Contractor Selection Using Integrated Goal Programming and Fuzzy ELECTRE

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ABSTRACT

Outsourcing plays an important role in the success of organizations. One of the risks associated with outsourcing is inappropriate contractor selection which significantly influences the implementation of projects in terms of time, quality, and cost. In this study, we applied multi-criteria decision-making techniques in order to determine the best contractor using criteria such as reputation, offered price, and technical capacity. This study is primarily aimed at identifying important criteria of contractor selection, determining the significance of the criteria, and designing a framework for selection of the most appropriate contractor. Important criteria for selecting contractors were extracted from the literature and experts’ views were collected using questionnaire. Accordingly, six criteria were selected and their weights were determined by the application of goal programming. Finally, contractors were ranked and the best contractor was selected using fuzzy ELECTRE technique with trapezoidal fuzzy numbers.

Keywords: Contractor Selection, ELECTRE, Fuzzy Theory, Goal Programming, Multi-Criteria Decision-Making, Trapezoidal Fuzzy Numbers

1. INTRODUCTION

Not all organizations benefit from outsourcing their activities and the disadvantages of outsourcing can lead to serious problems and risks for an organization. These disadvantages include selecting improper contractor, poorly written contracts, ignoring staff’s problems, losing control over the outsourced activities, disregarding the hidden costs of outsourcing, and lack of appropriate planning for an exit strategy (Barthélemy, 2003). In addition, an inappropriate contractor increases the risks of delays, substandard work, disputes, cost

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overruns, or even bankruptcy (Hatush and Skitmore, 1997; Jaskowski et al., 2010). As a result, contractor selection is considered to be one of the most important decisions made by managers in the process of outsourcing. Owing to the diversity and variety of contractors which potentially have the required qualifications and capabilities to perform a project, contractors should first be evaluated, ranked, and then selected in order to ensure the project implementation to the best way.

Given the increasing importance of the contractors role in the design and implementation of various projects, several procedures are designed and used in the contractor selection process by governments and large employers; one of which is the use of multi-criteria decision-making (MCDM) techniques. In this study, the integration of goal programming, the ELimination Et Choix Traduisant la Réalité method (ELECTRE), and trapezoidal fuzzy numbers are used to rank contractors based on six criteria namely technical capacity, experience, offered cost and price, reputation, financial stability, and administrative capacity.

The remainder of the paper is organized as follows: Section 2 describes some basic concepts and reviews the literature of contractor selection. Section 3 and 4 introduce the linear goal programming and the fuzzy ELECTRE methods. In section 5, the proposed method is presented. In section 6, the method proposed in previous section is applied to the contractor selection problem. Finally, the results and conclusions are presented in section 7.

2. LITERATURE REVIEW

2.1. Contractor Selection Methods

Most real-world problems have different, conflicting and multiple measurement criteria. In terms of decision-making, different and contradictory qualitative factors are evaluated and suitable solutions are selected among several alternatives. The multi-attribute analysis (MAA), multi-attribute utility theory (MAUT), analytic hierarchy process (AHP), analytic network process (ANP), the technique for order preference by similarity to ideal solution (TOPSIS), PROMETHEE, fuzzy logic, matrix approach, case-based reasoning (CBR), cluster analysis (CA), and graph theory are amongst the most frequently used approaches in the contractor selection literature (Abudayyeh et al., 2007; Araz et al., 2007; Boran et al., 2009; Cheng and Li, 2004; Darvish et al., 2009; El-Sawalhi et al., 2007; Fong & Choi, 2000; Hatush & Skitmore, 1998; Holt, 1996, 1998; Holt et al., 1994; Juan, 2009; Lin et al., 2010; Mahdi et al., 2002; Ng, 2001; Plebankiewicz, 2012; Topcu, 2004; Wong et al., 2003; Zavadskas & Vilutienë, 2006).

For instance, Araz et al. (2007) developed an outsourcer evaluation and management system for a textile company by the use of fuzzy goal programming and PROMETHEE. Considering the interdependent influences specified in their model, Cheng and Li (2004) proposed an ANP model for contractor selection. In their research study, Darvish et al. (2009) showed how the graph theory and matrix methods may be served as a decision analysis tool for contractor selection. In addition, Fong and Choi (2000) applied the AHP in a contractor selection problem which would help construction clients to identify contractors with the best potential to deliver satisfactory outcomes in a final contractor selection process. Jajimoggala et al. (2011) presented an integrated approach for maintenance policy selection using fuzzy ANP and goal programming based on fuzzy pre-emptive priority. Sodenkamp (2012) proposed a multi-criteria decision analysis method to facilitate making supplier selection decisions by the distributed groups of experts and improving quality of the order allocation decisions. Golara et al. (2012) introduced a dynamic mixed integer linear programming model for the design and optimization of closed-loop supply chain network capable of recovering glass containers. Guchhait (2012) developed an inventory control problem under two-level trade-credit policy with fuzzy inventory costs. Fuzzy sets were for the first time used to build a contractor selection model by Nguyen (1985) taking into
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