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Impact of contractor's optimized financing cost on project bid price

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Abstract

The financing cost depends on the incoming and outgoing cash flow throughout the project, and can differ greatly from project to project. This study proposes a model that calculates the expected financing cost based on the cash flow forecast. This approach is more realistic than assuming an approximate percentage of the total cost. The proposed model calculates the bid price using an optimized financing cost that is obtained by selecting an optimum combination of available financing alternatives offered by different lenders. The proposed model minimizes financing cost, reduces the bid price, enhances the competitiveness of the bidder, increases the contractor`s negotiating power with a lender by providing an optimum financing schedule, and eliminates the risk of financing surprises during construction. This study investigates the impact of different financing considerations on bid price in three cases to prove the effectiveness of the proposed model.

Keywords: Bid price; Financing alternatives; Project financing cost; Cash flow forecast; Work schedules; Lines of credit; Loans

1. Introduction

Financial factors are the most common causes of contractor failure (Arditi et al., 2000). Excessive financing cost may reduce profitability. One of the reasons why contractors need financing throughout a project is the fact that in many projects a portion of the intermediate payments is withheld as retainage by the construction owner, causing a deficit at the end of each payment period. Even if an owner does not withhold retainage, financing is still necessary when the periodic owner payments are delayed (Lu et al., 2016). Therefore, as Elazouni and Gab-Allah (2004) state, it is critical for construction contractors to procure sufficient cash with minimum financing cost in a timely manner to execute construction operations on schedule. Cost estimating and control should include financing considerations to represent the situation realistically. Since cash should not be consumed faster than the rate agreed with the lenders, cost control constitutes an important part of financial management in the construction stage. Cost control should be executed in the most effective way to make sure that the costs including financing cost are within budget (Turner, 2008). However, most researchers who have worked on scheduling problems (e.g., Abeyasinghe et al., 2001; Leu et al., 2001; Sunde and Lichtenberg, 1995; Zhang et al., 2006) and cost control (e.g., Aliverdi et al., 2013; Pajares and Lopez-Paredes, 2011; Peng et al., 2016; Ying, 2016) did not consider financing cost in their models.

Because the execution of construction projects demands large investments, contractors seldom use their own savings to perform projects (Elazouni and Metwally, 2005). They borrow money from banks or alternative lenders. Since contractors have to pay interest on borrowed money, some contractors consider a percentage of the total cost when preparing their bid. This practice is based on an approximate assumption and may result in overestimating or underestimating of the bid price. If the bid price is overestimated, the contractor may cease to be competitive, and if, as a result, the

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contractor is not awarded the contract, they forfeit the money they spent preparing the bid, around 0.2 to 0.5% of the total bid amount (Clough et al., 2005). If the bid price is underestimated, the contractor may well win the contract, but may see a decline in profits or may even incur a loss because the actual financing cost is higher. Therefore, when preparing a bid, it is important to correctly estimate the financing cost based on the project`s cash flow forecast instead of assuming an arbitrary percentage of the construction cost. In addition, a financing plan developed at the bidding stage and be refined at the design stage is likely to make cash flow management and cost control in the construction stage more effective and on-budget completion more likely (Jackson, 2002; Sears et al., 2015; Bode, 2003). Although cost control is quite important at the construction stage, this study focuses on the impact of financing cost at the bidding stage. The objective of this study is to reduce the bid price by using an optimized financing cost based on the project`s cash flow forecast.

Some models have been developed to calculate and minimize the bid price (e.g., Chou et al., 2015; Kuyzu et al., 2015), but none of them consider financing cost based on a cash flow forecast. Some other models have been proposed that calculate the financing cost based on a cash flow forecast (e.g., Alghazi et al., 2013; Ali and Elazouni, 2009; Al-Shihabi and AlDurgam, 2017; El-Abbasy et al., 2016, 2017; Elazouni and Gab-Allah, 2004; Elazouni and Metwally, 2005; Elazouni et al., 2015; Fathi and Afshar, 2010; Gajpal and Elazouni, 2015; Liu and Wang, 2010), but these models can be used only after the contract is signed to find the schedule that satisfies cash availability constraints, not to calculate the bid price. In addition, past studies considered only one financing alternative (i.e., only a line of credit) in their models. Therefore, a model is needed not only to calculate the actual financing cost based on the cash flow forecast, but also to minimize the financing cost in order to reduce the bid price.

According to Turner (2008) and Sears et al. (2015), costs are estimated to determine whether the project is worth undertaking, to prepare a bid price, to obtain financing, to manage cash flow, and to perform cost control. The financing cost is calculated based on a cash flow forecast, which in turn is created based on a work schedule. Since the line of credit is one of the most common financing methods in construction projects (Ahuja, 1976), the construction financing cost is usually calculated using only a line of credit. The contractor that uses a line of credit can borrow money on an as-needed basis up to the credit limit and pays interest on the amount of funds borrowed (Fathi and Afshar, 2010; Al-Shihabi and AlDurgam, 2017). The reason why other financing alternatives are not as common as the line of credit, is because no methods exist that can provide a financing schedule that makes use of an optimum combination of different financing alternatives, each with an optimum amount, and an optimum timing of borrowing and repaying money.

This research proposes a model that (1) minimizes the expected financing cost of a contractor by using a financing optimization method that considers different financing alternatives (i.e., short-term loans, long-term loans, and lines of credit); (2) provides an optimum financing schedule of borrowed and repaid moneys; and (3) reduces the bid price of the contractor, hence enhancing their competitiveness. Three scenarios are tested and analyzed in this research. In Scenario 1, the financing cost is calculated by considering a percentage of the total cost. In Scenario 2, only a line of credit is considered (as was the case in past studies). In Scenario 3, the model proposed in this research is adopted to minimize the expected financing cost by selecting the right combination of financing alternatives out of many available. This optimized financing method is expected to lower bid price and enhance competitiveness compared to the models in Scenarios 1 and 2.

2. Methodology

As shown in Fig. 1, the proposed model is developed in three steps: (1) a scheduling model, (2) a cash flow model, and (3) a financing optimization model. A work schedule is needed to create a cash flow forecast, the cash flow forecast is needed to find the minimum financing cost, and the minimum financing cost is needed to reduce the bid price. The proposed model begins by creating a work schedule and developing a cash flow forecast using work schedule information. Then, the proposed financing optimization model is activated to calculate the optimal financing cost, to develop the optimal financing schedule, and to calculate the bid price for the project using optimized financing. The proposed computational model that is presented in Fig. 1 is executed by an automated system using MATLAB 2013a.

2.1. Scheduling model

The project starts when a customer provides a statement of work and when a project charter is defined. The project charter is an important input when the work schedule is planned. To create a work schedule, the activities are first defined using the schedule management plan and the scope baseline. Then, an activity list, activity attributes, and a milestone list are prepared and used to sequence activities and create a project network schedule. Afterwards, activity resource requirements and activity duration estimates are calculated to create a project schedule (Project Management Institute, 2013). It should be noted that the overall product lifecycle should also be considered ahead of the project management process to obtain higher quality estimates (Laporte et al., 2016). It should be noted that this study assumes that the activity list, activity attributes, the milestone list, the activity sequences, and the project network schedule are prepared based on product-based planning after performing overall product lifecycle analysis of the system.

The start and finish times of activities are needed to create a cash flow forecast. CPM is widely used to calculate the early start, early finish, late start, late finish, and total float of activities. Even though financing cost may be lower if activities start and finish as late as possible, this situation creates a schedule composed of mostly critical activities. In order to avoid such a situation, all activities are scheduled at their early times in this study.

Although, linear programming or dynamic programming are used to analyze the network and to find the critical path, Shankar and Sireesha (2010) proposed the modified Dijkstra's algorithm for CPM since the mathematical approaches (i.e., linear programming