A Study on Key Factors Influencing Bid Decision Model for Construction Projects

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Abstract. Competitive bidding serves as a platform for public/private contractors to execute the works specified by the client. Deciding to bid or not to bid for that job proves to be a major hindrance between the bidder and the work. Smart contractors tend to bid for a work, based on facts studied through a pre-bid survey rather being heuristic in taking their decisions. This paper identifies the potential factors influencing the contractors’ bid decisions for different construction projects through a structured questionnaire survey. The factors were ranked based on their importance and utilized as a base for developing a bid decision model using DEA, a non-parametric approach. These factors govern the framework of bid decision model being developed. DEA creates a favorability score from the top and least ranked factors for each and every bid opportunity with a cut-off value as a reference. The public and private bidders utilize the cut-off value as a pivotal point of making bid decisions. This study serves as a tool for decision making process whenever a bid opportunity is created. This paper also recommends the contractors to utilize the bid model, to not only execute the work successfully, but also to improve the self-credibility and effectiveness among the global market.

Keywords: Bidding, DEA, Decision, Credibility, Heuristic, Construction

1. Introduction
Out of all sectors in India, construction industry accounts for a 19% of GDP growth, making it a major contributor for the development of the nation’s economy. Most of the public works are tendered through a bidding process and the person with the least bid value (in terms of cost) procures the project. Deciding to bid or not to bid for the specified work is quite vital in the initial phases of the project as it challenges the contractor’s identity among the global market. Decision making poses a major obstacle between the contractor and the bid which has a greater impact over the successful completion of the project and profit obtained. In general contractors are heuristic in nature while bidding for a project, deciding based on their experience and familiarity of the specific work. Smart contractors on the other hand consider the internal and external factors influencing the bid decision process rather being instinctive on their decisions.

In today’s competitive market, the contractor needs to have a perfect bidding strategy to obtain and execute the work efficiently. In order to develop a suitable strategy which ensures higher rate of efficiency, the contractor must be aware of all the internal and external factors governing the bidding process. This strategy
analyses the factors governing the bidding process, which acts as a base for developing a bid decision model. This bid decision model not only helps in contractor’s decision making process but also proves to be a reference tool for future projects to be obtained through bidding. The Data Envelopment Analysis (DEA) proves to be an effective tool for developing a decision model as it increases the success rate in winning a bid. With this development of the bid decision model, the contractors will be able to analyze the current bid scenario and make a decision to bid or not for a particular project.

2. Literature study

Bagies and Fortune (2009) identified that out of all the respondents, 95% agree considering the factors influencing the bid decisions, not only to be critical but also improves the performance of the company. Large number of internal and external factors governing the decisions of a contractor makes the bidding process quite a complex one. The study recommended an implementation of optimum mark-up model in facing the challenges at the time of bidding. Nyoman Yudha Astana et.al (2015) developed a bidding strategy by surveying the importance of the factors governing the bidding process and validated the data using Confirmatory Factor Analysis (CFA) and calculated the loading factor by adopting Structural Equation modelling of partial least squares. Economic situation, competition, client characteristics and company experience were found to be the most influential factors from the study. Shash (1993) reported that many of the top contractors in United Kingdom decided to bid for a project and their mark-up value based on a subjective assessment conducted through a questionnaire survey. The weightage of all the factors were calculated using importance index and the results showed that, experience with the specific work and strength in the industry enhances the contractors’ confidence in winning the project. Ahmad and Minkarah (1987) identified the top factors affecting the contractors in United Kingdom by conducting a questionnaire survey. The data collected were assessed subjectively to identify the potential factors affecting the bid decisions of the contractors. D.K.Chua and D.Li (2000) developed a bid reasoning model using Analytic Hierarchy Process (AHP) with the data collected through a questionnaire, surveyed over 153 contractors. The findings of the study suggested that the bidding failure occurs due to over estimation of cost to do the work and formulated the hierarchies based on competition, risk, need for work and company’s position in bidding. Oyeyipo et.al (2016) collected the factors through a questionnaire and determined the significant differences of the factors which have a greater impact over the bidders’ decision. Availability of capital, financial capability of client, degree of hazard was found to be the vital factors affecting the bid decisions of indigenous contractors. S.Ping.Ho and Y.Liu (2004) showcased the dynamic nature between the claims and opportunistic bidding by developing a framework using Claims Decision Model. This model analyses the decisions and the construction claoms rationally and systematically. R.Sammoura (2010) developed a simulation model for bid decisions using Crystal Ball decision engineering software. This software considers the number of bidders and size of the project as the vital governing factors while developing the model. El-Mashaleh (2013) reported the weightages and the deviation aspect of the factors governing the bidding process along the
Jordan area. This study analysed the concordance of respondents using Cronbach alpha reliability test and Kendall’s ranking consensus. The study reported the statistical difference among the private and public bidders using Analysis of Variance tool. Egemen and Mohamed (2007) reported the completeness of bid documents, risks due to inflation as the important factors considered by the top contracting firms over the Northern Cyprus region in facing the bid process.

3. Methodology

Formulating a decision framework necessitates the study of the potential factors influencing the entire bidding process. An effective development of a decision framework requires a methodology suiting the conditions relating to the current bidding scenario under study. This study identifies the key factors through a structured questionnaire survey conducted among the top contractors in India. The methodology of this study is shown in the flowchart figure.1

![Flowchart of Methodology](image)

Figure.1. Methodology for development of bid decision model

4. Potential factors influencing the bidding decision

Developing a framework model necessitated the assimilation of key factors influencing the decision making process of a contractor. The top ranked factors (tf) and the least ranked factors (lf) are shown in the table 1 and table 2 respectively.
Table.1 Top Ranked Factors

| Description                                      | Top ranked factors                        |
|-------------------------------------------------|-------------------------------------------|
| tf 1 Project (total bid value)                   |                                           |
| tf 2 Amount of possible upcoming profitable projects in future |                                           |
| tf 3 Current financial condition of the company |                                           |
| tf 4 Having qualified material suppliers         |                                           |
| tf 5 Project type                                |                                           |
| tf 6 Experience and familiarity with the specific work |                                           |

Table.2 Least Ranked Factors

| Description                                      | Least ranked factors                        |
|-------------------------------------------------|-------------------------------------------|
| lf 1 Possessing enough qualified technical staff to do the job |                                           |
| lf 2 Desire of qualified contractors to bid and win the project |                                           |
| lf 3 Uncertainty related to construction site    |                                           |
| lf 4 Need for continuity in employment of key staff personnel |                                           |
| lf 5 Current workload in bid preparation         |                                           |
| lf 6 Technological difficulty of the project beyond the capability of the firm |                                           |

The questionnaire was formed with the potential factors governing the bidding scenario, as shown above their level of importance was determined with a score of 0 to 6 ranging from least importance to high importance and. The results of this survey forms the basis of developing a bid decision model which is explained with a real time project obtained through competitive bidding. A sample of questionnaire survey and the rate at which the responses were recorded are as follows,

How far does the current financial situation of the company affect the contractors' bidding decision?

![Responses](image)

Figure.2. Number of responses from the survey

5. Data envelopment analysis

Data envelopment analysis is non-parametric linear programming model developed to measure the productive efficiency of the Decision Making Units (DMU). The DMU are the core study under the DEA approach. Compared to other areas of study, the utilization of this analysis is in its nascent stages in
construction industry. DEA analyses the decision making units and this framework is governed by inputs and outputs as the former are minimized and (or) the latter are maximized. The DEA is executed in the following stages.

- Top ranked and least ranked factors are identified from the survey conducted.
- The ranked factors are rated on a scale of 0 to 10 ranging from least to highly important based on the current bidding scenario.
- The favourability score is calculated from the inputs and outputs given and compared with the cut-off value which consequently indicates the contractor to bid or not to bid for that particular works.

An envelopment surface is developed with the DEA approach, which paves way in determining decision making units (DMU). The DMU within the determined envelope are considered to be favorable bidding conditions. The framework of the decision making unit is shown in the Figure.3.

![Figure.3. Input / Output Decision making unit](image)

The efficiency of the decision making unit are calculated as follows

\[
\frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}} = \frac{\sum_{i=1}^{n} u(i)y(iq)}{\sum_{j=1}^{m} v(j)x(ij)}
\]

where, \( v(j) = 1, 2, \ldots, m \) are the input weights

\( u(i) = 1, 2, \ldots, n \) are the output weights

This efficiency value is compared with a cut-off value which acts as a reference value computed from the previous bids stored in the contractor’s database. A real time project obtained through bidding process after the Data Envelopment Analysis is discussed. The bid under consideration is a provision of a sewage treatment unit at TBM colony and provision of RCC tank of 90000 liters capacity, under corporate welfare plan. A total of five contractors submitted their bids and the contractor with the least bid procured the work. The details and the specifications of the proposed bid are shown in table 3.

Table.3. Proposed bid details for Overhead Tank

| PROPOSED WORK | TOTAL BID VALUE (IN RUPEES) | BIDDER DETAILS | SELECTED BIDDER |
|---------------|-----------------------------|----------------|-----------------|
| Provision of RCC overhead tank of 90000 liters and sewage treatment unit | 94,16,917 | M.RAMESH, C.SARAVANAN, A.SADAGOPAN, N.SWAMI, C.JAGADEESAN | M.RAMESH |
The contractor obtained the bid by submitting the least value (in terms of cost) for the proposed work using Data Envelopment Analysis. The scores of the top ranked and the least ranked factors provided by the winning bidder and other competitors are shown in the table 4 as follows.

Table.4 Proposed bid details for Overhead Tank

| Bidder details | Top ranked factors | Least ranked factors |
|----------------|-------------------|---------------------|
|               | tf1 | tf2 | tf3 | tf4 | tf5 | lf1 | lf2 | lf3 | lf4 | lf5 |
| M.Ramesh (B1) | 7   | 4   | 4   | 9   | 6   | 5   | 2   | 4   | 8   | 3   |
| C.Saravanan (B2) | 5   | 3   | 2   | 5   | 1   | 3   | 2   | 4   | 5   | 4   |
| A.Sadagopan (B3) | 7   | 5   | 5   | 4   | 3   | 4   | 5   | 3   | 9   | 5   |
| N.Swami (B4) | 4   | 2   | 5   | 4   | 3   | 1   | 7   | 6   | 6   | 8   |
| C.Jagadeesan (B5) | 8   | 4   | 1   | 5   | 5   | 5   | 4   | 4   | 7   | 4   |

The favorability scores are calculated with the equation mentioned above and compared with the cut-off value for each bidder, as shown in Table 5.

Table.5 Favorability score of all bidders

| Bidder details | Favorability scores |
|----------------|---------------------|
| B1             | 1.363               |
| B2             | 0.889               |
| B3             | 0.923               |
| B4             | 0.642               |
| B5             | 0.958               |

6. Results
With the scores from all the bidders, the favorability score is calculated and from the above tabulation, the bidder B1 with a value of 1.363, obtained the bid as the efficiency was greater than the cut-off value (1.0). This DEA approach proposes the contractor to bid by providing high scores for top ranked factors and low scores for least ranked factors so that the probability of winning a bid is high in order to obtain an effective model.

7. Conclusion
- This study reports the potential factors influencing the bid decisions of the contractors which act as a base for the development of the decision model. Total bid value, project type, availability of qualified material suppliers, current financial position are the most influential factors compared to
uncertainty related to the site, technological difficulty and current workload in bid preparation.

- A public work procured through competitive bidding is considered to understand the way Data Envelopment Analysis works. The DEA approach aids the contractors in analysing the current situation whenever a new bid comes. The favourability score is calculated and compared with the pre-determined cut-off value to determine whether to bid or not to bid for the work under study.

- This DEA approach proves to be developmental force to the industry as it finds its applications over vast areas, regardless of the size, location of operation and the number factors governing the bidding process.

8. Acknowledgement

I hereby acknowledge with deep sense of gratitude the valuable guidance, encouragement and suggestions given by my guide, company personnel and faculty of Civil Engineering Department of Saveetha School of Engineering, SIMATS who has been a constant source of inspiration throughout this project work.

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