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Procedia Engineering 182 (2017) 91 – 98

Procedia Engineering

www.elsevier.com/locate/procedia

7th International Conference on Engineering, Project, and Production Management

Modeling Contractor's Bidding Decisions

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Abstract

Experience and business intuition of a contractor are often insufficient to ensure that tender procedures will provide a good trade-off between the cost of bid preparation and the benefit of a high probability of winning a money-making contract. The authors put forward a set of decision-support models: a multi-criteria analysis for assessing the desirability of a potential new contract, and two linear programming models: one for calculating the total price, and the other for distributing the bid amount among the items of the bill of quantities to maximize the contractor's cash flows. Application of the models is illustrated with a numerical example.

Peer-review under responsibility of the organizing committee of EPPM2016

Keywords: construction management; decision support; decision to tender; linear programming; pricing

1. Introduction

Tendering stays one of the most popular means of selecting contractors to carry out construction works [1, 2]. Any invitation to tender is potentially a business opportunity. A decision is needed to either explore it (so use time and resources to prepare a bid) or decline it in search for better options. This implies that a variety of decisions are taken at different management levels to minimize cost and increase revenue. The key issue is whether to bid and it is made on the basis of the analysis of the client's tender documents (what is to be done and on what conditions?), assessment of the contractor's capabilities against current project portfolio (are we able to deliver?), and expected economic effects of the project (can we earn a decent profit?).

Assuming that the invitation to tender was accepted, decisions on bid price need to be taken. The total price is often the most important feature of the bid. In contrast to the manufacturing industry, prices in construction are calculated individually to account not only for unique scope and specifications, but also for the type of contract, and expected

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Peer-review under responsibility of the organizing committee of EPPM2016
doi:10.1016/j.proeng.2017.03.125

development of the market. Apart from items unequivocally defined in the tender documents whose cost can be simply "calculated", many components of the price need to be estimated individually on the basis of less tangible input; these are risks and profit. In practice, only small and highly specialized contractors present standard price lists to their prospective clients while advertising their service [1].

As the above mentioned decisions are often taken without analyses, the authors put forward a set of decision support models: a multi-criteria analysis (simple additive weighting method) for assessing desirability of a potential new contract, and two linear programming models: one for defining total bid price (a trade-off between the chance of winning the contract and maximizing profit), and the other for distributing the bid amount among the items of the bill of quantities to maximize cash flows.

2. Literature review

2.1. Decision to bid

There is a finite number of bids that a contractor can produce at the same time. Estimating departments worldwide work under pressure: the time is scarce, and a mistake in the estimate is likely to generate serious losses in terms of both money and contractor's reputation. Decision on to bid or not to bid is based trade-off between expected cost (bid preparation cost may be relatively low, but lost opportunity cost of getting no contract is considerable) and benefits (profit, positive cash flows, position in the market). Thus, ways of selecting invitations to tender is of interest for both practitioners and researchers.

Factors affecting bid/no bid decision and their relative significance have been studied repeatedly worldwide, mostly by means of questionnaire surveys and interviews with representatives of the construction industry. For instance, the United States' contractors were surveyed by Ahmad and Minkarah in 1988 [3], Sash [4] conducted similar research in the United Kingdom, Wanous et al. [5] in Syria, Chua and Li [6] in Singapore, Bageis and Fortune [7] in Saudi Arabia, Hassanein [8] in Egypt, Leśniak and Plebankiewicz [9] in Poland, or Oyeyipo et al. [10] in Nigeria. The factors, mostly of qualitative character and ambiguous, occur to be similar. However, their ranking is reported to vary country to country and according to changes of economic circumstances [9].

With the list of criteria established as above, and many available methods of multicriteria assessment [12–14], a considerable number of decision support models were proposed in the literature to compare invitations to bid, and find the best ones (among others, a parametric model to decide if to bid by Wamous et al. [3], and models based on fuzzy preference relations by Leśniak and Plebankiewicz [7] or Cheng et al. [9]).

2.2. Determining the bid price

As the price is usually the key criterion in client's assessment of bids, it strongly affects the chances of winning a contract. Some models that facilitate decision on the markup level by maximizing the expected value of contractor's profit allowing for probability of winning the contract are presented in the literature on the subject, among others, by Mielec et al. [15], or Wang et al. [16]. However, these models were designed to support repeatable bidding for specialized works. They assume that details such as the number of competitors in the bidding procedure and historical records of their prices are available, so that necessary probability distribution parameters can be estimated. In the real life of bids related with complex projects of unique scope, with incomplete information on competition and even the object of pricing, such probability-based methods are considered insufficient. It is generally observed that there are many project- or contractor-specific factors that may provide justification for reducing markup to improve chances for getting an attractive job (big, prestigious, or just badly needed in the times of recession), or to inflating it – to compensate for additional risks related e.g. with undefined scope in fixed price contracts, or just to use the opportunity. Thus, current objectives may not be convergent with the long-term aims of maximizing the expected value of profit [2], which makes the pricing problem even more complex. Therefore, models based on game theory (e.g. Cui and Zhang [17], artificial neural networks (e. g. Li et al. [18]), and fuzzy set theory (e.g. Fayek [19]) are being developed to allow for qualitative and approximate character of the input.