BID/ NO-BID DECISION MODELLING FOR CONSTRUCTION PROJECTS

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Not bidding for a project could result in losing a good opportunity to make substantial profit, improve the contractor's strength in the industry, gain relationship with the client, and more. However, bidding for inappropriate projects may result in large losses or the consumption of time and resources that could be invested in more profitable projects, ultimately even financial failure of the contractor. This dilemma expresses the importance of the bid / no bid decision till it become one of the most critical decisions that have to be made by construction companies. The high complex process is a major characteristic of the bidding decision, which involves a large quantity of objectives and reflection of several internal and external factors. Smart contractors realise the importance of doing initial research and project evaluation before committing themselves to a construction project. This paper reports on-going research aims to develop a framework that can be used as a decision aid for project evaluations at the initial project selection decision phase. The results from a review of the literature concerning the bid / no bid decision are presented, and a conceptual model is developed. The work aims to contribute to the body of knowledge available on project evaluation processes and the research agenda related to enterprise project management in the construction industry.

Keywords: bid/no bid decision, decision making, project evaluation.

INTRODUCTION

One of the most critical decisions that have to be made by contractors in the construction industry is whether or not to bid for a new project when an invitation has been received. Decision making at the earliest stages of construction projects involves a process of gathering information from disparate noisy sources. Too often contractors then commit resources to a time-consuming and expensive process that requires them to adjust and adapt their business processes in order to accomplish their projects perfectly. Smart contractors realise the importance of considering internal and external factors that affect the bid / no bid decision before committing themselves to a project. The decision making at this stage is accomplished by two related decisions: first, bid / no bid decisions that consider factors would help to determine the benefit expected from a particular project and an appropriate bidding strategy; secondly, mark-up decision, which is one of the consequences of the bidding strategy. The bidding strategy is an important aspect of the overall business planning of the contraction company (King and Mercer, 1985). This requires the analysis of both internal and external factors to determine the appropriate strategy.

The high complex process is a major characteristic of the bidding decision, which involves a large quantity of objectives and reflection of several internal and external

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factors (Aminah, 1997). The ambiguity which characterises these objectives and factors makes the bidding process even more complex. Moreover, the bidding decisions are very important because the success and existence of any construction company is strongly dependent on their outcomes. For example, a bidding decision made on any one project has a significant influence on the short-term profit of the firm with consequent impact on the firm's long term strategy and performance (Hillebrandt, 1977). Even if there is a good number of bids available for a contractor and the chance of winning is relatively high, this decision is still critical. Hence that obviously will help the contractor to manage his workflow but will not necessarily help him to determine his ability to achieve the company objectives. That will have impact on the survival of the contract but will not have significant influence and support on the growth of the contractor's business. In other words, the bidding decision provides a link between strategy and individual projects.

This research is considering the front end of a project selection process. In particular, it is based on the problem of business and projects failure in the Saudi Arabia (SA) construction industry. Business failure in the construction industry is caused by many factors. In the book, *A Contractor's Survival Guide*, by Thomas Schleifer, (1990), the author concludes that after ten years of examining distressed and failing construction firms, a finite number of causes may be repeated as the reason for profit loss or failure. These common factors include: an increase in project size from that normally handled, doing work in an unfamiliar geographic location, taking on new types of work or moving between the public and private sectors, losing key personnel in one of three primary areas of operation, construction operations, administration and accounting, lack of managerial maturity in expanding operations, use of poor accounting systems, failure to evaluate project profitability, lack of equipment cost control, poor billing and collection procedures, transition to a computerised accounting system from a manual one.

Moreover, the office of government commerce (OGC, 2005) identified eight common causes of project failure. The causes that are linked to the considered issue are a lack of clear links between the project and the organisation's key strategic priorities, including the agreed measures of success and the evaluation of proposals being driven by initial price rather than long-term value for money, especially securing delivery of the company's business benefits. Frame, (2002) stated that 'Careful project selection is the first step to the success of the construction company and it should not be carried out in a careless manner'. However, these causes of contractors' failure call for more investigation into the construction processes, and advise the industry to focus in particular on evaluating project profitability and linking the strategy with individual projects.

This research aims to develop a model or framework that can be used as a decision aid for project evaluations at the initial project selection decision phase. Nevertheless, the aim and objectives of this research are based on the exploration of the problems that influence the business failure for the construction company. Exploratory research will help to explore, understand, and identify the precise problems involved and point to their resolution. The study aim and objectives necessitated the identification of factors that influence the bid/ no bid decision, and, in addition, to produce a conceptual model that links the identified factors with existing models of a bid/ no bid decision. Quota sampling was used to conduct several interviews with practitioners to maximise the certainty level of the identified factors, and to examine if there other factors related to the construction industry of SA. That would help to determine particular aspects of the

SA construction industry that might influence such decision modelling. The interviews captured tacit knowledge [personal know-how] from the interviewees and have been analysed qualitatively. Then a questionnaires survey was designed to rank the identified factors related for their importance to the small construction enterprises (SCEs) in SA. Data from this phase of the study will need to be analysed by quantitative methods.

BID/NO BID DECISION MODELS (PREVIOUS STUDIES)

A great volume of literature concerned with bidding strategies has resulted in many bidding models. Wanous *et al.* (2000) stated that since Friedman's (1956) model the literature has been flooded with many bidding models. However, Friedman's study was the first research aimed to develop a quantitative bidding optimization model. Sadly, the evidence suggests that practitioners have made relatively little use of those models (Rothkopf and Harstad, 1994) and most of these models continued in academic circles and did not apply into the practical world (Wanous *et al.*, 2000).

A small number of qualitative studies have looked at how actual bidding decisions have been made in practice (Wanous *et al.,* 2000). Surprisingly, it has been found that most of these bidding models have concerned only the mark-up decision, which has received most of the concern. This school of research concerns models that focus upon maximizing the expected profit from a tender. In addition, the appropriate bidding strategy and the process of forming it have received similar concern. However, as yet, the bid/no bid decision has had less attention from the construction management research community. Work related to the bid/no bid decision has attracted concern from the point view of its importance to the bidding strategy and not from the point view of how this decision been made. These different perspectives are significant and need to be recognised. The view point concerns the factors affecting the bid/no bid decision, the use of the available data and the justification of it to set the appropriate bidding strategy, and not to use it to judge on the appropriate project to the company.

Friedman (1956-1957) has considered the strategy of how to win a bid. The results of that study called for maximisation of the expected profit from a tender in which each competitor concurrently submits one closed bid. It was found that the bidder should select the mark-up on cost that maximizes expected value of the profit. However, this approach of Friedman's model is not a bid/ no bid model. This is because he has assumed that the company has already made the decision to bid, and his strategy is to maximise the value of the expected profit. His solution was to establish the competitors' `bidding patterns' by calculating the ratios between their tenders and the cost estimates. Friedman addressed the existence of multiple bidding criteria by listing objectives of profit maximization. Boughton (1987) also addressed these multiple objectives in a survey of 126 construction firms; he found that profit maximization was the most frequently used bidding objective, and that it was the most important objective. However, what seems to be missed in Friedman's model is the previous stage of his model, which is the actual bidding decision. Models have been recognized as being, to some extent, developments of this pioneering work by Friedman.

Gates (1967) re-interpreted Friedman' s strategy for a single bid into a general strategy with general applicability of a profit maximizing pricing model for tendering. There are many similarities between the Friedman and Gates papers (Runeson and Skitmore, 1999). However, subsequent work by Gates (1983) took a non-mathematical decision support model based on the Delphi technique, and reformulated

it into an economic theory for pricing construction projects. The difference between the Friedman and Gates papers was in how the probability of winning over more than one competitor was estimated. The importance of the Gates paper was the transformation from a strategy for a single event to a general theory of price determination of construction projects. However, the transformation from a strategy into practical processes seems to have been missed. Also, the problem of identifying the appropriate bid to the company business has not been recognized (Gates 1983).

Gates, in opposition to Friedman's argument, has tended to be ambiguous on some of the more important limitations of many of the theoretic approaches to decision-making. Generally, the fundamental aim is to find a price or mark-up that will maximize the expected profit in the next and consequent bids, irrespective of any characteristics of the contracts (King and Mercer, 1985). The limitations of this fundamental aim were highlighted by Whittaker (1981) in a description of how bidding models were implemented. King and Mercer (1985) stated that "In reality, contracts do vary in their attractiveness to the bidder depending on such factors as the size of the contract, the bidder's resources that were available at that time, and the location of the contract". Furthermore, the factors may weigh differently with competitors, so that each of the competitors may view the attractiveness of a given contract in a different way. Consequently, the aim of a bidder's strategy should be to try and win those bids which are more attractive to itself and less attractive to its competitors.

Ahmad and Minkarah (1987), in their paper on optimum mark-up for bidding, looked at a preference-uncertainty trade-off approach for selecting the mark-up in competitive bidding situations. The procedure was developed on the basis of a multidimensional utility theory. The viewpoints of King and Mercer, (1985) and Whittaker, (1981) seem to be implemented in Ahmad and Minkarah (1988) work. They conducted a questionnaire survey to discover the factors that characterize the bidding decision-making process in the United States. Subsequently, Ahmad (1990) proposed a bidding methodology that was based on the decision analysis technique for dealing with the bid/no bid problem. This model judged the bidding problem to be a two stages problem. The first stage was a deterministic stage that concerns the bid/no bid decision, such as type of project and location. The second stage was probabilistic because the criteria considered in it, such as competition and risks expected, are uncertain. This model demands many inputs, some of which the bidder, especially one with limited experience, might not be able to provide (Wanous *et al* ,2000). This work appears to be the first consideration that has been given to the factors that affect the bid / no bid decision, and then it works as the basis of many research studies.

A great volume of literature concerning the bid/ no bid decision subsequently emerged after the contribution of the above research studies. It was aimed to investigate these previous studies to produce a comprehensive bibliography related to bidding in the construction industry. Therefore, it was necessary to classify the wide variety of approaches and models in that agenda. It could be seen that most of the research done in the last 50 years was on four main subjects, namely, bidding strategy, bid mark-up determination, factors that effect or characterise the bid/no bid decision, and the bid decision-making process. Table 1 shows the past research titles within the four main subjects that have been drawn from related reference sources.

Table 1: past researches concerning the bid/ no bid decision

Main subjects			
Bidding strategy	**Bid mark-up determination**	**Factors that affect the bid/no bid decision**	**Bid decision making process**
Friedman (1956-1957), a competitive-bidding strategy and bidding models	Ahmad and Minkarah (1987), Optimum mark-up for bidding: A preference-uncertainty trade off approach	Ahmad and Minkarah (1988), Questionnaire survey on bidding on construction	Ahmad, I. (1990), Decision-Support System for Modelling Bid/No-Bid Decision Problem
Gates (1967), bidding strategies and probabilities	Shash *et al* (1993) The effect of contractor size on mark-up size decision in Saudi Arabia	Shash (1993), Factors considered in tendering decisions by top UK contractors	Hegazy, T and Moselhi, O (1994), Estimator: a prototype of an integrated bid preparation system
AbouRizk *et al* (1993) BidExpert-an expert system for strategic bidding	Dozzi *et al* (1996), Utility-Theory Model for Bid Mark-up Decisions	Abdelrazig (1995), factors that affect the bid/no bid decision.	Shash (1998), Bidding Practices of Subcontractors in Colorado
Drew, D. and Skitmore, M. (1997), The effect of contract type and size on competitiveness in bidding	Aminah Fayek (1997), A Competitive Tendering Strategy Model And Software System Based On Fuzzy Set Theory	Hassanein, A A G (1996), Factors affecting the bidding behaviour of contractors in Egypt	Aminah Fayek *et al*, (1999), A survey of the bidding practices of Canadian civil engineering construction
Drew, D. and Skitmore, M. (2000), The effect of client and type and size of construction work on a contractor's bidding strategy	Li H., Shen L., and Love P., (1999), ANN-Based mark-up estimation system with self explanatory capacities	Hassanein, A A G and Hakam, Z H R (1996), A bidding decision index for construction contractors	Gunner, J and Skitmore, M R, (1999), Comparative analysis of pre-bid forecasting of building prices based on Singapore data
Liu, S L, Wang, S Y and Lai, K K, (2000), Multiple criteria decision making models for competitive bidding	Parvar, J, Lowe, D, Emsley, M and Duff, R, (2000), Neural networks as a tool for modelling the decision to bid process	Shash (1998), Subcontractors' Bidding Decisions	
Drew, D. *et al*, (2002), Developing a tendering strategy in two-envelope fee tendering based on technical score-fee variability	Seydel J. and Olson D., (2000), Multicriteria support for construction Bidding	Wanous *et al.* (1998), Tendering factors considered by Syrian contractors	
Jamshid Parvar *et al.*, (2002), Development of a decision support model to inform an organization's marketing and decision to bid strategies	Krishna Mochtar, David Arditi, (2001), Pricing strategy in the US construction industry	Wanous *et al.* (2000), to bid or not to bid: a parametric solution	
Skitmore, M R, (2004), The probability of winning sealed bid auctions: the effects of outliers on bidding models	Dulaimi, M F and Shan, H G, (2002), The factors influencing bid mark-up decisions of large and medium size contractors in Singapore	Parvar, J, Lowe, D and Emsley, M, (2001), A rational and optimal model of decision making for decision to bid process	

Lai, K K., Liu, S L, and Wang, S Y, (2002), Bid mark-up selection models by use of multiple criteria	Mohammed Fadhil Dulaimi and Hon Guo Shan, (2002), The factors influencing bid mark-up decisions of large- and medium-size contractors in Singapore
Symeon Christodoulou, (2004), Optemum bid mark-up calculation using neurofuzzy systems and multidimensional risk analysis algorithm	Wanous *et al.* (2003), A neural network bid/no bid model: the case for contractors in Syria
Liu, S L, Wang, S Y and Lai, K K, (2005), A general multivariate analysis approach for determining bid mark-up strategy	David J. Lowe and Jamshid Parvar, (2003), A logistic regression approach to modelling the contractor's decision to bid
Min Liu and Yean Yng Ling, (2005), Modelling a contractor's mark-up estimation	David J. Lowe and Jamshid Parvar, (2004), A logistic regression approach to modelling the contractor's decision to bid

From the given past research, it can be seen that the problem central to this study has not been researched yet. Moreover, the target companies (SCEs) have not been referred to in the context of the past research mentioned above. It seems that the previous stage of those models and research studies, which is the bid / no bid decision stage that is based on business benefit, has not yet been sufficiently addressed.

FACTORS AFFECTING THE BID/NO BID DECISION

The study aim and objectives necessitated the identification of the various factors that have been found to influence the bid / no bid decision. The review of the literature resulted in identifying 94 potential factors affecting a contractor's bid/ no bid decision (see Table 2). These 94 factors were drawn together from the sources shown in Table 1. The factors identified were then divided to ten groups. The groups were developed on an intuitive issues, including project characteristics, business benefits, the client characteristics, the contract, project finance, company characteristics/ situation, firms' previous experience, bidding situation, economic situation, and competition.

Table 2: Factors affecting the bid/ no bid decision

Factors identified from the literature review	
1 Project characteristics:	3. The possibility of delay or shortage on payment
1. Size of contract in SR	4. Project cash flow
2. Duration of the project	5. The project mark-up size
3. Type of project	6. Percentage of insurance premium
4. Job start time	7. Anticipated value of liquidated damage
5. Methods of construction (manually, mechanically	8. Tax liability
	9. Financial goals of the company
6. Location of the project	10. Degree of difficulties in obtaining bank loan
7. Type of equipment required	11. Market share
8. Type of labour required	**6 Company characteristics/situation**
9. Site clearance of obstruction	1. Availability of required cash
10. Degree of buildability	2. Ability of doing the job
11. Site accessibility.	3. Availability of required equipment
12. The projects' stakeholders	4. Availability of qualified human resources
13. Design quality	5. Uncertainty in cost estimate
14. Design team	6. Need for work
15. Local climate	7. General (office) overhead
16. Public exposure	8. Current work load
17. Degree of technological difficulties	9. Reliability level of subcontractors
18. Safety hazards	10. The project is matching the company strategy and future vision
19. Completeness of drawings and specification	
19. Degree of difficulties	11. Strength in industry
20. Type of procurement methods	12. Specific features that provide competitive advantage
21. Degree of possible alternative design to reduce cost	
	13. Availability of qualified sub-contractors
22. Expecting date of commencing	14. Familiarity with site condition
23. Pubic objection	15. Strength of business partner/ subsidiaries
2 Business benefits:	16. Company ability of design involvement and innovation
1. The benefits expected in terms of the company reputation	**7 Firms' previous experience**
	1. Past experience with similar project
2. Need for continuity in employment of key personal and work force	2. Past profit in similar job
	3. Past experience with general contractor
3. Establishing long relationship with the client	4. Past experience in managing similar project
3 The client characteristics:	**8 Bidding situation**
1. Local custom	1. Required bond capacity
2. Relationship with the owner	2. Time allowed for submitting bids
3. The client reputation among other contractors, with whom they had worked	3. Time of bidding (season)
	4. Bidding document price
4. The client requirements	5. Prequalification requirements
5. Owner (Private, Public)	6. Tendering duration
6. Prompt payment habit of the client	7. Bidding methods
7. The client financial capacity	**9 Economic situation**
8. Size of client	1. Risk involved in investment
4 The contract:	2. Availability of equipment and materials
1. Type of contract	3. Overall economy (availability of work)
2. Clearness of the work and specifications	4. Quality of available labour
3. The ability of modifying the contract	5. Availability of labour
4. The ability of portion subcontracted to others	6. Governmental division requirements
5. Fines for delay	7. Risks expected fluctuation in labour materiel etc
6. Type and number of supervisory and labour required	**10 Competition**
	1. Who else is likely to bid for this job?
7. Consultants' interpretation of the specification	2. How many bidders will there be?
8. Use of nominated sub-contractor	3. Are the bidders equal, or are they similar contractors with similar overheads?
9. The contract special requirements	
10. Contract conditions	4. Future project
5 Project finance	5. Market condition
1. Original price estimated by the client	
2. Work capital required to start the job	

These factors were essential in constructing the bid/ no bid decision model. The literature review was conducted for the purpose of studying the available bidding models. Thirteen bidding strategy models were recognised from the literature, including bid/no bid decision models and mark-up determination models. The models are listed in table 3 and were obtained from the following references:

Table 3: Models concerning the bid / no bid decision

The model name	Authour	Year
Utility-theory model for bid mark-up decision	Dozzi	1996
Ann-Based mark-up estimation system with self-explanatory capacities	Li and Love	1999
To bid or not to bid: parametric solution	Wanous *et al.*	2000
Multicriteria support for construction bidding	J. Seydel and D.L. Olson	2000
Multiple criteria decision-making models for competitive bidding	S.L. Liu *et al*.	2000
Key factors in bid reasoning model	Chua and Li	2000
The effect of client and type and size of construction work on a contractor's bidding strategy	Derek Drew *et al.*	2001
Bid mark-up selection models by use of multiple criteria	Lai *et al.*	2002
A neural network bid/no bid model: the case for contractors in Syria	Wanous *et al.*	2003
A logistic regression approach to modelling the contractor's decision to bid	Lowe and Parvarm	2003
Optimum bid mark-up calculation using neurofuzzy system and multidimensional risk analysis algorithm	Christodoulou	2004
A Fuzzy-Logic-Based approach for new product Go/No Go decision at the front end	Ching-Torng Lin and Chen-Tung Chen	2004
Modelling a contractor's mark-up estimation	Min Liu and Yean Ling	2005

Different research studies have identified and proposed different sets of factors. The differences of these models were regarding the considered number of factors and the techniques used to construct the model. For example: Wanous *et al*, (2000) aimed to build an integrated bidding model to help Syrian contractors in making both bid/ no bid decisions and mark-up size decisions. Only the 17 most influential factors were considered in the final model. The parametric solution was the primary technique that constructs the model. Also, Wanous had classified the factors into two groups: the first with positive factors and second with negative factors. Nonetheless, it is acknowledged that this classification might not be true in all cases. However, subsequent work by Wanous *et al.*, (2003) used another primary technique, which was an artificial neural network (ANN). Also, the same number of considered factors was concerned.

Parametric, utility- theory, artificial neural network (ANN), fuzzy neural network (FNN), fuzzy logic, and regression techniques were used to construct the mark-up determination models. These techniques are used to facilitate the input of contractors –as a response to the factors affecting the mark-up decision- and to propose / suggest a recommendation to the contractors. The diversity of used techniques was aimed towards a high accurate percentage of the designed model. It is worth stating that some of the models mentioned above are not intended to produce a bid / no bid decision support model, nor are they exhaustive identifying bidding factors. Rather, some of these studies are meant to explore the usefulness of using one of the above-mentioned techniques as a tool for decision-makers. The ordinary approach that has been used in the above-mentioned models is designed to identify the most important factors through a questionnaire survey, then through conducting a number of

interviews to learn more about the mark-up decision, and to set numbers of rules to be used in the designed model. The model design takes advantages of existing model techniques to reach / match / achieve the recommended decision (fig.1).

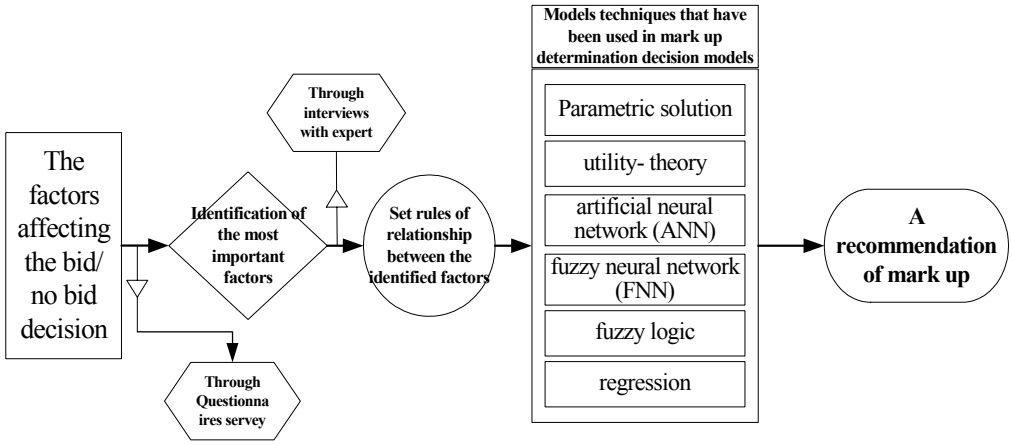

Figure 1: The ordinary (conceptual) model of the bid/ no bid decision

CONCLUSIONS

As a conclusion from the past research, as yet the bid/no bid decision has attracted less attention and has not been considered as a way to achieve the company's business strategy. The usual research studies are to make the "bid/no bid" and the mark-up decisions on the basis of correlation of each other. That is because of the strong link existing between factors affecting both decisions. The numerous surveys that have been carried out in many countries with the aim of identifying the important bidding decision's factors show the differences of the potential factors. Also, this necessitates a new survey and more interviews among the SA construction industry in order to discuss the particular aspects of the industry that might influence such decision modelling. The review of the literature resulted in identifying 94 potential factors affecting contractor's bid/ no bid decisions. Parametric, utility- theory, artificial neural network (ANN), fuzzy neural network (FNN), fuzzy logic, and regression techniques were used to construct the mark-up determination models. The differences of these models were regarding the considered number of factors and the techniques that were used to construct the model. Using one of these techniques in determining the bid / no bid decision and investigating the possibilities of getting higher accuracy result seems to be valuable in solving the dilemma of the bid / no bid decision.

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