PREQUALIFICATION AND C-COMPETITIVENESS

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Prequalification and C-Competitiveness

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Two major factors to be considered in prequalifying construction contract bidders are the likely costs and risks to be faced by the client upon award of the contract. Prequalification of too many bidders, although lowering client costs, increases risks and causes an excessive overhead on the bidding process.

A method of assessing the relative cost and risk implications associated with individual bidders is proposed. This involves calculating the percentage that bids are above the lowest bid in previous auctions, termed C-Competitiveness. It is argued that selecting only the lowest and most consistent C-Competitive bidders for a proposed contract auction will reduce client, risks and bidding overhead.

Key words - bidding, competitiveness, interfirm comparisons, performance ratios, prequalification, risk.
1. INTRODUCTION

CONTRACTOR SELECTION is a crucial aspect of the construction procurement process as different contractors have different levels of cost, quality, efficiency, etc. Most clients leave the task of contractor selection to a consultant. In undertaking this task, consultants are advised not to lose sight of the client's basic requirements, ie, procuring construction work of the best quality at the lowest cost that provides the best value for money and that is built as quickly as required within budget whilst exposing clients to the minimum risk [5, pp. 232]. This implies that consultants select contractors who are likely to:

1. be prepared to undertake and complete the work at a competitive price
2. complete the work on time
3. construct the work to the required quality standards
4. execute the work without a significant risk of extra financial burden on the client.

Contract auctioning by sealed bidding is the most common method of contractor selection in the market-based countries.

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1 A contract may comprise several projects for the construction of building and/or infrastructure work. Although the term 'project' is often used in a construction context, in this paper we prefer to use the term 'contract' instead as it more correctly denotes the object of the bidding process, ie., to secure a contract. Hence the term 'contract type' relates to the intended function of the projects contained in the contract, eg., a school or hostel contract. For consistency we use the term 'contract size' to denote the monetary value of a contract (usually the lowest bid).
This aims to use the market mechanism to ensure optimal price, time, quality and risk (PTQR) for the client. In open competition, consultants often have a good idea in advance, which of the competitors will be 'in the frame' for the contract award. This, with a need to minimise the costs of bidding, is the main motivation for the use of a closed competition. Bidders are preselected (prequalified) on their likelihood of entering low bids, producing good quality work on time, presenting little risk to the owner or a combination of these or other 'desirable' characteristics.

Prequalification has been defined as a process of determining a candidate's competence or ability to meet the specific requirements for a task involving a wide range of criteria for which information is often qualitative or subjective [21, pp. 169]. This may result in the selection of bidders who are unable or unwilling, or the non-selection of bidders who are able and willing, to fulfil the above criteria. Time, quality and risk are most frequently assessed on the reputation of the contractor, with larger contractors often preferred to smaller contractors irrespective of the proposed contract size [4].

In this paper we consider a more objective means of prequalifying bidders based on their previous price levels in competition - C-Competitiveness.
2. PREQUALIFICATION

Prequalification systems may be classified into two groups.

The first group sets out general ground rules and framework for competitive tendering irrespective of the type of contract. These may be intended for national use such as the UK's Codes of Procedure for Single and Two Stage Selective Tendering [17, 18] or specially devised to suit the needs of a particular client body. Public sector clients who, for the sake of public accountability, are forced to follow a strict procedure, normally fall into this category [eg 12].

The second group of prequalification systems is concerned with the selection of specific bidders for a particular contract. In Hong Kong for example, the Government prequalifies bidders for contracts that have unusual requirements. These include unusual scope or complexity of work; unusually high value contracts; very rigid time constraint; construction calling for a high level of co-ordination, technical expertise or unusual technology; unusual funding or financial arrangements; and non-standard forms of contract [13].

The benefits of prequalification for both clients and contractors are well documented [20]. For clients, prequalification aids in distinguishing unwilling and
inexperienced contractors from willing and experienced contractors. This should minimise the probability of contractor default or delays in bidding and enable a reduction in the number of eligible contractors involved. For contractors, prequalification should minimise the number of unqualified contractors who might enter unrealistic bids, provide a direct opportunity to decline without fear of future disqualification, and protect contractors from being awarded contracts they are not capable of performing. Also, due to reducing the number of bidders, the a priori probability of each bidder winning the contract is increased. In addition, surety companies may also benefit as prequalification should minimise the risk of contractor failure to discharge the contract.

Potential problems faced by clients using prequalification systems include inflated development costs, difficulties in developing quantifiable criteria and formalising the decision making process to make objective and sound decisions, and the possibility of higher contract prices when reducing the numbers of bidders. Potential problems for contractors include the possibility of unfair exclusion from the bidding process, and the expenditure of resources on promotion and public relations to secure an opportunity to participate in the bidding process.

Carefully structured prequalification systems for bidder selection appear to be generally under used in the construction industry. This results in (1) subjective bidder selection and
(2) the involvement of many bidders. Subjective practices may result in the unnecessary exclusion of bidders who would satisfy prequalification criteria, and the selection of bidders who would not satisfy prequalification criteria.

Procuring bids from too many bidders is likely to result in:-

- higher bidding overheads of approximately 0.7 - 1 per cent of contract value per bidder [8].

- bidders having to make more bids to reach target turnover.

- bidders having less control over the choice of work they really want to undertake.

- bidders having less accuracy in tender pricing and greater chance of errors of omission.

3. **C-COMPETITIVENESS**

*Degrees of competitiveness*

With either open or selective tendering the contractor has a two stage decision process to make - whether to bid or not and, if the former, the various bids and alternatives he could
offer.

If a contractor chooses to enter a bid, a baseline 'Estimate' is usually made. A percentage mark up is then applied (the 'Estimate' may or may not be a genuine estimate of the contractor's likely costs of discharging the contract - its exact nature is not important to this discussion except that it is intended to provide a consistent baseline for bidding). Some bidders incorporate the estimated value of other considerations, such as off-site overheads, into their mark up.

Contractors have six basic options in selectively tendered auctions [23]:

(1) decline to receive tender documents
(2) return tender documents without a bid
(3) submit a cover price bid
(4) produce a rough Estimate and add mark up
(5) produce a detailed Estimate and add mark up
(6) add 'non-price features' to (5).

Options (3) and (4) are usually regarded as 'non serious' bids, and options (5) and (6) as 'serious' or bona fide bids as detailed Estimates are invariably lower than rough Estimates. 'Serious' bids are expected to be lower, certainly long term, than 'non serious' bids. The prequalification system should, therefore, to comply with criterion (1) above, try to identify
contractors who are likely to enter serious bids.

Optimal level of competition

It is usually assumed that the mere existence of a free market will automatically ensure competitive bidding. As a result, large numbers of contractors are often encouraged to enter bids to guarantee a fully competitive auction. A sample of Hong Kong open tender public sector contracts, for example, contained an average of approximately 17 bidders competing for each contract, with some contracts attracting over 30 bids [3]. In the Hong Kong private sector, where selective tendering is generally used, a similar size sample contained an average of 10 bidders for each contract [4].

As the number of bidders varies from auction to auction, bidders typically adjust their bids to reflect the level of competition [1] and several empirical studies [11, 16, 27] have found an inverse relationship between the number of bidders and the value of the lowest and/or mean bid.

An objective of prequalifying bidders is to obtain an optimal level of competition, that is obtaining the lowest bid at a minimum cost of bidding. This requires engaging the minimum number of bidders to obtain a genuine competitive bid. At sub-optimal levels of competition, contractors or clients may
suffer as a result of under-competition or over-competition.

To overcome fears of receiving higher bids as a result of reducing the number of competitors in competition, consultants have been urged to compile tender lists more carefully by choosing the most competitive bidders [22]. It has been suggested [6] that this can be done by considering contractors' experience, performance and current workload.

Measuring competitiveness

The prequalification process should therefore try to ensure that a group of bidders is selected who will submit genuinely competitive bids. This can be done, to some extent, by considering factors such as the bidders' experience, resources and current workload. One approach is by systematically recording, in terms of competitiveness, previous bidding performances of bidders. Then, by selecting the most competitive bidders, it may be possible to have fewer bidders without necessarily increasing the likely value of the lowest bid. It is conceivable that a carefully monitored prequalification system may even generate lower bids than would have been received without prequalification.

Bidding performance concerns the relationship between bids submitted by different bidders in competition. Although this
relationship can be quantified in purely relative terms [24], the model and subsequent analysis is quite difficult and not easily treated by conventional means. For most practical purposes however it is sufficient to consider bids in relation to a baseline. Common baselines include the designer's estimate, a bidder's cost estimate, or the mean, median or lowest of the bids entered for a contract. In this case we use the latter measure as it is easily understood and because there are good theoretical reasons for assuming that the expected value of the winning bid is equal to the true value of the contract [eg 15, 28].

A measure of competitiveness in bidding commonly found in the literature is the percentage of each bid above the baseline, or C-Competitiveness, ie

\[ C_i = 100(x_i - x_{(1)})/x_{(1)} \] (1)

where \( x \) represents the bid value entered by an individual bidder, \( i \), and \( x_{(1)} \) represents the value of the lowest bid entered for the contract. Clearly, lower percentage values indicate greater competitiveness, the lowest bidder having a competitiveness value of zero per cent.

By aggregating the \( C \) values for an individual bidder over a series of auctions it is then possible to examine that bidder's performance in terms of the frequency distribution of the
aggregated C values. It is usual to consider two summary statistics describing the frequency distribution - the arithmetic mean, C', and standard deviation, C". Low values of C' are taken to denote high competitiveness and low values of C" are taken to denote a high level of consistency of competitiveness.

*Competitiveness factors in bidding strategy*

It has been said that long term differences between bidders' pricing are a reflection of their relative efficiencies - more efficient bidders tending to enter lower bids [7]. Indeed, this is the basic precept of the market mechanism. However, in a less than stable environment such as the construction contract market, short term commercial considerations often predominate. The mark up is such a consideration and, as a component of a bid, it follows that the factors influencing mark up levels also influence bid levels and thus competitiveness.

Many authors [eg 2, 10, 14, 26] have suggested many different factors that are considered in setting mark up values. Different bidders have different degrees of preference towards the individual characteristics, such as size, type and location, of proposed contracts. These are dictated to some extent by bidders' strategies and resources available. Further
considerations are present and future workloads, the workload of the industry as a whole and differences in perceptions of bidders concerning these matters.

Factors influencing competitiveness may be grouped into those affecting (1) group behaviour, (2) individual behaviour, and (3) contract characteristics (see Fig. 1). The degree to which these factors influence competitiveness levels is dependent on the baseline estimates and levels of mark-up emanating from the bidders' strategies or policies.

Bidding strategy is concerned with setting the mark up level to a value that is likely to provide the best pay-off. In determining mark up levels, different bidders have differing degrees of selectivity between contracts. Those who are more selective concentrate on particular contract characteristics such as type and size. Those who are less selective place less emphasis on the contract characteristics than on other factors such as workload or resources available. Bidders who carefully select contracts for which they enter serious bids may be regarded as 'market' or 'preference driven'. Those bidders who place most emphasis on workload may be regarded as 'resource' or 'constraint driven'. These categories are neither exhaustive nor mutually exclusive and some bidders may place equally high or low emphasis on market and resource factors.

Separating selective from constraint based strategies is a
reflection of the two complementary approaches economists have developed in studying business behaviour. One is to try to explain business behaviour through the goals of the firm, the argument being that decision makers select the actions and strategies that they perceive best contribute to reaching the firm's goals. The other holds that market conditions and competition drives or constrains a firm's behaviour [25, pp. 251]. It also effectively reflects Gabor's [9] work on pricing behaviour that separates 'market oriented' from 'resource-based' pricing approaches.

The idea of preference and constraint driven bidders can also be related to Porter's work [19] in which he identifies three strategies;

1. cost leadership: firm aims for the lowest cost and achieves superior profitability from an above average price margin.

2. differentiation: firm strives to differentiate its products such that it can raise price more than the cost of differentiating and thereby achieve superior profitability.

3. focus: firm concentrates on a particular segment of the market and applies either a cost leadership or differentiation strategy.
Bidders who adopt a cost leadership strategy are likely to be constrained by their ability to cut costs in an attempt to achieve superior profitability rather than be selective towards certain contract characteristics. However, bidders who choose a focus strategy are likely to place a greater emphasis on preference rather than constraint.

The idea of preference and constraint driven is not directly applicable to bidders who use a differentiation strategy. These bidders are hoping to win contracts through, for example, reputation even though their bids may not be the lowest. It is worth noting that such a strategy is likely to be more successful in the private sector. This is because of public accountability in the public sector normally means that contracts have to be awarded to the lowest bidder only.
Classification of bidders

The degree of influence with which various competitiveness factors affect bidding performance can be measured in terms of C-Competitiveness. The smaller the values of C the greater, in terms of competitiveness, is the influence of a particular combination of competitiveness factors. This combination varies from bidder to bidder and from contract to contract. Some factors are likely to emerge as more dominant than others. For example, a preference driven bidder is likely to be consistently more competitive in bidding for contracts with certain characteristics, such as contract size and type.

If the average C-Competitiveness, C', observed for certain competitiveness factors is a reflection of the preference the bidder places on each of those factors, then significant differences between C' values for each factor necessarily indicate significant differences in preferences between the factors themselves.

Prequalifying bidders by their C-Competitiveness can be used to distinguish those bidders who are likely to submit serious bids from those who are likely to submit non-serious bids. The more competitive bidders, ie bidders who attain lower C' values, are likely to have submitted the greatest proportion of serious bids in previous competitions. Considering C' together with C", we can represent various classes of bidding
behaviour (Fig. 2). Bidders with low C' values and low C" values represent Sensible bidders, as they are consistently competitive. In contrast, bidders with low C' values but high C" values represent Suicidal as, besides being serious, they are also erratic - a potentially fatal behaviour in competitive bidding. Conversely, bidders with high C' values and low C" values are Non-Serious as they are consistently uncompetitive. Consequently, bidders with high C' values and high C" values (termed Silly here) are generally uncompetitive but erratic, not an uncommon characteristic in construction contract bidders. Although a rather crude and insensitive classification system, this does have considerable intuitive appeal in reflecting the underlying pivotal characteristics of the actual behaviour of participants in competitive bidding environments.

This 4-way classification - Sensible, Suicidal, Non-Serious and Silly - is important from the clients' viewpoint. Sensible and Non-Serious are essentially low risk bidders, whilst Suicidal and Silly are essentially high risk bidders. Non-Serious and Silly, on the other hand are essentially high cost bidders, whilst Sensible and Suicidal are low cost bidders. Which class of bidder is to be prequalified ultimately depends on the client's attitude to risk and cost trade-off. It is also important for bidders to be able to identify their competitors and themselves in terms of these classes. It has been found that success in winning contracts is associated with consistent competitively bidding for particular contract types or
comparatively high bidding variability [3].

The information needed to identify the appropriate class of bidder can be obtained by analysis of historical data contained in tender reports. A bidder's likely classification can be adduced according to discrete variables such as contract type, location or client or according to continuous variables such as contract size. These variables can be analysed individually or, providing there is sufficient data, according to any desired combination.

Previous empirical studies have shown that competitiveness of individual bidders is correlated in varying degrees with contract type [3, 4] and these differences are accentuated in the public sector [3, 4, 6]. As a result, a case study was undertaken of various types of public sector contracts to investigate the competitiveness approach to the classification of bidding behaviour.

4. CASE STUDY

A total of 2531 bids from 193 bidders for 199 contracts let between 1980 and 1990 were collected from the Architectural Services Department of the Hong Kong Government. This represented general construction contracts for six contract types according to CI/SfB classification (see Table 1). Each
bidder was assigned a code to preserve identity. On average 13 bids were received for each contract.

All bidders

Using data for all the bidders in the sample, the overall mean C-Competitiveness, C', was correlated with the standard deviation, C". This produced a positive correlation coefficient of 0.614 (n=149, p=0.000) for bidders having more than one bidding attempt. As pointed out in an earlier paper [4], the correlation of C' with C" is expected as bidders with high C' but low C" (i.e., Non-Serious) would fail to get any work. Conversely, bidders with low C' but high C" (i.e., Suicidal) would eventually become bankrupt.

Fig. 3 shows the scatterplot of all the coded bidders in the sample (bidders entering only one bid have been assigned a zero standard deviation). The central cluster of bidders represents the typical bidders performance in terms of C' and C". It is also interesting that no bidder has a low C' and high C". This has been denoted Fig. 3 as the 'impossible region'. Clearly this phenomenon is symptomatic of the measure used for, as C-Competitiveness is constrained to be above zero, small C" values are hardly possible for greater values of C'. It could also, however, be because there are few Suicidal bidders in the sample.
Most frequent bidders

The most frequent bidders, ie those who bid ten times or more in the sample, were selected for analysis as it was considered that the results obtained would be more representative of their bidding behaviour. The C' and C" values of this subset of 78 bidders were found to have an even stronger correlation of 0.755 (n=78, p=0.000).

Fig. 4 shows the overall bidding performance broken down into the four competitiveness classification quadrants, the axes of the quadrants being determined according to the mean C' and C" of this grouping of bidders. Due to the strong positive correlation, most bidders fall in the Sensible-Silly quadrants, 44 being classified as Sensible and 18 as Silly. Of the 16 remaining, 13 were Non-Serious while 3 were Suicidal. There appears to be some evidence of a lengthy Sensible-Silly continuum, with several bidders reaching towards the extremities. The Non-Serious-Suicidal continuum, on the other hand is much shorter - indicating fewer extreme differences between the bidders on this scale.

The objective of submitting a bona fide competitive bid is to become the lowest bidder and thereby win the contract. The next part of the analysis therefore examines the question 'which of
the four groups is most successful at becoming the lowest bidder and thereby securing the contract?' In terms of success at becoming the lowest bidder, the logical sequence should rank in descending order of Suicidal, Sensible, Silly and Non-Serious. To answer this question, therefore, the number of lowest bids was expressed as a proportion to the total number of bidding attempts to produce the success ratio for each quadrant. This yielded the following success ratios; Suicidal = 0.163, Sensible = 0.100, Silly = 0.048, Non-Serious = 0.034 against an overall average of 0.082. The result therefore concurs with the above stated hypothesis.

Bidders were then considered in terms of contract type groupings, within each classification, and tabulated according to their overall performance classification. Table 2 shows the classification for each bidder across contract types, single bidding attempts being shown separately. Consider first the Sensible group of bidders. Some bidders are clearly consistently Sensible over all contract types (eg bidders 1, 6, 7, 72, 96, 136, 150 and 178). It could be argued that this group of bidders is of unfocused cost leaders as they appear to be competitive over all contract types, and that clients can be assured of receiving a competitive bid irrespective of contract type. Those border line cases who just fall into the Sensible competitive quadrant (eg bidders 20, 40, 84, 119, 135 and 141) show a mixed classification over the various contract types. In this case it could be argued that these bidders are focused. In
general then it seems that this *Sensible* group of bidders can be regarded as lying on an unfocused-focused continuum. This corresponds to a C'-C" diagonal line running from bottom left to top right through the *Sensible* quadrant in Fig. 4. Based on this model, we would therefore consider bidders 11, 75, and 178 for instance also to be unfocused cost leaders despite the lack of available direct evidence.

Of the few bidders classified as *Suicidal*, none are actually classed as *Suicidal* for individual contract types. With one exception, they are classed as either *Sensible* or *Silly*. This suggests that they are focused but, as implied by the class, are rather more risky in their bidding than the bidders in the *Sensible* group. In the *Non-Serious* group, some of the bidders (eg 95, 121 and 142) may be considered focused, whilst others in the group are clearly *Non-Serious* over all contract types. Similar but weaker traits to the *Sensible* bidders are reflected in the results for the *Silly* group of bidders. Bidder 43 is unique in that he is classified as *Silly* over all contract types while bidders 45, 92 and 114 have shown themselves to be either *Silly* or *Non-Serious* over all contract types.

Table 3 gives a breakdown of the total number of bidding attempts and successes for the various contract types. As indicated in the Table, the number of successes is not evenly distributed over the different contract types (eg bidder 96 has
a success ratio of 0.47 for contract type 848 compared a success ratio of 0.08 for the remaining contract types). Again, this appears to support the existence of focusing strategies.

Table 2 and 3 together show that all bidders who had 5 or more successes at a particular type were classified as Sensible for that particular type. Although those bidders who had between 1 and 4 successes at one particular type came from the different classification groupings, the dominant grouping in terms of success is the Sensible group of bidders. The most successful bidders from the Sensible group were bidders 7, 96, 119, 148, and 150 who had a bid/success ratio of 0.37, 0.21, 0.17, 0.16, and 0.18 respectively. The principal reason for the comparatively high success ratios may be that in all instances these bidders were more competitive on particular contract types. For example, bidders 7, 96, 119 and 150 had success ratios of 0.45, 0.47, 0.22 and 0.33 respectively for contract type 848. Bidder 148 had a success ratio of 0.26 for contract type 374. Of the Suicidal bidders, bidder 52 with a success ratio of 0.16 in total, was classified as Sensible for contract type 712 with a success ratio of 0.40.

Apart from bidder 61, who had three successes (ie a success ratio of 0.21) on contract type 713, those classified as Silly on individual types were restricted to 1 or 2 successes on each type. All the Non-Serious bidders were restricted to either 1 or 2 successes on each contract type. The least successful Non-
Serious bidder was bidder 142 who didn't win a single contract in 67 bidding attempts. Bidders who were successful more than once were found in five of the six contract types. The exception was contract type 373. This is probably due to the comparatively small sample size for this type.

5. CONCLUSIONS

A major issue in prequalification is in ensuring that genuine competitive bids are likely to be received from bidders. Bidders may be classified from a client's perspective in terms of cost and risk. Low cost/low risk bidders are termed Sensible, high cost/low risk bidders are termed Non-Serious, low cost/high risk bidders are termed Suicidal and high cost/high risk bidders are termed Silly. The type of bidder to be selected depends on the balance between cost and risk, which is ultimately the concern of the client and should be reflected in the prequalification system. In general, the most desirable bidders are likely to be:

- 'Sensible', irrespective of the contract characteristics such as contract type (i.e., identifying those who are unfocused cost leaders)

- 'Sensible', in terms of certain contract characteristics such as contract type (i.e., identifying those who are
focused cost leaders)

The latter group consists of specialists whose competitiveness is likely to have been developed over a period. Specialists are distinguished by their unequal distribution of successes across different contract types. Specialists who had been successful more than once for a particular contract type were found to exist for all but one of the six contract types under study.

In this paper we describe a method of identifying and classifying potential bidders' contract preferences in terms of C-Competitiveness.

In a case study of construction contract bidding, a significant positive correlation between competitiveness and consistency resulted in most bidders being classified as Sensible or Silly. More extreme cases of Sensible and Silly bidders were found than in the Suicidal and Non-Serious categories, where bidders were much less differentiated. Some evidence was found for separating focused and unfocused bidders depending on their position in Sensible quadrant. An analysis of 'most frequent bidders', ie bidders recorded as entering bids for ten or more contracts, showed this trend to be even stronger.

The average success ratios for the four groups of bidders
indicated the Suicidal bidders had the most success in winning contracts. This was followed, as expected, by the Sensible, Silly, and Non-Serious groups. Analysis of the Sensible group, identified bidders who were consistently Sensible (ie unfocused cost leaders) over all contract types, and bidders who were Sensible (ie focused cost leaders) over only some contract types. The position of these bidders in the Sensible quadrant suggested the existence of an unfocused-focused continuum and this was used to identify further unfocused bidders. Bidders classed as Suicidal were also thought to be focused but, as implied by the class name, rather more risky in their bidding. Some evidence of focusing was also found in the Non-Serious and Silly groups, but on a much reduced scale.

Bidders who met with five or more successes for a particular contract type were invariably classified as Sensible for that type. Bidders classified as Silly or Non-Serious were, with one exception, restricted to one or two successes per contract type. An interesting inference from this observation might be that those Sensible bidders winning more than one contract for a particular type did so more by judgement than luck. Silly bidders winning more than one contract for a particular type, on the other hand, could be said to do so more by luck than judgement.

Clearly, it is important to add more qualitative data to
the analysis to confirm the postulated relationships between bidders' strategies and the classifications developed here. This could best be achieved by meetings with successful and unsuccessful bidders and this is planned for the next stage of the research.

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