthe importance degree. Whatever the point of approach is farther from 1, it is more suitable for selection. According to the table the sub-criteria have been ranked considering the importance degree. So the highest criteriahave the highest criteria.
Therefore, the criteria ranking table are presented as the following:

Table 1: Ranking the criteria and sub-criteria

Dimensions	Index	Rank in class	Index rate	Final weight	Total rank
	Ability to plan a management	0.104096157	0.358334447	9	17
	degreeHolding	0.144298793	0.496725623	1	1
	To supply machines	0.107184799	0.368966605	8	15
	Reports	0.115721356	0.398352345	6	10
	Holding the organizational	0.116894292	0.402389991	5	9

	institutes				
	Technical ability for implementation	0.08930651	0.307423443	13	**27**
	Ability for technical design and engineering services	0.109457656	0.376790556	7	14
	Having the software power	0.124768933	0.429497188	3	4
	Having competency certification	0.11718109	0.403377246	4	8
	Quality guarantee	0.100162064	0.344791958	11	23
	work Knowledge	0.098274869	0.338295591	12	24
	Human resources	0.103157495	0.355103253	10	18
	Base and rank of company	0.126020774	0.43380645	2	3
	Company responsibility	0.075614443	0.2917449	6	33
	Company management experience	0.097262268	0.375269186	5	26
Management 25918.0	Management skills	0.101749603	0.392582774	4	19
	Holding management specialty	0.117732742	0.454250876	3	
	Participating in specialized training courses	0.119167979	0.459788484	2	7
Financial ability 19114.0	Membership in the specialized associations	0.132334545	0.510589338	1	6 2
	Value of current assets	0.073298556	0.383480987	4	35
	Value of current debt	0.071556654	0.374367764	6	37
	Capital value	0.068348376	0.3575828	7	38
	The financial turnover value of annual projects	0.07394996	0.386888982	3	34
	Value of the fixed assets	0.080008868	0.418587777	2	31
	The ability for the financial funding	0.067765776	0.354534773	8	39
	Price of previous projects	0.071900403	0.376166179	5	36
	Annual gross income rate	0.085914336	0.449483813	1	30
	Capability of managers' administrative and technical and experience	0.066394319	0.347359626	9	40
	Implementation of similar project	0.087059665	0.335904254	11	29
	Brand	0.115620664	0.4461018	2	11
Experience 25918.050.0	Quality of previous projects	0.087698675	0.338369763	10	28
	Good experience in previous projects	0.078418463	0.302563712	12	32
	The number of projects under implementation	0.107050809	0.413036535	5	16
	Holding certificate of appreciation, testimonial, encourage	0.123283421	0.475667185	1	5
	Lack of contract cancelation	0.100344183	0.387160209	8	22
	Lack of contract termination	0.11514507	0.444266804	3	12
	Without history of	0.101125894	0.390176303	6	20

	exclusion from participation in tender				
	Without history of confiscation of participating in tender	0.10072768	0.388639862	7	21
	High evaluation record in the previous tenders	0.112182938	0.432837943	4	
	professional background profit	0.098267274	0.379146826	9	13

CONCLUSION

According to the performed calculations, the administration technical ability includes the highest rank and holding management degree includes the lowest rank, in technical ability level, the responsibility criterion of company includes the highest rank and membership in the specialized associations includes the lowest rank, in the management level; rate of managers' administrative and technical ability and experience includes the highest rank and annual gross income includes the lowest rank, in the financial ability level and good record in the previous projects includes the highest rank and holding certificate of appreciation, encourage a testimonial includes the lowest rank among all criteria in experience level. Finally, the rate of the directors' administrative and technical ability and experience includes the highest rank and holding the management degree includes the lowest rank among all criteria.

REFERENCES

Abbasniya Reza, Afshar Abbas and Eshthardyan Ehsan (2005). A new method in evaluating the prequalification of contractors. *International Journal of Engineering Sciences, Iran Science and Technology University* **6**(4) 10-1.

Aghabagheri Mostafa, Kazem Khanlou, Hamid and Sharifitabar Hasan (2010). Assessment of the contractors by the local indices and selection by Grey analysis model. *Second International Congress about Local Ability Enhancement with Contractor System Development.*

Alvin Ali, Harischian Mahmoud and Hosseinali Pourmojtaba (2009). Presentation of subcontractors' logistics management model in terms of the contractors' criteria. *Third National Conference of Supply and Logistics System in Proje*cts.

Bochenek J (2014). The contractor selection criteria in open and restricted procedures in public sector in selected EU countries. *Procedia Engineering* 69 – 74.

Darvish M, Yasaei M and Saeedi A (2009). Application of the graph theory and matrix methods to contractor ranking. *International Journal of Project Management* **27** 610-619.

Marzouk M, El Kherbawy A and Khalifa M (2013). Factors influencing sub-contractors selection in construct ion projects. *HBRC Journal* **9** 150-158.

Plebankiewicz E (2009). Construction contractor perqualification from polish clients' perspective. *Journal of Civil Engineering and Management* **16**(1) 57-64.

Rajai Hasan and Hazrati Ayub (2008). Presentation of Fuzzy TOPSIS andFuzzy Saw multi-criteria decision making for prequalification and selection of the contractors and comparison of the related results. *Fourth Conference Of Project Management.*

Rezvan Taghi, Shahlai Afshin Hejazi and Seyyed Reza (2006). A fuzzy approach based on E-concept for assessment and selection of the contractors. *International Third Conference about Project Management*.

Sadeghi Hasan, Sasaniyan H and Moeeni F (2009). First introduction of a fuzzy integrated approach for ranking and selection of contractors in the EPC projects. *The first National Conference on Project Administration via EPC Method.*

Shafahi A and Haghani A (2014). Modeling contractor s' project selecti on and markup decisions infl uenced by eminence. *International Journal of Project Management* **32** 1481 – 1493.

Shahi MA, Haas CT, Dawn Fiander, Safa Ma, Hipel K, Safa S Gillivray (2015). Competitive intelligence (CI) for evaluation of construction contractors. *Automation in Construction* **59** AUTCON-01862 1-9.

Tabatabaipour Ahmad (2014). Applying F-PROMETHEE for the evaluating and ranking the projects (case study: construction general office of Yazd province). M.A. thesis.

Taheri Davoud and Rezvanian Oveys (2008). Offering the outsourcing model in investigation of the various feedback contracts (case study: Design and implementation project of Tehran metro line). *The Fourth International Conference on Project Management*.

Watt DJ, Kayis B and Willey K (2010). The relative importance of tender evaluation and contractor selection criteria. *International Journal of Project Management* **28**(1) 51 – 60.