Selection of a Contractor - Evaluation of Bids

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Abstract
Factors other than price are being considered increasingly often during the procurement process. These other factors can include quality, competence, resources, recycling, longevity of materials and constructions, or the impact on the environment of the implementation. The tendering procedures of a great number of public works projects carried out in Sweden during the last few years have been studied. Special attention has been devoted to the evaluation of factors other than the price in relation to the choice of contractors. This project also aims to show how bids are evaluated in practice and, on the basis of this, suggest a bid evaluation model better suited to the requirements of the client. The aim of this paper is to describe some models that are commonly used to evaluate bids concerning tendering of public works.

Keywords: tender evaluation, evaluation models, contractor selection
The need for development in the construction sector

In order to create and maintain a construction sector that can meet the requirements for increased effectiveness, the construction sector and the client in particular must devote more resources to research and development. The construction sector in Sweden and the rest of Europe are marked by a slow rate of development, especially in comparison to the fixed industries. Many of those involved in the branch hold the view that the reason for the present slow rate of development is that the forms of procurement that are usually used discourage innovation. In order to create larger dealing freedom, new forms of procurement must be developed.

Construction work clients are striving for forms of procurement that provide a secure process, as well as a long-term innovative process. The choice of form of procurement and the choice of method for evaluating the bids affect the prerequisites for reaching this goal (see Fig. 1).

![Figure 1](image)

**Figure 1** The choice of form of procurement affects the choice of bid-evaluation method.

One effect of the increased desire of contractors to develop new, more effective solutions will probably be bids with larger variations in price and size than is usual today. All bids must, however, be able to be compared and evaluated in a similar way. At the same time, the evaluation methods ought to reward good suggestions with innovative content.

The more freedom a contractor is given, the more possibilities there is of finding solutions that fulfil the client’s requirement of limited use of resources. However, the more freedom they are given, the more factors must be taken into account when evaluating the bids (see Figure 2).

![Figure 2](image)

**Figure 2** Relationship between the extent of evaluation work and the degree of freedom given to contractors

The factors may have to do with the environment, quality, safety, etc. Evaluation of these factors is accomplished with the help of evaluation models that include price factors.

In addition to being a tool for selection, the evaluation models serve to direct contractors’ bid presentations toward the project goals. Another reason for using evaluation models is that the client, in creating a model, gains a better knowledge of what is important in construction.

Objective and Limitations

The main objective of the research project is to contribute to the development of a construction sector that is more inclined toward innovation. The aim of this paper is to

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1 Atkins, 1994  
2 Janson Patric, 1970  
3 Ericson Gösta, 1971  
4 Totalentreprenad, 1981
review models for evaluating bids and describe currently occurring bid evaluation methods for road-building procurement in Sweden.

The research project is selective to include procurement of road projects outside of the cities.

**Scientific Method**

An evaluation model must help ensure that the client’s wishes are fulfilled. Figure 3 shows the various factors that contribute to an evaluation model.

![Figure 3 Evaluation model for bids, seen as a system composed of several subsystems.](image)

Based on this reasoning, it is appropriate to choose the way of viewing the system as the starting point for the research project.

Research work can be regarded as a process of finding things out. The knowledge that is generated forms the basis for the next phase. The method in the first phase has involved studying the literature and empirical research of various models used in the reference project.

A great many theories exist about how to achieve the best results in evaluation of bids. This paper deals with the structure and description of some general theoretical principles, including various evaluation methods and how evaluation models are constructed, as well as the most common evaluation models used by the Swedish National Road Administration.

After going through the literature, it can be stated that there are shortcomings in the theories regarding the effect of the evaluation method on the end result for different forms of procurement and types of project. Moreover, there is no analysis of how the methods and models that are used affect the propensity for innovation.

**Various Selection Principles for Choosing a Bid**

The following is the principal system for choosing a bid in procurement situations:

<table>
<thead>
<tr>
<th>Pre-qualification</th>
<th>Price evaluated</th>
<th>Price set by the Client</th>
</tr>
</thead>
<tbody>
<tr>
<td>lowest price</td>
<td>Verification of minimum requirements</td>
<td>Verification of minimum requirements</td>
</tr>
<tr>
<td></td>
<td>Evaluation of soft parameters</td>
<td>Evaluation of soft parameters</td>
</tr>
</tbody>
</table>

*Figure 4 Principal alternatives for choosing a bid.*

As shown by the diagram, several of the principles can occur together. Above all, there are almost always some sort of minimum requirements. Then there are methods that are more or less mixtures of these. For example, after pre-qualification, the point system can be used for soft parameters and pricing.

**Pre-qualification** involves evaluating various aspects of the bidding company’s performance. A pre-qualified contractor must be capable of carrying out the planned
project as the client wishes. The aim of pre-qualification is mainly to make it possible to select the contractors who will be asked to take part in a procurement process.

**Choice of contractor based on lowest price:** First it is verified that the bids contain everything that is asked for in the invitation to tender. The bids often contain conscious deviations (reservations) from the invitation to tender. For the sake of price comparison, the evaluators must know what it would cost to remove these reservations. The evaluators can either request this information from the contractor or make an estimate themselves.

**Verification of minimum requirements:** When using this method, it must be verified that the so-called soft parameters fulfil certain minimum standards; they are then given a mark of ‘pass’ or ‘does not pass.’

**Choice of contractor based on evaluation of soft parameters:** The parameters are given different values, depending on how well they fulfil the client’s requirements. They can be assigned different importance or weight in relation to each other, based on what type of project it is. The parameters are added up, yielding a total sum that indicates to the client which bid to choose.

**Choice of contractor based on quality with set price:** When a procurement is for a job in which the construction company has the main responsibility for the project, it is possible to set a maximum price for the building and then evaluate only the qualitative parameters of the bid.

**Establishing an Evaluation Model**

When it has been decided that the bids will be evaluated according to different parameters, an evaluation model is then established. The client begins by deciding which parameters will be included in the model. After this is established, how the parameters are to be evaluated must be defined. Usually this involves giving each parameter points on a scale from 1 to 5 or 1 to 10. The easier it is to evaluate a parameter, the greater the scale that may be assigned to that parameter. A scale of 1 to 10 may sometimes be seen as too large a spectrum for obtaining a correct evaluation every time. However, a more limited scale may cause information to be lost unnecessarily. It must also be observed that the distinctness of the rankings decreases with a more limited scale.

Difficulties may arise when the criteria must be evaluated, since some factors are not directly measurable. Hard parameters such as price pose no problem in this respect, as variations in price can be directly correlated with a point system. The value of a soft parameter, however, is often impossible to measure directly, and it is therefore significantly more difficult to assign it points. Methods must be found of relating the qualities of the parameter to some sort of point scale. Price parameters must be assigned points within the same system as the soft parameters in order to allow comparative weighting.

After the point scale is established, the relative importance of the different factors is defined. Weights are numbers that represent the absolute or relative importance in the total evaluation. Weighting must form the basis for a comparison of the different factors so that total values can be found for the various bids. Weighting can be assigned to parameters chosen for the evaluation model in several different ways. One method is to give each factor a monetary value. These values are totalled and the weight of the factors is proportional to their monetary value.

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* Soft parameters are all evaluated aspects that are separate from price/expenses.

5 Byggindustrin, 1968

6 Pernu Pirjo, 1997
Another alternative is to weight the parameters by comparing them all with each other and deciding for each comparison which parameter is most important.\textsuperscript{7,8}

Yet another weighting system involves comparing each soft parameter to the cost parameter. The increase in cost that keeps the total value of the bid the same when a certain soft parameter is raised from the least possible to the highest possible level indicates the weight for that parameter.\textsuperscript{9}

Comparative weighting of factors can be accomplished by different methods that do not necessarily all yield the same results. The easiest way is, of course, to assign the same weight to all the parameters. Then they can be totalled as is (straight comparison), and the contractor with the highest total should be chosen.

The most common way of comparing parameters with different weights is to add up the products of each parameter’s value and weight (weighted comparison). Dividing each product by the maximum points possible for the parameter removes the significance of the differences in value scales between parameters (corrected weighted comparison). Then the focus is on how large a portion of the total value the parameter occupies in the given bid.

This reasoning requires that all parameters are independent of each other. In reality, it is highly unlikely that the parameters would not relate to each other in various formations. The theoretical way of solving this problem is to form a new parameter from the overlap between two parameters. It can, however, be a question of a large number of factors and the ones that are important to the project must be isolated.

\textbf{Sensitivity Analysis}

Before beginning to use the evaluation model, a sensitivity test must be performed, including a critical examination of the reliability of different types of evaluation. The analysis should answer the following:\textsuperscript{10}

- Which uncertainties and variations must be taken into account when assigning weight and points?
- How do such uncertainties affect the result of the evaluation, i.e. the rankings?
- How large a change can one make in the given weighting system before it affects the results, i.e. the bid rankings?

The client must be especially conscious of the fact that assigning points to soft parameters is in many cases rife with risk of subjectivity, randomness and mistakes in measurement.

\textbf{The evaluation models of the Swedish National Road Administration}

Representative evaluation models used by the Swedish National Road Administration between January 1994 and June 1996 have been studied. The models are continuously under development, but several basic principles can be discerned.

Just half of the Road Administration’s regions make use of evaluation models for new procurement investments. Procurement of up-keep and maintenance projects in all regions is carried out using evaluation models produced centrally at the Road Administration. The Swedish National Road Administration uses three different criteria for selecting bids:

- Evaluation of \textit{soft} parameters and price according to an evaluation model,
- Verification and evaluation of established minimum requirements,
- Lowest price.

\textsuperscript{7} Janson Patrik, 1970
\textsuperscript{8} Andresen Inger, 1997
\textsuperscript{9} Ericson Gösta, 1971
\textsuperscript{10} Ericson Gösta, 1971
The evaluation models that exist all arrive at their evaluation based on both soft parameters and price. Evaluation models contain criteria for both the contractor and aspects of the project itself. The most common parameters are:

- **The contractor's quality-control system.**
- **The bidder's ability to complete the task.** (The client considers the size of the bidding company, physically and economically)
- **Previous projects.** (For example: what was the quality level, how was the traffic situation taken care of, did the contractor present unmotivated demands or have a tendency to make things difficult? In certain cases it is worth points if the client has previous experience working with the contractor.)
- **Partners offered** (experience, qualifications, number of years in the business, etc.)
- **Contractor's models, methods for procurement of sub-contractors**
- **Production time** (time when the project will be opened to traffic, identification and minimisation of traffic disruptions)
- **Production methods**, as well as alternative course of action in case of any extreme circumstances. (Points can also be awarded to contractors that demonstrate that they have paid the most possible attention to the environment through environmentally-friendly methods and equipment and environmentally-safe storage and material handling.)
- **Aesthetics** (For projects that include bridge-building, aesthetics will be judged based on the opinion of a special committee.)
- **Secondary offers** (In some few cases points will be awarded if the bid is accompanied by secondary offers that make it possible for the client to reduce costs).

The Road Administration’s evaluation models take into account 5-6 soft parameters with 3-4 sub-parameters each. The weight of the main parameters varies between 5% and 20%. The bid total is heavily weighted (40–60%) in all the models.

Points are usually awarded with the help of guides that specify which information the bid must include in order to receive certain points. In most cases, a scale of 0 to 4 or 5 is used for every sub-parameter.

The amount of points in the bid total (if it is given points) is decided based on how much the bid total deviates from the lowest bid. The remaining bids receive points depending on how many percent higher they are than the lowest bid, on a linear scale (see Figure 5). If the contractor requires an advance on the payment, the bid total is usually increased according to a nationally established interest rate. For larger contracts a longevity factor is often also evaluated and assigned points.

![Figure 5. Example of how the bid total can be assigned points.](image)

The points are worked into a total sum by dividing the total points of each parameter by the maximum points for the main parameter and multiplying by the weight. Lastly, these points are added to figure out the *(corrected weighted comparison)*.

**New Investment**

The most common type of evaluation model in use in procurement of new investments is a function of several different parameters, P:

\[
\text{Model} = F(P_1, P_2, \ldots P_n)
\]
The model shows how the values work out to a points total, \( T_p \), for each bid; this forms a basis for decision-making when a bid must be chosen. The bid that has the highest \( T_p \) will be accepted.*

\[
T_p = \sum_{j=1}^{n} P_j , \quad \text{where} \quad P_j = \left( \sum_{j=1}^{m} a_{ij} \right) \cdot \left( \sum_{j=1}^{n} w_j \right) / \left( \sum_{j=1}^{m} a_{ij} \max \right)
\]

\( w_j \) is the weight for parameter \( j \) and \( \sum_{j=1}^{n} w_j = 1 \).

\( a_{ij} \) represents for certain \( P \) several sub-parameters (the target for the contractors to aim at). \( a_{ij}/a_{ij}\max \) is then a value of how well the target for parameter \( ij \) is fulfilled. For some values of \( P \) (the parameter for evaluating aesthetics, environmental consequences, etc.) \( a \) is a mark given by a special evaluation group, such as an aesthetics committee, for example.

For so-called hard parameters (for example investment expenses, longevity expenses or interest expenses for advance payments) \( a \) is a point that has a direct relationship to the monetary value.

As shown in the formula above, every \( P \) is divided by the maximum point total that the parameters can reach, \( a_{ij}\max \). This provides a degree of goal achievement and means, practically speaking, that the effect on the total sum that would have originated in the parameter’s point range is eliminated.

This model allows the parameters, \( P \), that the client regards as most important to have a stronger effect on the ranking than other, less important parameters (see Example 5).

**Example 5** Assuming that there are two bids, A and B, the evaluation model appears as follows:

The bid was awarded the following points:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Quality</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2. Time</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3. Price</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Both bids have received 8 points in all but A has the highest total points: A: \( 3 \cdot 0.35 + 1 \cdot 0.10 + 4 \cdot 0.55 = 3.3 \)

B: \( 1 \cdot 0.35 + 3 \cdot 0.10 + 4 \cdot 0.55 = 2.85 \)

There are other types of models used less often. In one region a model has been developed for procurement of new investment objects from general contractors in which the wishes of the customer are taken into account in a more pronounced way. In this model points are also given if the bids include secondary offers that are better than the client’s wishes. This model does not include weighting the parameters; instead, the bids are ranked according to their point totals.

Another type of model multiplies the points for respective parameters by their weights, and these products are added up to calculate the total value of the bid. The total value is then divided by the bid total, expressed in thousands of Swedish crowns. The quotients are then finally multiplied by 1000 (see Example 6).

**Example 6** Assuming that there are two bids, A and B, which received points as shown in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total pts. Bid A</th>
<th>Total pts. Bid B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competence</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Quality</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Organisation</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Traffic</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Bid</td>
<td>500 000</td>
<td>450 000</td>
</tr>
</tbody>
</table>

The total points for both bids are calculated:

\[
A: \left( \left( 5 \cdot 0.35 + 6 \cdot 0.35 + 3 \cdot 0.15 + 8 \cdot 0.15 + \right) / 500 \right) \cdot 1000 = 9.9
\]

\[
B: \left( \left( 4 \cdot 0.35 + 8 \cdot 0.35 + 2 \cdot 0.15 + 6 \cdot 0.15 + \right) / 450 \right) \cdot 1000 = 11.1
\]

* Under the condition that the ‘most economical& advantageous bid’ must be chosen.
An attempt to provide the contractors with a little more space was made in the evaluation model and calculation methods for the points of the bid total. Normally the lowest bid alone gets to receive maximum points for this parameter. Instead, the lowest bid, along with all other bids up to 5% higher, received the maximum points, raising the significance of the soft parameters.

**The Up-Keep and Maintenance Model**

Since 1996, up-keep and maintenance procurements have been made with the help of an evaluation model that verifies how well certain requirements are met. All requirements had to be fulfilled to a certain degree and the bids could receive extra points for parameters that were especially well fulfilled.

If the company fulfils some of the different parameters’ surplus requirements, a percentile deduction is made from the bid at the bid-total level. In this way, meeting the requirements especially well can have an effect on the ranking of the bid totals.

The invitations to tender ask for bids in two parts: one with the bid total and the other including additional offers and suggestions. The parts containing the additional offers and suggestions are opened first. The reason for opening the bid totals afterwards is to avoid the risk of subjective evaluations affected by the prices.

**Invitations to Tender**

In all the cases studied, it was specified that the bids be evaluated in a professional way, and that the most economically advantageous bid should be selected, which means that more than just the price of the bid must play a significant role in the process.

In general, it can be said of the descriptions in the invitation to tender about how the bid evaluations will be carried out that they are insufficient. When an evaluation model is used, it is not always provided with the invitation to tender.

In the administrative introduction to the invitation to tender, under the heading ‘Form and Content of the Bid,’ it is specified which information and documents must be enclosed with the bid. The parameters listed under the heading ‘Basis of Evaluation’ can not always be taken solely on the basis of the ‘Form and Content’ section. It is left up to the contractors themselves to decide which documents ought to be enclosed with the bid.

An empirical study of how the evaluation models are utilised in practice has been made. Some of the conclusions that can be drawn from it are that the total value of a bid can vary based solely upon which documentation has been enclosed with the bid, and that the better the client knows the contractor, the less the significance of the documentation.

**Conclusion/Continuing Research**

Alternative methods for evaluating bids have been reviewed in brief. To reach the overall goal of a more innovative construction sector, the conditions of procurement must be altered. The invitation to tender must be designed to show contractors clearly that innovative input is expected and will be rewarded. Evaluation models must be created that allow this rewarding to occur.

The evaluation system should also function in such a way that there is documented follow-up of the project results, which can then be compared with evaluation models and procurement data (see Figure 6).
Experience-based feedback will help in part when the client must choose principles for evaluation. It will also act as the basis for the creation of a new evaluation model or the improvement of an existing one.

In the next stage of the research project, selected methods for bid evaluation will be analysed and one or several model methods will be developed that are suitable for bid evaluation in contracting that encourages innovation on the part of those involved in the construction process. During the analysis, special attention will be paid to the effect of evaluation methods on innovative contributions. More concretely, one of the questions will be how much the evaluation method can encourage innovation from those involved.

As a basis for development of evaluation models, an empirical (quantitative) study will be undertaken and several interviews (qualitative) will be conducted. The analysis of current evaluation methods will also form the basis for suggestions for evaluation models that will work for the procurement of innovative projects. The suggested models for bid evaluation in innovation-oriented procurement will be duly tested in some actual construction projects, thereby testing the hypotheses.

**Figure 6. System for follow-up and experience-based feedback on project results.**

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