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Probabilistic approach to determining overhead-cum-markup rate in bid price

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Abstract

Contractors often use an all-in rate to lump overhead and markup together on top of direct cost for arriving at a bid price. Such a method is naturally prone to inaccuracy and involves a greater risk in competitive bidding, if the applied rate is selected subjectively. The present research aims to develop an improved approach to determining the combined rate of overhead and markup in the bid price for a project. Four factors, i.e., direct cost, duration, type of work, and location, were used as inputs to build a regression model from cost and bid data of collected projects for predicting the overhead and markup rate in the winning bid for a project, which, together with the model error, is used to estimate the probability of winning for a bid level. Then, based on minimization of overall loss risk proposed by a previous research, the bid preventing over-cuts in price competition is determined by using the model, the probabilistic estimates of project cost, and the probability of recovering costs if losing the bid. The approach is illustrated using two cases and the suggested bids for the cases are compared with those from other models.

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1. Introduction

The bid or contract price for a construction project comprises the contractor's estimated direct cost and overhead cost plus its applied markup, i.e. profit. The contractor's direct cost refers to all expenses for labor, equipment, materials, and subcontracts directly connected with completion of the elements of the project as required by

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specifications and regulations. The contractor's overhead cost consists of the site overheads for supporting a project, such as supervision, offices, utilities, and services, as well as the project's share of the home-office overheads for running the firm, such as corporate management, procurement, financing, and marketing. The profit portion of the bid price is business-oriented and a higher or lower level may be charged as deemed appropriate.

Since direct cost constitutes the greatest part of a bid, it draws most attention of contractors. The site overheads can be estimated based on a construction program, as recommended by McCaffer and Baldwin [1], Diamant [2], and CIOB [3] etc. However, such detailed estimation is time consuming and not favored by many contractors, who often exercise their experience-based judgment and use a selected rate of estimated direct cost to cover all site overheads. A project's share of the home-office overheads is usually determined simply as a fixed rate according to the ratio of the firm's annual total home-office cost to its annual total revenue. Similarly, the profit charged for a project is usually determined also as a rate based on the conditions of the project, the firm, and the market. Therefore, contractors often use an all-in rate to lump overhead and profit together on top of direct cost for arriving at a bid by using Eq. (1):

$$b = \bar{d} + \bar{o} + p = \bar{d} \times (1 + \frac{\bar{o} + p}{\bar{d}}) = \bar{d} \times (1 + r) \quad (1)$$

where b = bid price; $\bar{d}$ = estimated direct cost; $\bar{o}$ = estimated overhead cost (site overheads plus project's share of home-office overheads); p = charged profit; r = combined rate of overhead and profit applied in b.

In Eq. (1), $1+r$ equals the ratio of bid price to estimated direct cost ($b/\bar{d}$). Thus, with $\bar{d}$ and r established, b is obtained readily. Despite the advantage of giving a quick result, such a simple method is naturally prone to inaccuracy, if the applied rate (r) is selected subjectively. Because project owners usually award a construction contract based on the lowest bid, intense price competition is common and contractors often have to cut their bids to increase the chance of winning. However, cutting bids not only gives up possible profits but also undoubtedly increases the risk of making a loss in completing a job, if the winning bid is exceeded by the actual total cost. Using a combined rate of overhead and markup in competitive bidding without a sound approach certainly involves a greater risk for the contractor.

Because the time available for preparing a bid usually is short, the all-in-rate method represented by Eq. (1) is widely used by contractors in bidding. To avoid suffering an unworthy loss as a result of haphazardly applying an inadequate r, they should evaluate the impact of reducing r on the increase in loss risk against the increase in the chance of winning. However, although topics on bidding and estimating in construction have attracted much research interest over the years, the question of how to select a suitable r for a project has not yet been addressed. The present research aims to develop an improved approach to determining the combined rate of overhead and markup for a project in competitive bidding, in order to achieve a balance between a high chance of winning and a low loss risk as a basis for bid decision. The proposed approach is built upon previous researches by Chao [4] on overhead rate estimation and Chao and Liou [5] on bid-cutting limit determination.

2. Review of literature

Existing models for bidding in construction focus on determination of the markup rate in the bid price. In conventional models such as Carr [6], the optimum markup rate is suggested as one with the maximum expected profit, where the expected profit for a markup rate is defined as the product of it and its probability of winning that is estimated using statistics of past bids. Theoretically such a markup rate will achieve the highest profit in the long term, but it tends to give too low a chance of winning for contractors in intense competition, who often sacrifice profit in order to raise the chance of winning. As an illustration, a zero markup will never be recommended by conventional models since its expected profit of zero is always less than a positive markup's, but a zero markup is not uncommon in construction. Ahmad and Minkarah [7] took the lead in conducting a comprehensive study of factors influencing the markup decision that are grouped into the environment, company, and project aspects. Others followed, for example, Chua and Li [8] identified key factors affecting bid-reasoning sub-goals. Meanwhile, various multi-criteria markup models built upon identified factors have been proposed, e.g. the multi-attribute utility model