

Contracting Strategies in Mid-Rise Buildings and Analysis Using SPSS Software

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Abstract: *Bid decisions either results in procuring good opportunities or lead to large loss due to selection of inappropriate projects. The decisions to bid or not, made on experience and instincts have lower success rate compared to decisions made on real time facts governing the whole process. Smart contractors tend to be more realistic rather being more heuristic while bidding for a project. To improve the bidding process and the competitiveness over a global market, the contractors need to identify and analyze the key factors influencing the bid process, which in turn boosts the economy of the country. This project reports the factors influencing the bid decisions obtained through the response from the survey questioning various contractors from different construction projects. This study ranks the factors obtained based on their importance weightages based on the analysis. The findings would benefit contractors and subcontractors by increasing their understanding of the main factors affecting the bidding decision process. Contractors armed with such valuable information will be able to enhance their bidding decision-making process in terms of effectiveness and efficiency. Towards the end of the paper a Bidding Decision Support System that supports contractor's decision making is also provided.*

Keywords: Bidding Strategy, Bidding Decision Support System, Contractors, Construction Industry, Factors

1. Introduction

Getting a new project is the lifeblood of project-oriented organizations, which significantly differ from traditional supplier businesses with their highly specialized marketing, human resources, and customer involvement operations. As project oriented businesses, the survival of construction companies also depends on how they make their future investments; therefore, selecting the appropriate projects is crucial. In general, contractors could get bid opportunities from various channels: from a client who had a pleasant business experience in the past, from a referral person who knows the provided services, from client's website, from a tendering web portal or based on contractor's own attempts. Construction bidding is a process of offering the job by inviting tenders to different parties. The person who wins the bid is those with lowest price estimate and satisfying the terms and conditions enlisted by the tenderer for executing the project on time. The decision to bid or not to bid for a job becomes critical when the consequence on acceptance directly impacts the contractor because of the uncertainty involved in the process. In India Construction industry accounts to 16% in overall GDP growth, also the future improvement depends on the successful completion of the tendered projects. Prime importance should be given during the initial stages of the project to complete the work successfully. Decision making in each stage of construction projects involves a process of gathering information from different sources. The bid decisions are usually heuristic in nature and often contractors commit to a time consuming and expansive projects as the internal and external aspects are not considered. On the other hand, some contractors consider the external and internal factors associated with the bid

decisions before engaging for a project.

Improvement in the contractor's selection of projects would give significant benefit to the industry and consequently to its clients. Further, identifying and understanding the factors affecting the bidding decisions for projects as well as developing a suitable decision support system which will gain acceptance in practice and deal systematically with different bidding situations and assist the contractors in reaching the correct decisions will be of greater value.

2. Research Objectives

The Objective of this study was to explore the following:

- 1) To study the most common key factors that influence bid/no bid decisions.
- 2) To understand the firm's Policy regarding bidding decision making.
- 3) To conduct a survey among experts in construction industry based on the factors.
- 4) To analyze the findings using IBM SPSS Software.
- 5) To provide a Decision Support System for decision making.

3. Scope of the Work

- To increase profit.
- To increase capability.
- To improve customer satisfaction.
- To enhance project performance.
- To increase value and predictability of work.
- To improve productivity and quality.
- To improve decision making ability.

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4. Research Methodology

Following methodology was followed to complete the research work:

- 1) Investigating Previous literature: The purpose of this stage was to review previous literature to establish an initial list of the factors affecting contractors bid/ no bid decisions as well as to explore the different techniques used to determine such decisions in order select the appropriate one.
- 2) Data Acquisition: The purpose of this stage is to determine the final list of influencing factors.
- 3) Questionnaire Preparation
- 4) Questionnaire Survey: The questionnaire survey was done from the experts in construction industry.
- 5) Analysis of Result: The purpose of this stage is to analyze the result using IBM SPSS Software by Factor analysis based on Principal Component Analysis with Varimax Rotation Method.
- 6) The final stage is recommending a Decision Support System by Development of bid decision framework using Data Envelopment Analysis (DEA).

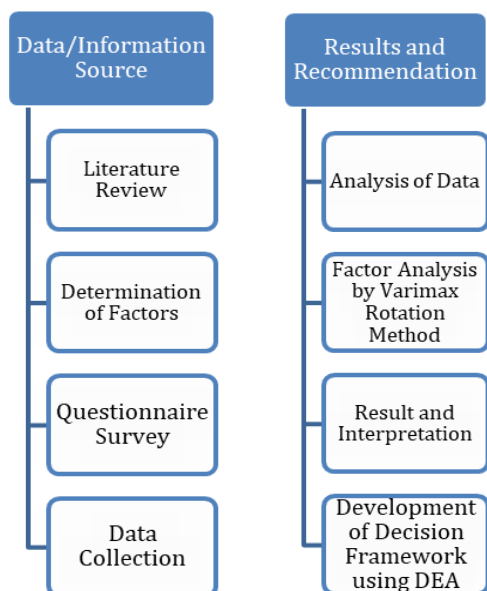


Figure 1: Research Methodology

5. Data Acquisition

The review of the literature resulted in identification of more than 100 factors and from among them 14 common potential factors affecting a contractor’s bid/ no bid decision were selected for this project. The final list of the key factors, which are identified based on the selection criteria are:

- 1) Type of Building based on Occupancy
- 2) Duration of the Project
- 3) Contract price
- 4) Location of the project
- 5) Employers reputation in market
- 6) Complexity of bidding documents (i.e., drawings, specifications)

- 7) Experience and familiarity of your firm with this specific type of work
- 8) Current workload of projects, relative to the capacity of the firm
- 9) Availability of reliable subcontractors
- 10) Current financial situation of the company
- 11) Market's direction, whether its declining or expanding
- 12) Profits from similar past projects
- 13) Previous experience of contractor with employer
- 14) Project's contribution to the strength of company brand and reputation

6. Data Collection Method

A questionnaire survey was carried out in offline mode, that is, on site survey was conducted among construction experts who work on mid-rise buildings and whose experience is more than 8 years.

6.1 Model of Questionnaire

The questionnaire was tested with a pilot survey for clarity, ease of use, value of information that could be gathered. The Questionnaire consisted of three main parts (Appendix-A):

- Part A contains questions on the basic information about the respondent such as Name of Project, Name of Organization, Contractor Name and other descriptive data.
- Part B contains the questions related to the potential factors influencing the bid decisions.
- Part C contains questions in order to understand the firm’s policy regarding bidding decision making process.

Apart from this a Sub-part (Part D) is also provided for the respondents to add if any comments are there that would be helpful in this context.

6.2 Measurement of Data in Questionnaire

The respondents were requested to indicate to what extent he or she agrees with the statement on a Five-Point Likert scale shown in Table 1. It allows the respondent to express how much he or she agrees with a particular statement.

Table 1: Five-Point Likert Scale

Response Category	Scale
Very Low	1
Low	2
Medium	3
High	4
Very High	5

7. Data Analysis

An On-site Questionnaire survey was done from experts in construction Industry. 20 responses were received, and the collected data was analyzed to find out the High Impact, Moderate Impact and Low Impacting factor affecting the bidding decision and also to know the firm’s policy regarding bidding decision making. Here, factor analysis based on Principal Component Analysis with Varimax

Rotation was carried out for the analysis.

7.1 Survey Analysis Tool

Factor analysis based on Principal Component Analysis with Varimax Rotation using IBM SPSS Statistical Software was the tool for the analysis.

The technique of factor analysis extracts maximum common variance from all variables and puts them into a standard score and helps to reduce large number of variables into a fewer number of factors. Principal Component Analysis (PCA) is one of the widely used methods for factor extraction. Also, a Varimax rotation is used to simplify a sub-space into few major items. Rotated Component Matrix is a Key output of PCA. The variables in rotated component matrix were forced to load on Three Components:

- Component 1: High Impact
- Component 2: Medium Impact
- Component 3: Low Impact

Kaiser-Meyer-Olkin (KMO) Test is the measure of the suitability of the data for Factor Analysis. The KMO Measure of Sampling Adequacy may be a statistic that indicates the proportion of variance within the variables which may be caused by underlying factors. Bartlett's test of sphericity tests the hypothesis that the matrix is a unit matrix.

7.2 Results of Analysis

The KMO value was 0.616 (Range 0.5-1) which is above 0.5, and Bartlett's Test of Sphericity was significant with significance level of 0.003 (less than 0.05) indicating that factor analysis can be continued.

The variables were grouped together according to the factor loading which exceed 0.5.

Table 2 shows the rotated component matrix, which is the key output of PCA obtained from the analysis.

Table 2: Rotated Component Matrix

	COMPONENTS			Rank
	Component 1	Component 2	Component 3	
Q14	0.770			1
Q10	0.741			2
Q3	0.717			3
Q11	0.655			4
Q7	0.555			5
Q13				6
Q2		0.869		7
Q5		0.809		8
Q1		0.511		9
Q4			0.714	10
Q6			0.610	11
Q8			0.545	12
Q12				13
Q9				14

7.3 Interpretation of Results obtained on Firm's Policy Regarding Bidding Decision Making

Table 3 shows the percentage of work obtained through competitive bidding. Table 4 shows the percentage of the respondents corresponding to the percentage of work for which performance bond is provided. Table 5 shows the frequency of sub-contractors performance bond requirement by the general contractors. Table 6 show the trend of consideration of Uncertainty in cost item.

Table 3: Percentage of work obtained through competitive bidding

Range (%)	Per cent of Respondents
Under 25%	25%
25-50%	35%
50-75%	35%
75-100%	5%

Table 4: Percentage of Work for which Performance Bond is provided

Range (%)	Per cent of Respondents
Under 25%	25%
25-50%	45%
50-75%	10%
75-100%	20%

Table 5: Frequency of Subcontractors Performance Bond Requirement

Response	Per cent of Respondents
Always	5%
Most Times	40%
Sometimes	55%
Never	0%

Table 6: Uncertainty in Cost Item

Response	Per cent of Respondents
Considered by Applying Correction Factor	35%
Considered by Adjusting Mark-up	50%
Not Considered	15%
Others	0%

The best time in a year to bid for a project does not depend on the calendar year but rather there is a chance that it depends on the financial year and the type of project. Also usually monsoon season is avoided when considering beginning of a project. 75% of the respondents think that the best job duration is 1-2 year and the rest 25% think it is half-1 year. More than 2 year is not good job duration according to the general contractors.

In response to the question "Do you use any statistical/mathematical techniques to assess the competitive situation?"- 80% of the respondents checked "No". In addition, 11.1% do use some sort of computational technique, including the use of computer software. The rest of the respondents try to assess competitiveness by studying information available about their competitor.

The questionnaire contained one question asking for the factors that make contractors feel that "there is a good chance of winning this project," and a number of factors were listed for the respondents to check, if applicable. It is

interesting to note that the firms gain a substantial amount of confidence from their experience and strength, and the state of the economy does not have a great influence on this confidence. The responses are shown in Table 7. Additional factors mentioned by the respondents are Profit or Benefit and project financing.

There was another question that asked for the factors which make them think: "I must get this work". The response obtained is shown in Table 8. It is important to note that Strength in Industry and size of job emerge as the most important factor in this category. Additional factors mentioned by the respondents are previous project quality and signature after the project.

Table 7: Factors that Make Contractors Feel Optimistic

<i>Response</i>	<i>Per cent of Respondents</i>
Owner	55%
Competitor	15%
Type of Job	65%
Strength in Industry	85%
Experience	90%
Overall Economy	30%

Table 8: Factors that Make Contractors Feel Desperate

<i>Response</i>	<i>Per cent of Respondents</i>
Need for Work	35%
Strength in Industry	70%
Size of Job	70%
Location of Project	55%

When the general contractors were asked whether they are comfortable with the way they make bid decisions, 25% said "yes", 45% said "somewhat", and 30% replied "no".

8. Conclusions

The findings of this study serve as a basis for making the following conclusions and recommendations:

- The purpose of this study was to identify and understand the factors that influence the contractor's decision to bid or not to bid for a proposal.
- This paper highlighted the major influencing factors considered by contractor.
- This paper contains the findings of a questionnaire survey conducted among contractors who work on flat or apartment projects and it highlights the importance of considering the factors governing the bid decisions and ranks the same based on their weightages.
- Factors such as Project's Contribution to Strength of company brand and reputation, Current financial situation of the company, Contract Price, Market's direction whether it's expanding or declining and experience and familiarity of firm with specific type of work are the top potential factors influencing the contractors over bid decisions.
- The factors such as Location, Complexity of bidding documents and current workload of projects relative to capacity of firm tends to be the least important factors of all.

- It is also observed that existing client-owner relationship, having qualified material suppliers have a greater impact over the bid decisions.
- Apart from the factors identified from the literature other factors that affects bidding decision according to the respondents are Quality, Deliverable from previous project, Material and Labour availability, Locality or social factors, Political or general risk, Organization of work, usual trend of quoting for work, Portfolio Improvement, Competitive edge, Funding agencies and Fund for the project.
- Also it is identified that most of the contractors obtain the work through competitive bidding and sub-contractor's performance bond is usually not required.
- The best time for bidding for projects does not depend on the calendar year but there is a chance that it depend on financial year and type of project; it is also identified that the best duration of a project is between one and two years.
- More than 50% of the respondents are not comfortable and satisfied with the way they make the bid decision at present and they are in need of a support system that will help them to make decisions on accordance with the project and not just on the basis of experience and intuition derived from a mixture of gut feelings, experience and guesses.
- This paper also developed a bid decision framework using DEA that would help construction experts to self-evaluate them before they bid for a project or choose a project.
- This study serves as a base for understanding the bidding process and guides the contractors in selecting successful projects, keeping the construction sector healthy and adds to the growth of economy both nationally and globally.

9. Recommendations

From this study it was identified that at present there is no certain system or technique followed by contractor's or construction experts to make bid/no bid decision. The usual practice is to make the bid decision on the basis of intuition that is derived from a mixture of gut feeling, experience and guesses. It was also identified that they are in need of a decision support system that will gain acceptance in practice and easy to interrupt. To fulfill this need in the industry a Bid Decision Framework using Data Envelopment Analysis is being designed.

9.1 Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a robust non-parametric linear programming approach, which is mostly used for benchmarking, performance measurement, and decision making problems. The utilization of DEA is in its nascent stages in construction industry.

In DEA, a Decision Making Unit (DMU) is employed as an organizational unit. It is based on an input-output framework, which aims to maximize the ratio of weighted outputs to the weighted inputs. DEA analyses the DMUs and

this framework is governed by inputs and outputs as the former are minimized and 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 1 to 14 ranging from highly to least important based on the current bidding scenario (Table 2).
- The favourability score is calculated from the inputs and outputs given and compared with the cut-off value of 1 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 DMU. The DMU within the determined envelope are considered to be favourable bidding conditions. The framework of the decision making unit is shown in figure 2.



Figure 2: Input/output DMU

The efficiency of the j^{th} DMU, θ_j is calculated as follows:

$$\theta_j = \frac{\text{Weighted Sum of Output}}{\text{Weighted Sum of Input}} = \frac{\sum_{m=1}^M y_m^j u_m^j}{\sum_{n=1}^N x_n^j v_n^j}$$

Where, DMU $_j$'s known M outputs y_1^j, \dots, y_m^j are multiplied by their respective weights u_1^j, \dots, u_m^j and divided by the N inputs x_1^j, \dots, x_n^j are multiplied by their respective weights v_1^j, \dots, v_n^j .

The Inputs here are Employer's Reputation, Type of building based on occupancy, Location, Complexity of bidding documents, Current workload of projects relative to capacity of firm, profit from similar past project, availability of reliable subcontractors. The Outputs here are project's contribution to strength of company brand and reputation, current financial situation of the company, contract price, market's direction, experience and familiarity of firm with specific type of work, previous experience of contractor with employer and duration of the project.

This efficiency value is compared with a cut-off value which acts as a reference value which should be greater than 1. 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.

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5	No. of Storey	
6	Contract Sum & Period	
7	Experience of Contractor	
8	Contact Number/Email ID	

- 1) Very Low
- 2) Low
- 3) Medium
- 4) High
- 5) Very High

Part B: Factors Affecting Bidding Decision

Sl. No.	Factors Identified	1	2	3	4	5
1	Type of Building Based on Occupancy					
2	Duration of the Project					
3	Contract price					
4	Location of the project					
5	Employer’s reputation in Market					
6	Complexity of bidding documents (i.e., drawings, specifications)					
7	Experience and familiarity of your firm with this specific type of work					
8	Current workload of projects, relative to the capacity of the firm					
9	Availability of reliable subcontractors					
10	Current financial situation of the company					
11	Market's direction, whether its declining or expanding					
12	Profits from similar past projects					
13	Previous experience of contractor with employer					
14	Project's contribution to the strength of company brand and reputation					

Please Add Other Factors You Think is important but Not Listed Here: _____

Part C

The Firm's Policy Regarding Bidding Decision Making Process

- 1) Percentage of work obtained through competitive bidding:
 Under 25% 25-50% 50-75% 75-100%
- 2) Percentage of work for which performance bond is provided:
 Under 25% 25-50% 50-75% 75-100%
- 3) How often do you require subcontractors' performance bond?
 Always Most Times Sometimes Never
- 4) Uncertainty in the cost item is:
 Considered by Applying Correction Factor
 Considered by Adjusting Mark-up
 Not Considered
 Others
- 5) What time in the year is best for bidding?
 Beginning of Calendar Year

APPENDIX – A

A.1 Questionnaire for Field Survey

The information in the questionnaire is required only for project purpose and under no circumstances will the names of individuals be revealed. The personal data sought is only for authenticity of the project.

The objective of this survey is to identify the major factors influencing the bid/no bid analysis in construction Projects. Following are the factors based on literature review. Please rank these factors on the scale given to the best of your knowledge. The responses received will be used solely for academic purposes.

Rankings are done accordingly:

Part A: Basic Information

Sl. No.	Details	Responses
1	Name of the Organization	
2	Contractor’s Name	
3	Name of the Project	
4	Type of Project	

- End of Calendar Year
- Does not depend on calendar year
- Others

- 6) What job durations you think are best?
 ½ - 1 Year 1-2 Year
 2-3 Year >3 Year
- 7) Do you use any statistical/mathematical technique to assess the competitive situation?
 Yes No Other
- 8) What factors make you feel that "there is a good chance of winning this project?" (please check all that are appropriate):
 Owner Competitors Type of Job
 Strength in Industry Experience
 Overall Economy Others
- 9) What factors make you think that "I must get this work?" (please check all that are appropriate):
 Need for Work Strength in Industry
 Size of Job Location of Project Others
- 10) Are you comfortable about the way you make bid decisions at present?
 Yes Somewhat No

Part D (Comments)

If you have any additional comments that would help us to understand your firm's bidding process, please add these below:

Thank you very much for your cooperation

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