Price and Nonprice Criteria for Contractor Selection

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Abstract: Although the public sector has a long tradition of using the lowest bid as the award criterion for contracts, reliance on nonprice criteria is increasing. The purpose of this paper is to describe and explain how public owners use multiple criteria for the award of construction contracts. It is likely that nonprice criteria support the alignment of owner and contractor interests, and that bidder behavior should be affected by the likelihood of repeated contracts, and by the transparency of owners' evaluation procedures. Data from 386 bidding documents reflecting practice in Swedish municipalities in 2003 are analyzed. A typical pattern is a 70% price weight combined with three nonprice criteria. Price formulas, translating bid prices into scale values, were found to be based on the lowest bid, bid spread, or average bid. Nonprice criteria were evaluated on either relative or absolute merits. Owners should be aware of the incentives that their selection practices create and view this in a policy perspective, whereas contractors should be ready to assess the short and long term values of nonprice features.

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Introduction

The public sector has a tradition of using the lowest bid as the award criterion for construction contracts. Although an ASCE seminar on contract award practices, held in 1965, only identified prequalification of bidders as a possibility for protecting "capable and established firms" as well as giving the client "a better and over the years, a more economical job" (Hunt et al. 1966), the principle of using other criteria than the lowest bid emerged in the late 1980s (Ashley et al. 1987; Birrell 1988; Russell et al. 1990). Herbsman and Ellis (1992) studied multiparameter bidding for highway projects as an innovative alternative to the traditional low bid approach. More recent U.S. contributions to this field include contract award practices in design-build projects (Molenaar and Gransberg 2001), performance-based procurement (Kashiwagi and Byfield 2002), and guidelines for warranty, multiparameter, and best-value contracting (Anderson and Russell 2001; Thompson et al. 2002).

Outside the United States, there have been investigations of contractor evaluation and selection methods (Holt 1998; Hatush and Skitmore 1998) as well as of the perceived importance of evaluation criteria (Wong et al. 2001), and there is at least one attempt to create a broader synthesis of how public procurement could benefit from the application of multiple criteria (Palaneeswaran et al. 2003). Taking a global perspective, there are now governments as far apart as the European Union (Rocha de Gouveia 2002), Turkey (Topcu 2004), and China (Lai et al. 2004; Shen et al. 2004) that encourage or prescribe the use of multiple criteria in the selection of contractors. As a consequence, new procurement practices develop. The purpose of the present paper is to describe and explain how public owners use multiple criteria for the award of construction contracts.

The paper proceeds as follows. First, there is an overview of how transaction cost theory can be applied, leading to a discussion of how owners might wish to reduce costs by offering incentives to bidders so that these invest in routines and competences that correspond to owner priorities. Then results are brought in from an empirical investigation of how actual multiple criteria are defined and weighted in Swedish municipal procurement of construction. Given these findings, it is possible to question whether assumptions current in the procurement literature are adequate for an understanding of the dynamics that multiple criteria set in motion. This is followed by an analysis of the system of price and nonprice criteria and in particular the issue of transparency. The paper concludes with a brief reflection on the potential value of the survey findings, and a number of implications for practitioners, both owners and contractors.

Costs, Incentives, and Criteria

If owners can be seen as organizing their procurement in a transaction costs perspective, there follows an explanation why they should be concerned with providing incentives to bidders.

Transaction and Production Costs

The use of multiple criteria and the organization of construction procurement in general consume administrative resources, within both the procuring unit and companies that bid for contracts. Transaction cost theory is relevant to the analysis of construction projects (Walker and Wing 1999; Winch 2001; Yates and Hard-

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castle 2002) and a case can be made for its application as to how the public sector owners choose to organize procurement.

The basic assumption is that the parties to a contract minimize the sum of production costs and transaction costs. For the owner, actual payments to the contractor represent the production costs. Transaction costs for the owner are less easily measured and arise through efforts to specify the project, to conduct the procurement process, to monitor the chosen contractor, and to resolve any conflicts related to the contract. An optimizing owner has to choose between activities that affect transaction costs before the contract has been signed and activities that give rise to transaction costs afterwards. Engaging greater resources at an early stage may result in reduced transaction costs at a later stage. Also, it is assumed that lower production costs can be achieved by increasing transaction costs belonging to either stage. With regard to bidder costs, each bidder is faced with transaction costs for bidding, and if awarded the contract, also for being subject to monitoring and involved in conflict resolution, in addition to the bidder's own production costs.

An advantage of relying on transaction cost theory is that it makes it possible to consider the use of nonprice criteria applied by owners when awarding contracts. In this perspective, the choice of contractors is no longer the same as a selection among inanimate objects that possess fixed sets of characteristics. On the contrary, bidders are understood to react and adapt to the signals emitted by owners that apply nonprice criteria.

This mechanism is recognized and exploited by leading manufacturers. Supply chain thinking has led to reliance on multicriteria choice of suppliers and transformed earlier practices of purchasing in the manufacturing industry (De Boer et al. 2001). Here, buyers use either a linear weighting model or another type of function when relying on multiple, nonprice criteria. The crucial issue is how an approach takes into account supplier development, including both reactive and strategic responses among the supplier community (see Krause et al. 1998). Thus the emphasis shifts toward costs that arise in the bidder's organization for reviewing specifications, estimating production costs, assessing risks, and possibly introducing new management and production routines to meet buyer requirements. In such a context, buyers and bidders look further than to the single contract, and both are influenced by the prospect of recurring commercial relationships in future contracts. Bidder behavior is influenced by nonprice criteria signaling that appropriate management routines and stronger capabilities are rewarded by a higher probability of winning future contracts. This is a case of strategic interaction between owners and bidders.

Owners develop and use practices such as partnering intended to improve alignment between owner and contractor interests in construction projects. The use of multiple criteria in the selection of contractors should be investigated as one of several means to achieve alignment. Transaction cost theory allows seeing the effect of owner/contractor interest alignment not least as a reduction of the effort to renegotiate contracts during construction projects. Some of the bargaining that takes place during the course of a project might arise from incomplete or erroneous specifications, thus possible to reduce by increased effort at an early stage, although other causes include new needs announced by owner, third-party action, or unexpected environmental changes. Contractors can be thought to be bidding for a bundle of *both* construction according to the original specifications *and* the temporal contractual relationship with the procuring unit, a relationship that is institutionalized and includes the option to perform additional services, entering a particular set of norms for resolving disputes, etc. Instead of trying to predict all contingencies and to specify how to deal with them, which is a path of action that would incur excessive costs prior to signing a contract, it should be more efficient for the owner to develop nonprice criteria for selecting a bidder who is likely to combine low production costs, relying on bid price as an indication, with low transaction costs after the contract has been signed.

Incentives for Bidders

One measure of the strength (both for the owner and for the bidders) of the economic incentives generated by a multiple criteria model is whether weights and scales used by the owner would reverse the ranking of the two bidders that offer the two lowest prices. Incentives for bidders are weakened both by the risk of losing the contract they are currently bidding for, and by the risk of losing other contracts in the future, contracts for which their investment in routines and capabilities should have improved their competitive position.

Unfortunately, what is known about the statistical properties of bid distributions cannot be translated into more precise assessments of how incentives are weakened. Bid spread can be analyzed assuming a lognormal probability distribution (Skitmore et al. 2001). It has usually been thought that bid spread is a function of contract value and number of bidders. However, there is little agreement on how these factors are interrelated and as to what the general conclusions should be (Skitmore et al. 2001). Thus, at the same time, as bid spread can be expected to influence contractor incentives, it is impossible to make general predictions based on the statistical properties of bid distributions.

Evidently, the strength of incentives depends on how they are communicated, so the amount of information about award criteria that the owner reveals in the bidding documents is significant. Transparency is often invoked as a principle that acts on the choice of award criteria so as to minimize patronage and corruption in public procurement (Hart et al. 1997). The main consequence for criteria design is that criteria should be tangible (Tirole 1994) and support independent verification. In general, attributes such as these criteria should be complete, operational, decomposable, nonredundant, and minimal, according to Keeney and Raiffa (1976, p. 50f). However, a concern with verifiable operationalization may lead owners to exaggerate the importance of tangible criteria such as the bid price itself, whereas also choosing very simple quality criteria such as the presence or absence of a third-party certified quality assurance system in a bidder's organization. In a transaction cost perspective, this concern with objectivity can be explained as intended to reduce conflict resolution costs associated with the procurement phase although running the risk of municipality/contractor misalignment during the construction phase.

Since the owner is subject to uncertainty as to the range of bid prices that will be submitted, the actual levels might lead to an unexpected higher or lower influence for nonprice characteristics. Thus the intended balance between price and, e.g., quality might be upset. The remedy that may be applied is to design a price formula that reduces the effect of fluctuation in the local construction market and possibly also tendencies to collusion among bidders.

Criteria, Qualities, Attributes

Depending on the theoretical base chosen, contract award decisions can be thought of as a function of attributes, criteria, param-

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eters, or qualities. Thus auction theorists rely on a terminology that distinguishes between price and quality features of bids (Che 1993, Branco 1997), using "quality" in a broader sense than most construction practitioners would do. Decision theorists prefer "attributes" or "criteria" to "qualities" (Fishburn 1965; Dyer et al. 1992).

Here, the expression "multiple criteria" is retained because it is used in legislation and often found in the construction management literature. Bids are characterized here using the terms *price* and *nonprice criteria*. The formalization is as follows. There are m criteria $(1,2,\ldots,i,i+1,\ldots,m)$, and n bidders $(1,2,\ldots,j,j+1,\ldots,n)$ who submit bid prices b_j, and their bids are characterized by scale values q_{ij} for each nonprice criterion. Each bid price b_j is translated by the owner into a price scale value p_j. The overall assessment of a bid is based on a weighted sum of scale values. In order to introduce uniformity, it is postulated that weights sum up to one

$$w_p + \sum w_i = 1 \tag{1}$$

The award criterion can then be written as: choose the bid (j) that maximizes

$$\sum w_i q_{ij} - w_p p_j \tag{2}$$

Obviously, Eq. (2) implies that price scale values are positive and increase monotonously with actual bid prices.

Method: Data from Swedish Municipalities

What happens in procurement practice when a category of public sector owners turns to multicriteria award procedures? Early results from a Swedish investigation of how municipalities develop new practices exploiting nonprice criteria when awarding construction contracts indicate the presence of both ingenuity and competence gaps (Waara and Bröchner 2005). The legal context is that of the Swedish Public Procurement Act, requiring public sector owners that wish to select the tender that is the "most economically advantageous" to make an "overall assessment including considerations such as cost, delivery date, running costs, quality, aesthetic values, performance, technical features, service, technical support, environmental impact, etc." This text is related to the European Community Directive (2004/18/EC, Art. 53) that lists "quality, price, technical merit, aesthetic and functional characteristics, environmental characteristics, running costs, cost-effectiveness, after-sales service and technical assistance, delivery date and delivery period or period of completion" as examples of contract award criteria.

The sample used in the analysis consists of data from 386 bidding documents. These bidding documents represent construction projects procured by Swedish municipalities in 2003. As many as 169 (out of 290) Swedish municipalities were found to be included in the sample, which should represent a great diversity of award criteria practices. In the Swedish system it is common that public sector owners like most private sector owners use a standardized system, AF AMA 98 (1997), for the internal structure of their bidding documents. The AF AMA system facilitated the review and codification process as information on award criteria is presented under a particular heading (AFB.52) in the documentation.

The bidding documents were derived from a commercial database that contains records of bid invitations from public sector owners in Sweden. Construction procurement was defined according to the common procurement vocabulary codes employed by the European Union. Thus, the projects represent a variety of facilities that are associated with municipal services. Infrastructure projects, such as roads, bridges, and water and sewage systems (36%), school buildings (23%), public facilities, such as libraries and sports centers (14%), housing (13%), technical facilities, such as fire stations and sewage treatment works (8%), offices (3%), and buildings for elderly care (3%) are included in the sample. Relying on the general technical description found in the bidding documents all projects were graded on a small/medium/large scale. A potential bias arises from that the sample might be skewed toward municipalities with advanced award criteria practices because these municipalities might also have a greater tendency to publish digitally their bid invitations.

Data Analysis

At this point, the interest lies in the relative strength of the economic incentives transmitted to bidders by the municipalities. In 164 cases, weights were given for nonprice criteria. Moreover, 48 cases were analyzed in more detail where information about weights and scales had been revealed by the municipalities. It should be noted that the typical procedure of evaluating price and nonprice criteria involves the assignment of a scale value for each criterion. Scale values are then multiplied by the corresponding criteria weights. However, there are municipalities that conflate the assignment of scale values and weighting; scale values have then been recalculated and the corresponding weight derived according to Eq. (2).

Assigning Weights to Criteria

For each project, the lowest weight $w_{\min}$ of any nonprice criterion could be expected to depend on the number m of criteria or more precisely the inverse of m. Using regression (Johnson and Wichern 1998) for the 164 cases where nonprice criteria were applied and the weights were given, the following quantitative relationship is obtained:

$$w_{\min} = \frac{0.273}{m} + 0.0148 \tag{3}$$

that explains more than half the variation in minimum weights, as indicated by the coefficient of determination ($R^2=0.51$). The average $w_{\min}$ is 11.3%, but the two most frequent percentages found in the sample are lower, being 10 and 5%. The regression fit is much less satisfactory ($R^2=0.12$) for $w_{\max}$, the highest weight of any nonprice criterion

$$w_{\max} = \frac{0.140}{m} + 0.1256 \tag{4}$$

The average $w_{\max}$ is 17.6%, and again, the most frequently found percentage is 10%, but here followed by 20 and 15%.

The relation between the number of nonprice criteria and w_p, the weight assigned to price (ranging between 9 and 91%, with an average of 64.8%), is also weak ($R^2=0.12$). The corresponding equation is, again relying on the inverted value of m

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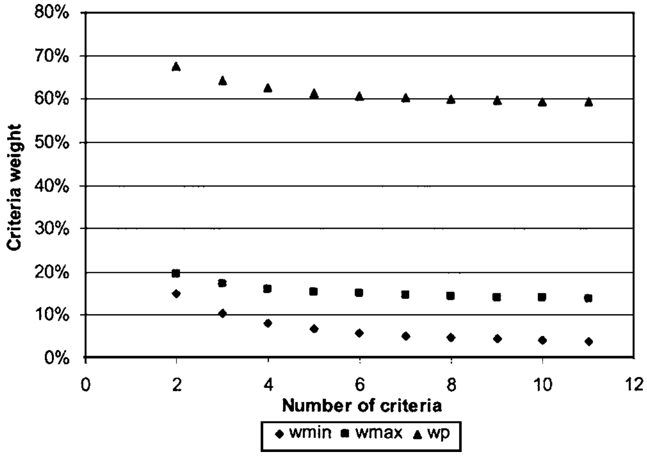

Fig. 1. Criteria weights versus number of criteria

$$w_p = \frac{0.202}{m} + 0.5750 \tag{5}$$

Among the 164 cases, the median case displays a price weight of 70% and the remaining 30% spread between three nonprice criteria. Eqs. (3)–(5) are illustrated in Fig. 1.

Price Scales and Formulas

In this section, only the group of bidding documents where the municipalities revealed information about price formulas (48 out of 386 cases) is analyzed. The purpose of a price formula is to translate bid prices into price scale values $(p_{\min},\ldots,p_{\max})$ so that the municipality through weighting may compare bid prices with nonprice criteria. Within the group the minimum price scale value $(p_{\min})$ was either 0 or 1, whereas the maximum price scale value $(p_{\max})$ took on values from 4 to 130. Most frequently, however, the maximum price scale value was 5, 10, or 100. The price formulas that were identified can be divided into three main types: (I) based on lowest bid, (II) on bid spread, and (III) on average bid. All formulas, as they are given here, assume that $p_{\max}$ equals 100, but not all formulas are equally sensitive to other values for $p_{\max}$.

Type I: Based on Lowest Bid

The formulas based on lowest bid can be subdivided into four categories (I.a–I.d) as follows.

I.a. In 11 cases, a simple ratio was used

$$p_j = -\frac{p_{\max} b_{\min}}{b_j} \tag{6}$$

I.b. The formulas most frequently used (24 cases) by municipalities was

$$p_j = p_{\max}\left(\frac{b_j - b_{\min}}{b_{\min}(k_1 - 1)} - 1\right), \quad b_{\min} \leqslant b_j < k_1 b_{\min} \tag{7}$$

in combination with

$$p_j = p_{\min}, \quad b_j \geqslant k_1 b_{\min} \tag{8}$$

where restrictions are necessary to avoid negative scale values and k_1 is a constant, in the sample ranging from 1.20 to 2.00 (mean 1.70). Among these 24 cases there were five cases where price scale values decreased stepwise, implying that bid prices within a certain range are assigned identical scale values. Eq. (7) gives only the continuous function.

I.c. In three cases, a fixed bid price deviation formula was used

$$p_j = k_2(b_j - b_{\min}) - p_{\max} \tag{9}$$

where k_2 is a constant. Again, in all these three cases, the scale value actually decreases stepwise, whereas Eq. (9) gives the continuous version. Formula (9) is the only one where the municipality reveals an indication of the estimated price, although implicitly through the value chosen for the constant k_2.

I.d. The following formula, used in one case for a residential project, is the only formula that incorporates the second-lowest bid (b_2):

$$p_j = \frac{b_j - b_{\min}}{k_3 b_2} - p_{\max} \tag{10}$$

where k_3=constant (in this case 0.015), and for $b_{\min} < 0.9b_2$, which was interpreted by the municipality in question as an indication of irrelevant price dumping by the lowest bidder, there is the more complicated alternative

$$p_j = \frac{1 - b_{\min}/b_2}{k_3 + k_4(0.9b_2 - b_{\min})} + \frac{b_j - b_2}{k_3 b_2} - p_{\max} \tag{11}$$

where k_4=0.05 in this case.

Type II: Based on Bid Spread

The second type of price formula is based on bid spread. In four cases, the following formula was used:

$$p_j = p_{\max}\left(\frac{b_j - b_{\min}}{b_{\max} - b_{\min}} - 1\right) \tag{12}$$

where it is obvious that the highest bidder plays a key role.

Type III: Based on Average Bid

The third type of price formula is based on the arithmetic mean (b_{mean}) of all submitted bids. This type of formula can be subdivided into two categories (III.a and III.b) as follows.

III.a. The following formula was used in three cases, which all involved excavation work:

$$p_j = \frac{p_{\max} b_j}{b_{\text{mean}}} \tag{13}$$

III.b. In two cases, both infrastructure projects, there were practices that have been translated into

$$p_j = \frac{p_{\max}}{2}\left(\frac{b_j - b_{\text{mean}}}{k_5 b_{\text{mean}}} - 1\right) \tag{14}$$

where k_5=constant. Note that in both Eqs. (13) and (14) the average bid price only acts as a reference point, and that a low bid price remains more competitive than a high bid price.

Types of Nonprice Criteria

In this section, 314 cases with nonprice criteria are analyzed, thus excluding projects procured on the basis of lowest bid price only (42 cases) and projects where the municipalities had failed to reveal information about nonprice criteria (30 cases). Basic data for these 314 cases are found in Table 1. Although there were no project data on expected contract sums, the bidding documents for each case were used to classify projects into small, medium, and large. It was found that the median number of nonprice cri-

Table 1. Criteria for Contractor Selection by Swedish Municipalities Using Multiple Criteria (2003, $N=314$)

Variable	Mean	Median	Minimum	Maximum	Standard deviation
Number of nonprice criteria	3.21	3.00	1	10	1.66
Price weight (%)	64.79	70.00	9	91	16.15
Highest nonprice weight (%)	17.64	15.00	3	60	10.19
Lowest nonprice weight (%)	11.33	10.00	1	60	9.72

teria was two for "small" projects and three for "large" projects. For larger and complex projects, municipalities may expect added transaction costs associated with a higher number of criteria to be offset by lower transaction costs due to better relations during the construction stage.

The analysis of bidding documents gave the opportunity to classify nonprice criteria used by Swedish municipalities according to examples of criteria given in the EC Directive and the Swedish Public Procurement Act (see Table 2). It was found that there is only weak consensus among municipalities concerning the use of nonprice criteria and corresponding subcriteria. Multiple regression failed to disclose any significant influence of number of inhabitants, which could be seen as a variable reflecting both the total local volume of construction contracts and local access to competence.

Table 2 shows clearly that many municipalities rely on criteria that properly belong to a stage of prior approval of contractors rather than as exemplified under contract award criteria according to the present legislation. In some cases "references" constituted a single criterion without further information about what these references were supposed to measure, but since the use of references ordinarily refers to contractor capability it was included here in that category. Only a few cases were found where health and safety aspects were included or constituted a single criterion. In addition, no cases were found where the municipalities required the contractor to use identical or similar nonprice criteria in the (subsequent) procurement of subcontractors or purchases from suppliers, even though subcontractor candidates still might have to be approved by the municipality before a contract is signed.

Table 2. Criteria Used by Swedish Municipalities

EC directive Article 53: Examples	Swedish public procurement Act: Examples	Municipal examples of criteria and subcriteria
Quality	Quality	Quality, quality assurance system, quality plan
Price	Cost	Bid price, unit price
Functional characteristics,	Performance, technical	Function, technical solution,
Technical merit	features	Technical design
Environmental characteristics	Environmental impact	Environmental characteristics, environmental management system, corporate environmental policy
Running costs	Running costs	Operation costs, maintenance costs, life-cycle costs
After-sales service and technical assistance	Service, technical support	Service, responsiveness, availability
Delivery date	Delivery date	Project duration
—	—	Contractors' capabilities, skills, training, references, past experience, and past performance
—	—	Project realization, construction methods
—	—	Financial capacity, solidity
—	—	Health and safety
—	—	Conformity with bidding documents

Evaluating Nonprice Criteria

An observation when studying the price criterion was that the weight assigned to bid price only gives contractors imperfect guidance in preparing their bids. Likewise, specifying only nonprice criteria and their weights gives little information about how these criteria are to be evaluated by a municipality. It was found that municipalities evaluate nonprice criteria based either on (1) relative or (2) absolute merits of the submitted bids.

When evaluation based on relative merits is used, two main variants can be identified. In the first variant, the municipality compares the bids and assigns the highest scale value on a nonprice criterion to the best bid and the lowest scale value to the worst bid. The other bidders' scores are then distributed between these two extremes. In the second variant, the municipality also compares the bids, but it will not necessarily use the full scale range. Thus the best bid may attain the highest scale value, whereas the worst bid may be assigned any score depending on how much it is perceived to deviate from the best bid.

When municipalities evaluated nonprice criteria on the basis of absolute merits, they had usually explained what was required to attain some or all of the scale values. A typical example is the quality assurance system criterion, where bidders with a third-party certificate generally achieve the highest score. Bidders with a well-functioning quality assurance system but no third-party certificate generally achieve the second-highest score. Thus if all bidders have a quality assurance system with a third-party certificate they achieve an equal score. It is interesting to note that criteria such as function, technical solution, and technical design never had any prespecified requirements for the scale values, and that they most likely were evaluated based on relative merits.

Discussion

Our empirical findings indicate a strong trend away from lowest price selection of construction contractors. Nevertheless, municipal practice in Sweden shows that price competition between contractors remains in vigor, while the choice of nonprice award criteria reveals an awareness of the risk that focus on price might result in project delivery problems.

The System of Price and Nonprice Criteria

How complicated should a system of price and nonprice criteria be? The literature on criteria that are important for contractor selection often lists far more criteria than is manageable—Wong et al. (2001) include no less than 37 criteria—and no municipality in the sample had used more than eleven criteria ($m=11$). A reason for keeping (m) low, given a high price weight, is indicated

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by Eq. (5); adding more criteria would be increasingly unlikely to affect the choice of bidder. Another reason for a municipality to concentrate on few nonprice criteria is that each additional criterion also generates higher transaction costs for the municipality due to the evaluation effort. A typical pattern in the sample is a 70% price weight combined with three nonprice criteria.

The frequent inclusion of nonprice criteria that refer to contractors' capabilities, skills, training, references, past experience, and past performance, in spite of the absence of such examples in national legislation and EC directives, indicates that many municipalities in the Swedish sample formulate criteria that would lead to a high degree of interest alignment between the municipality and the contractor.

When a municipality resorts to multicriteria contractor selection it must also decide on a procedure for evaluation of nonprice criteria. Findings from the survey suggest that some nonprice criteria are appropriate to evaluate based on absolute merits. These criteria are characterized by easily verifiable levels, such as "having a quality assurance system with a third-party certificate." The strength of evaluating bids on absolute merits, and also prespecifying the requirements for each score, is that bidders easily can identify what is needed to increase their competitiveness. A weakness of this emphasis on absolute merits, on the other hand, is that it provides no incentive for bidders to exceed the requirements for the highest score. Therefore, when the municipality has imperfect prior knowledge of the range of values to which a nonprice criterion refers, it makes sense to base the evaluation on the relative merits of each bid according to that criterion.

Criteria and weights to be applied to any multicriteria decision context can be derived by deduction from existing policy goals and objectives, or by a procedure that leads to consensus among a group of individuals. The most widely known example of the group consensus variety is the analytical hierarchy process as introduced by Saaty (1980). The Saaty process is intended to help the decision maker, often a group of persons, to decompose and simplify a complex problem by constructing a hierarchy where pairwise comparisons of criteria can be made. Although this process can be applied to selection of contractors (Fong and Choi 2000), it is doubtful whether any process for aggregating the preferences of a limited group of individuals is appropriate for public contract awards. Palaneeswaran et al. (2003) in their treatment of "best value" contractor selection for public sector projects have recognized the basic difference between public and private procurement.

The variety of price formulas in the sample were categorized into formulas based on the lowest bid, bid spread, and average bid. The most common price formula was Eq. (7) together with Eq. (8), which belong to the standard minimum price deviation model in the taxonomy proposed by Rocha de Gouveia (2002). Although there were two formulas that relied on the average bid [Eqs. (13) and (14)], none of them resembles what is termed the average-bid method by Ioannou and Leu (1993). In the Swedish cases here, the lowest bid is the most competitive with respect to price, while in the average-bid method the bid closest to the average is defined as the most competitive.

Given the variety of price formulas, does it matter which one of them that the municipality chooses to rely on? Formula (12) can be used as an example with its weaknesses due to dependence on bid spread. Suppose that only two bidders participate. Then one bidder receives the maximum scale value ($p_{\max}$), whereas the other one receives the minimum scale value regardless of the deviation between the two bid prices. This suggests that bid price easily becomes the decisive criterion when few contractors submit bids. Also note the resemblance between Eqs. (12) and (7) which are equivalent for cases where the highest bid $b_{\max}$ equals $k_1 b_{\min}$. However, Eq. (7) is neither affected by the number of bidders, nor by the highest bid price.

As noted, one measure of the strength of the economic incentives is whether weights and scales used by the municipality would reverse the ranking of the two bidders that offer the two lowest prices. The various price formulas in the sample may lead to different outcomes, which implies that the nominal weight that a municipality assigns to bid price is a poor indicator of its actual importance. To sum up the discussion so far, the survey findings suggest that multicriteria contractor selection must be understood as a system, where criteria, weights, scales, and price formulas interact.

Information to Bidders

A municipality has to decide how much information about the system of price and nonprice criteria that is going to be kept private and how much that is to be known to bidders in advance or after the award of a contract. At one extreme, the municipality keeps all information private, and at the other extreme all information is made public. The empirical sample shows that information practices of municipalities can be found spread between these extremes. This result should be interpreted in light of the current Swedish Public Procurement Act, which stipulates that public sector owners in their bid invitations must announce their criteria and if possible rank these criteria in order of importance. Thus, there has been no formal requirement saying that a public sector owner must announce criteria weights, scales, or price formulas.

When a municipality chooses to inform bidders about the multiple criteria system from the outset, bidding behavior ought to resemble that occurring under a lowest price award regime, insofar as a bidder can predict what value the municipality will assign to nonprice criteria. This allows any bidder to evaluate nonprice criteria in monetary terms. Bidders with poorer nonprice capabilities than among their competitors have three alternatives. Bidders can (1) refrain from submitting a bid because of the weights and scales that the municipality will apply, if they suspect that their combination of bid price level and nonprice characteristics will make it hard to compete, (2) aim to submit a bid that is lower than competing bids, or (3) invest in nonprice capabilities. The "invest" reaction is what can be referred to as the incentive effect of a multiple criteria system. If the municipality, on the other hand, chooses to keep information about the system of price and nonprice criteria secret, bidders will lack information about municipal preferences. They submit bids, but remain unable to predict the exact list of criteria and the values that the municipality will assign to criteria.

Why the degree of transparency varies among municipalities can be explained if their behavior is assumed to follow from a minimization of the sum of transaction and production costs for construction projects. In the case where a municipality expects at least one bid to contain process or product innovations that would lead to a sizable reduction of production costs, it might be unwise to prespecify criteria, weights and values in great detail. Instead, higher transaction costs associated with writing and applying technical specifications in performance terms would then be a better alternative use of municipal resources. In general, greater transparency is likely to be found when it is important that bidders are well attuned to the needs of the procuring municipality and that there will be a low level of contract conflict. Investment in a well-developed system for evaluating bids should also lead to

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lower transaction costs because the evaluation effort will be lower. Moreover, objectivity of criteria and their application reduces the risk that bidders accuse the municipality of favoritism (Laffont and Tirole 1993). Therefore, municipalities might choose a high degree of transparency that raises transaction costs associated with the preparation of bidding documents in order to reduce future transaction costs arising from bid protests and legal complications in general.

Although most of what has been written on decisions based on multiple criteria assumes that there is no interaction between what is evaluated and the decision maker, the picture that emerges from the present data is easier to understand if it is assumed that municipalities are aware of and also exploit reactions from the bidder community. When the municipality announces initially the nonprice criteria and their weights, there is scope for learning and reactions from bidders, either within the time available during bid preparations or in the medium run because of new contracts to bid for.

The ultimate test of the effects of a particular set of criteria and weights would be if there was an identifiable reduction in the sum of transaction and production costs compared to similar construction projects that have been procured under the traditional lowest-bid criterion. However, multicriteria practice is a recent phenomenon and the number of background variables to be kept constant for a comparison does not yet permit an empirical analysis of cost outcomes.

Conclusion

This investigation offers an overview of emerging procurement practice that relies on multiple, nonprice criteria. The analysis of how Swedish municipalities have developed and applied a broad range of criteria confirms what can be predicted from transaction theory: Owners prioritize bidders that are likely to function efficiently in a contractual relationship. The incentive function of nonprice criteria should be emphasized. Contractor incentives should generally be stronger when an owner uses a transparent evaluation model, when the likelihood of future contracts is high, and when weightings and scales result in nonprice criteria being decisive.

It should be kept in mind that using complicated but imperfectly revealed or formulated multiple criteria in public contract awards may substantially increase transaction costs, especially as the public sector owner faces the risk of litigation initiated by rejected bidders. It is probable that municipalities will have to reconsider how they organize construction procurement and how they will invest in professional skills to manage the contract award stage.

The findings do not contradict the principle that criteria and their weights should be derived from public policies rather than from applying a method for group consensus among individuals. Correspondingly, multiple criteria use by private sector owners should be guided explicitly by corporate goals, policies, codes, and other elements of corporate good governance.

The analysis leads to a number of implications for practitioners. For public sector owners, multicriteria contractor selection can be used to establish incentives to increase contractor alignment with owner needs, and to incorporate public policy objectives in the procurement of construction. Public sector owners should also be aware of how the transparency and complexity of their system of price and nonprice criteria affect the incentive power. For contractors, multiple criteria selection opens up new possibilities for supplier development through subcontractor selection, and argues for organizational procedures for assessing the short and long term value of nonprice features. Contractors should thus be ready to acknowledge the investment nature of criteria such as third party certification of a quality assurance system.

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Notation

The following symbols are used in this paper:

b_j = bid price submitted by bidder j;
m = number of nonprice criteria;
n = number of bidders;
p_j = price scale value of bid submitted by bidder j;
q_{ij} = scale value for nonprice criterion i in bid by bidder j;
w_i = weight of nonprice criterion i; and
w_p = price weight.

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