

Comparative Comparison of Contractors' Evaluation Criteria, Sub-Criteria and Indicators in Water Industry Tender Using Questionnaire and Text Mining

Majid Parchami Jalal^{1*}, Hadi Shakiba Zahed², Mohammad Amin Ghaaderi³

¹ associate professor in Project and Construction Management, Faculty of Architecture, University of Tehran, Tehran, Iran

² Ph.D. candidate in Project and Construction Management, Faculty of Architecture, University of Tehran, Tehran, Iran

³ Masters Student in Project and Construction Management, Faculty of Architecture, University of Tehran, Tehran, Iran

ABSTRACT

The efficiency of contractors selection in infrastructure projects is always one of the main concerns of employers. The purpose of this study is to propose a new method for the specification of evaluation criteria, according to the type of project under assignment and prioritization, and to determine the proposed score of the evaluation criteria of the contractors using two different methods. The first involves statistical analysis of the questionnaires, and the second involves the text mining of the interviews. For this purpose, after library studies, fieldwork, and questionnaire design, questionnaires were given to experts in the industry, and their statistical analysis identified important criteria and sub-criteria and then interviewed another group of experts. Using the text mining and clustering of interview texts, the criteria and indices of contractors' evaluation were identified, and the results of these two methods were compared with the bidding law implementing regulations in Iran. SPSS software was used to analyze the interviews, and the K-means algorithm was used to interviews text mining. The findings of the study indicate that the results of the text mining and questionnaire are in agreement, and It can be concluded that the identified criteria have acceptable accuracy and generalization capability, and organizations can use these criteria and evaluation indicators to select the most suitable contractor in the tenders. Identified Criteria, in addition to covering all the criteria introduced in the Bidding Law Implementing Regulations, also include two new criteria, namely Claim Management and Safety Management & Quality Control.

KEYWORDS

Construction Evaluation Criteria, Text Mining, Data Mining, Clustering, Tender

* Corresponding Author: Email: parchamijalal@ut.ac.ir

1. Introduction

Today, choosing the most suitable contractor is one of the most important decisions for employers. Contractor evaluation requires evaluation criteria and indicators [1]. In most of the researches used to identify contractors' evaluation criteria, a questionnaire tool has been used to identify contractors' evaluation criteria [2] [3]. One of the disadvantages of identifying contractors' evaluation criteria using the questionnaire is that the way the questionnaire is designed and the factors that are mentioned may influence the audience's orientation and affect the way the questionnaire is filled. Compensating for this weakness led the researchers to identify contractors' evaluation criteria and indicators using two complementary tools, a questionnaire, and a text mining. The overall process of the research is shown in Figure 1.

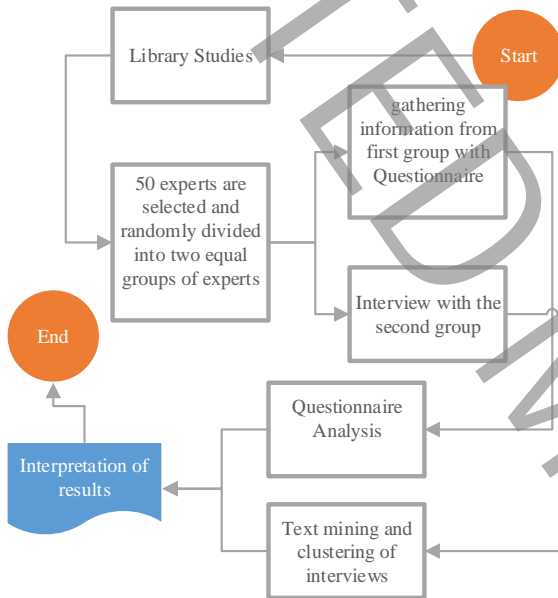


Figure 1- Research process

2. Methodology

This research consists of three parts. In the first part, contractors evaluation criteria were identified using library studies and questionnaire tools and In the second part, water industry experts were interviewed and text mining operations were conducted on the Interview transcripts. Then they were compared, and finally, the findings of the research were compared with the bidding law implementing regulations in Iran. In other words, contractors evaluation criteria and indicators are identified using a questionnaire, statistical analysis, and text mining, and after comparing the results, final criteria are presented. The statistical population consists of 78 people working in the marketing offices of a

consulting firm. 64 industry experts from two different companies (to ensure the generalizability of the research results) were identified and invited, and 50 of them agreed to participate in the research. The experts were randomly divided into two equal groups. Opinions of the first group were collected through questionnaires and statistical analysis, and the second group's opinions were collected by interview and text mining tools.

3. Discussion and Results

In this study, the Delphi method was used to design the questionnaire. Pairwise comparisons were used to determine the significance ratio of each of the main criteria in Expert Choice software. To determine the significance of the sub-criteria, respondents were asked to assign a number from 1 to 7 to each sub-criteria. The number 1 represents the least important, and the number 7 represents the most important. Then the mean scores assigned to each sub-criteria were calculated and considered as the significance index. Seven main evaluation criteria and 14 sub-criteria and their weight were identified by questionnaire

In the data preprocessing step, stop words were removed. To perform text mining operations, the textual data must first be converted to numerical vectors to be processed by software [4]. This way unstructured data is converted to structured data. With the "Generate TFIDF" operator, words are converted to numerical vectors, and the text of the interviews is converted to a numerical matrix. TF-IDF is a statistical proposition which means the weight of the words that represents the importance of the words in the text. After calculating the TF-IDF matrix, clustering operation was performed on this matrix using the K-means algorithm. The value of K, which represents the number of clusters, was determined from 2 to 10, respectively, and each clustering result was recorded, and by comparing them, it was concluded that $K = 6$ produced the most appropriate cluster composition [5]. After performing the clustering operation, the data were subdivided into 6 different clusters, and the keywords in each cluster were identified using two criteria, TF-IDF value and cluster center value for each word [6]. The topic of each cluster was considered as the main criteria and it was found that the topics of the 5 clusters are highly correlated with the 5 main criteria identified by the questionnaire, and the sixth cluster can be considered as new criteria. In the next step, by analyzing the keywords of each cluster, the evaluation indices for each of the criteria and sub-criteria are determined.

The high consistency and consistency of the results of the first tool (questionnaire and statistical analysis)

and the second tool (interview and text mining) indicate that contractors' evaluation criteria, sub-criteria, and indices are extracted with acceptable accuracy and generalizability.

4. Conclusions

In this study, the main criteria, sub-criteria, evaluation Indicators, and their weights were identified using two text mining and interviewing tools (Table 1). The main criteria identified in this study are Work Capacity, Technical skills, Performance on previous projects, Claim Management, Financial situation, project management skills, reputation, and HSE management. The results of the study, in addition to

covering all the criteria presented in the bidding law implementing regulations in Iran, have added the following items:

- Claim Management and HSE management as the two main criteria
- Three evaluation Indicators to assess claims management ability and eight evaluation Indicators to assess safety and health management ability
- Determine the weight of the main criteria, sub-criteria, and evaluation Indicators specifically for the water bidding industry.

Table 1- Evaluation main-criteria and sub-criteria and their weight

Main-Criteria	Weight	Sub Criteria	Weight
Work Capacity	14	-	-
Technical skills and key staff skills	14	Technical Skills	36
		Key Staff	32
		Understanding and regulations	32
Performance in past projects and Organizational experience	14	Performance in past projects	50
		Organizational experience	50
Claim Management	13	-	-
Financial situation	12	-	-
Management skills	12	Project Management Skills	50
		Innovative technical solutions	50
Good reputation	11	-	-
HSE and Quality Control	10	HSE	50
		Quality Control	50

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