ANALYSIS OF PRICE CORRECTION AWARD MECHANISMS APPLIED IN THE DUTCH CONSTRUCTION INDUSTRY

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ABSTRACT. Building innovation literature and policy documents state that public clients should evaluate bids on the highest value-price ratio, but as an ongoing investigation into Economically Most Advantageous Tender (EMAT) award mechanisms applied in the Dutch construction industry shows, in practice hardly any mechanism exists that explicitly defines the total value of offers. This paper investigates that discrepancy for the so-called price correction mechanism by mapping it into the value-price model. Therefore the two options of preference determination, namely value minus price or value divided by price, need to be explored. The result of this procedure is the conclusion that with the current price correction mechanisms the total value is determined in an implicit way, and that it would be better to determine the total value of offers explicitly. Furthermore it becomes evident that with price correction mechanisms preference is based on value minus price rather than value divided by price, which is strange from a theoretical point of view.

INTRODUCTION

Background; Innovative Procurement

In 1998 an interdepartmental working group presented a plan (van der Laan 1998) with the goal to stimulate new ways of procuring in the Dutch construction industry in order to encourage the supply chain to reorganize itself into innovative clusters, which in turn should lead to projects with a higher price quality ratio. By allowing contractors to integrate their experience and expertise in bids, they are enabled and

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stimulated to become more responsible counterparts. It also implies that public clients should interfere less in details of the design and construction process. The ministries related to the construction industry embraced this vision and took several measures to implement the suggested changes. One of them was to favour and even obligate the so-called Economically Most Advantageous Tender (EMAT) award mechanisms, rather than the traditional lowest price award mechanism. Formulating an EMAT award mechanism involves scoring and combining several criteria and this area of expertise was well developed, considering numerous publications on subjects such as Operations Research and Multi Criteria Decision Analysis, which had their own journals. Despite this overview of methods (KC BPI 2004), their implementation in procurement practice was lacking. EMAT was applied increasingly in projects, but with mixed results. In order to gain and improve knowledge about EMAT and the related concept of value-based procurement, a PhD study was started. Main element of the PhD study is the analysis of applied EMAT award mechanisms. Main questions are about how EMAT award mechanisms are configured and why are they configured like that.

Problem Statement

Policy documents (RWS 2004, Min. EZ 2003, PWC 2002) as well as building innovation sources state that public clients should evaluate bids on the highest value-price ratio, but as an ongoing investigation into EMAT award mechanisms applied in the Dutch construction industry shows, in practice hardly any mechanism exists that explicitly defines the total value of offers. This paper investigates that discrepancy.

Structure of this Paper

First, the theory behind the value-price model and the relation with EMAT will be described. Then an overview of price correction award mechanisms that were encountered in practice is presented and the discrepancy between theory and practice becomes clearer. In order to describe it further, a price correction mechanism as encountered in practice is mapped into the value-price model. The assumptions that are needed to do that are presented in the methods section. This will lead to graphs, which are presented in the results section. Possible explanations for the encountered phenomena and suggestions for improvement will be discussed and that will conclude this paper.

THE VALUE-PRICE MODEL AND EMAT

A Definition of Value

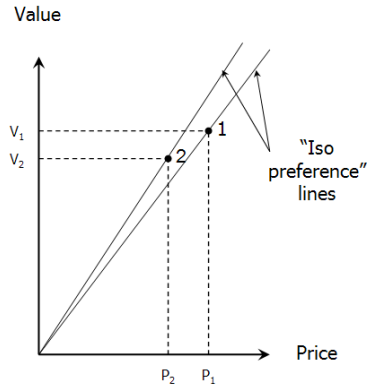
The concept of "value" is used in many contexts, so in order to prevent miscommunication, it is very important to provide a clear definition. Given the amount of literature on this subject, going back to the 17th century with economists such as Smith, Bastiat and many others, and even earlier, this is certainly no easy task. A previous study (Dreschler 2005) identified three categories of value definitions: (1) value as an absolute quantity (the sum of all desirable and positive characteristics), (2) value as a difference (the sum of desirable and positive characteristics minus the costs) and (3) value as a ratio (the sum of desirable and positive characteristics divided by the costs). In this paper the first category of value definitions is adhered. Not to impose this category, but for clarity. Using this category, the value of a construction project can be defined as "the amount in which all persons involved are influenced in their well-being as a consequence of the project". But it can also be defined as "quality for which someone is willing to pay" or "the level of desirability (according to an evaluator) expressed in monetary terms".

The Value-Price Model

In 2002 de Ridder introduced a report (de Ridder 2002) in which the value-price selection principle was explained. Later this was elaborated in the Living Building Concept (de Ridder 2006) and a model of the procurement space was added. The value-price model (Figure 1) illustrates the value for money notion, the principle that clients want to maximize the value they receive for their money.

According to value-price selection principle, customers will choose the product with the highest value-price ratio. In the example in figure 1, prospect number 2 is preferred over prospect number 1. The preference for products with the same value-price ratio is the same, as depicted by the iso-preference lines in Figure 1. For offers with the same value-price ratio the choice will have to be based on additional criteria.

FIGURE 1
The Value-Price Model and Two Iso-Preference Lines



The Procurement Space

A procurement space originates when boundaries are added to the value-price model. The procurement space is defined by a certain minimal desired value, a maximum available budget and a certain value to price ratio, which represents the "value for money" notion, see the grey area in Figure 2. Proposals located outside the procurement space will not be accepted by the client.

Selection Strategies

Clients have several strategies to their disposal to select the offer with the highest value-price ratio. These are mapped in Figure 3.

The most common strategy amongst public clients in the Dutch construction industry is to specify the object they want, ask several suppliers what it would cost to build and then select the supplier that has promised to do it for the lowest price. That strategy corresponds with arrow number 1 in Figure 3. Another strategy is to ask suppliers what they would deliver for a certain amount of money and then pick the one that has promised to deliver the highest value. In the case of a public procurement, the value determination mechanism has to be objective and stated in advance (Pijnacker Hordijk, 2004). That strategy corresponds

FIGURE 2
Model of the Procurement Space

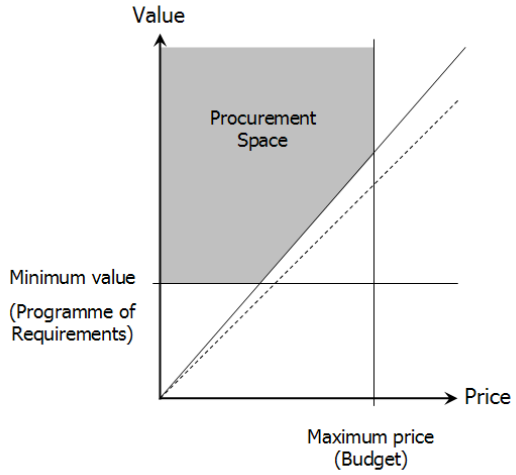
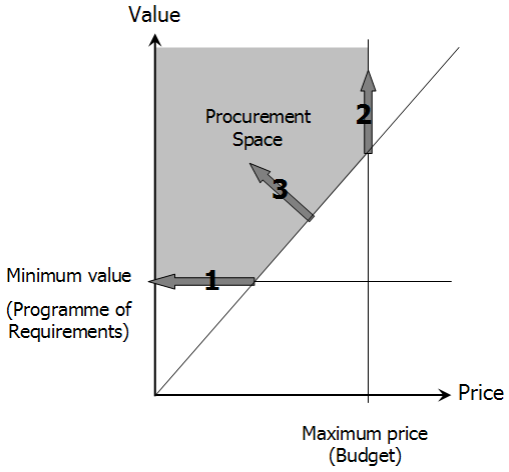


FIGURE 3
Selection Strategies Mapped in the Value-Price Model



with arrow number 2 in Figure 3. The third strategy is to allow that the value as well as the price of offers vary. That strategy corresponds with arrow number 3 in Figure 3. Again, the system that will be used in order to grade the bids has to be objective and known in advance by the suppliers.

The EMAT Award Mechanism

According to article 53.1 of Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts (European Parliament, 2004) public clients have two possibilities for awarding contracts:

> Without prejudice to national laws, regulations or administrative provisions concerning the remuneration of certain services, the criteria on which the contracting authorities shall base the award of public contracts shall be either:
>
> (a) when the award is made to the tender most economically advantageous from the point of view of the contracting authority, various criteria linked to the subject-matter of the public contract in question, for example, 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, or
>
> (b) the lowest price only. (European Parliament 2004)

The distinction between selection on lowest price and EMAT can be confusing, because the tender with the lowest price can actually be the economically most advantageous. With the selection strategies as depicted in figure 3 in mind, the difference becomes clear. The lowest price award mechanism corresponds with the selection strategy that is depicted by arrow 1, the EMAT award mechanism corresponds with the selection strategy that is depicted by arrow 3. Both strategies are aimed at obtaining products with the highest value-price ratio that the market can offer. But with EMAT the value of offers is allowed to vary. That explains the term value-based procurement. And it can be stated that the other way around a value-based procurement has to use EMAT.

Features of EMAT

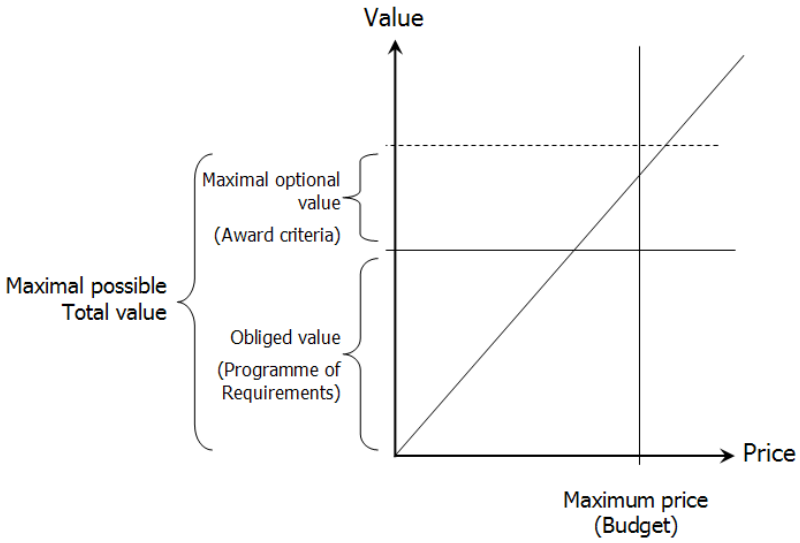
There are some important differences between the traditional lowest price award mechanism and the EMAT award mechanism. First of all, besides a fixed performance part, EMAT has a variable part in its preference evaluation formula. So where the lowest price mechanism only takes into account an obliged or required value, the EMAT mechanism takes into account an optional or compensatory value as well, as shown in Figure 4.

Secondly, in a lowest price mechanism the price is the only variable, whereas with EMAT both value and price are allowed to vary. As a consequence, in order to come to a preference in an objective and transparent way, the EMAT award mechanism needs a method for combining value and price of the offers.

Types of EMAT

Globally, three methods for combining price and value exist (Doornbos, 2005; Jansen, 2007; Dreschler 2007).

FIGURE 4
In EMAT Total Value Has an Optional Value Share



1. Point system: both value and price are expressed in points. Higher performance as well as a lower price will lead to more points. The bid with the most points is awarded the contract.
2. Monetization system: value is expressed in Euros. Two subtypes can be distinguished. The most common is the price correction system, in which optional value forms a fictive correction on the price. The bid with the lowest price after this correction is awarded the contract. Another possibility is a system in which the total value of an offer is expressed in Euros. Then the price is subtracted from the value and the offer with the highest difference is awarded the contract.
3. Division: value can remain in the unit that is chosen to express the value in, i.e. points and is divided by the price. The offer with the highest ratio is awarded the contract. Main problem is how to express the obliged value as well as the optional value.

Other systems are the two envelope system and the design contest. In the two envelope system, the value of the bids is evaluated first. Then the price envelope of the bid with the highest value is opened and if it fits the budget, it is awarded the contract. If not then the price check is repeated for the bid with the second highest quality and so on. In the design contest bids are evaluated on value only, because they all have to comply with the same budget and other contractual demands. Both mechanisms are not included in the overview of valid EMAT award mechanisms, because they do not fit in the thought of the procurement space theory. Using the two envelope system, the possibility exists that the offer with the best value-price ratio is not awarded the contract. The design contest has the same limitation as lowest price selection: the evaluation is one-dimensional. As a result, suppliers are not stimulated in finding the optimal value-price combination of their production system.

Why Focus on the Price Correction Mechanism

Monetization systems are likely to develop into the preferred EMAT award mechanism type. Literature (Jansen 2007, Dreschler 2007) and field experts state that the monetization systems deserves priority, because it is clearer for everyone involved when value is expressed into money. Furthermore, earlier research (Dreschler 2007) showed that current point systems have methodological errors. The division type of EMAT award mechanisms has the same problem as the point system type; why express value in points or some other unit, when it can be

expressed in Euros? Once value is expressed in Euros, the division type becomes a subtype of the monetization type. So the monetization type is the most interesting to investigate. However, in practice only mechanisms of the price correction subtype have been encountered for works, hence this paper focuses on price correction mechanisms and how they are configured.

PRICE CORRECTION MECHANISMS IN PRACTICE

So far, ten price correction mechanisms that were actually used to award contracts for works have been found. Six cases come from the civil sector and four from the commercial sector.

TABLE 1
Properties of Encountered Price Correction Mechanisms

Case	Object	Type PC	# Optional value items	Share	Budget
A	Waste soil depot	Com.	6 (4r+2a)	± 19%	± 50 M€
B	Bridge	Com.	2 (1r+1a)	± 19%	?
C	Highway objects	Com.	5 (2r+3a)	± 19%	6,4 M€
D	Sluice doors	Rel.	4	± 30%	?
E	Dredge works	Rel.	2	± 40%	?
F	Road renovation	Abs.	2	± 7%	± 55 M€
G	Secondary school	Com.	4 (?r+?a)	± 26%	± 2 M€
H	Educational institute	Abs.	6	± 19%	± 20 M€
I	Parking garage	Abs.	4	± 1%	± 12 M€
J	Ice skating track	Abs.	5	± 24%	± 11 M€

Table 1 presents the price correction mechanisms and their relevant properties. The first two columns state the cases. The third column presents the type of price correction mechanism that was used, abbreviated to ‘Type PC’. Three types can be distinguished, the relative, the absolute and the combined type, abbreviated to ‘rel.’, ‘abs.’ and ‘com.’ respectively. These types will be explained in the next section. The column ‘# Optional value items’ states how many (main) value

items the price correction mechanism has. The higher the number of value items, the lesser the ability of each value item to distinguish becomes. In case of a price correction mechanism of the combined type, the notation between brackets indicates how many of the value items are relative and how many absolute, indicated by the letters ‘r’ and ‘a’ respectively. The column ‘Share’ indicates the share of maximum possible optional value in the total value. It is an indicator for the progressiveness of the award mechanism when compared to a traditional lowest price award mechanism, for which the share of optional value is zero percent. Finally, the budget is given in order to give an idea of the magnitude of the projects.

Types of Price Correction Mechanisms

The relative type defines the added value as a percentage of a reference that is based on the prices of the offers. Only the average of the prices of all validated offers has been encountered in practice, although other references could be theoretically possible as well, i.e. the lowest price or some estimate of a reference value. The absolute type of price correction mechanisms does not need price information of one or more offers in order to define added value. Extra performance is directly translated into money or added value via a multiplier. The combined method uses both types. Please note that the distinction between relative and absolute value determination does not tell anything about the way performance on that value item is determined, because that can be done in an absolute and relative way as well, it merely tells something about the way performance is coupled to Euros.

Obliged Value Not Explicitly Defined

Previously (Figure 4), it was stated that EMAT award mechanisms take into account optional value as well as obliged value. However, none of the encountered price correction mechanisms explicitly defines obliged value, only the optional value is defined. Hence the hypothesis that in price correction systems the obliged value is defined implicitly.

METHODS

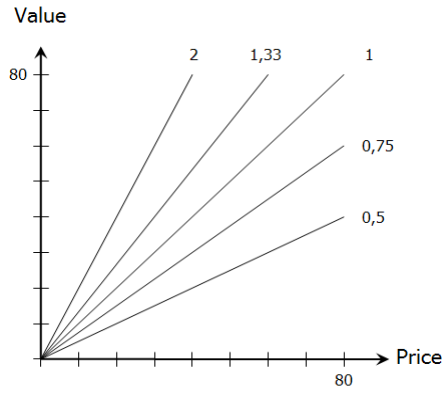
In order to test the hypothesis that in price correction systems the obliged value is defined implicitly, the principle of a price correction award mechanism will be mapped into the value-price model. To do that, some assumptions are necessary. First of all, the way in which preference

is determined needs to be explored. Literature (Jansen, 2007) states there are two possibilities: to base preference on the highest difference between value and price, or to base preference on the highest value price ratio. These two types of preference systems are represented in Figures 5 and 6 respectively by drawing their iso-preference lines. The numbers indicate the preference, the higher the better. Since there is no way of choosing in advance on which main type the price correction mechanism is based, the most likely option will be explored by mapping a price correction mechanism in both types and then compare the consequences. For these mappings additional assumptions will be made.

RESULTS

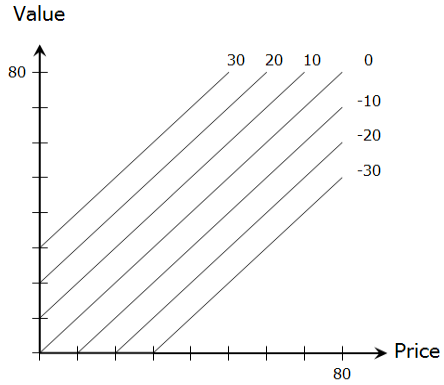
Imagine a fictive procurement with two bid, A and B. The price of offer A is 50 and the price of offer B is 70. Both offers comply with the minimum requirements and propose an equal extra performance, that leads to equal price corrections of 10. According to the price correction mechanism, these bonuses are subtracted and then offer A wins the contract, because the corrected price of A (40) is lower than the corrected price of B (60). The situation so far only involves the price dimension. Now both offers are mapped into the value price model, first for the

FIGURE 5
Iso-Preference Lines When Preference Is Based On V/P



situation in which preference is based on value divided by price, see Figure 5, then for the situation in which preference is based on value minus price, see Figure 6.

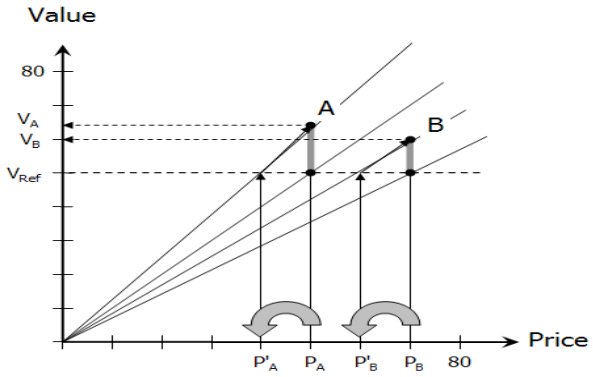
FIGURE 6
Iso-Preference Lines When Preference Is Based On V-P



Mapping of Fictive Procurement When Preference is Based on V/P

Mapping the fictive situation into the value price model under the assumption that preference is based on value divided by price results in Figure 7.

FIGURE 7
Price Correction Mechanism Mapped In V/P Model

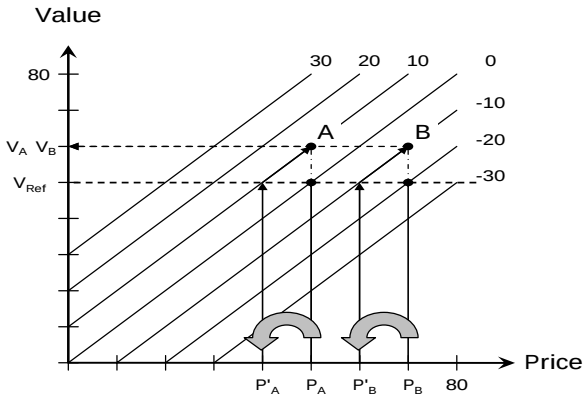


The value of the offers is constructed via the assumption that complying with the programme of requirements has some value. Both offers comply, otherwise they would not be eligible for selection. In Figure 7 this obliged value is called V_{Ref}, which stands for a certain reference value. In this case the reference value is the same as the lowest price, but some other approximation could have been taken as well. If preference lines are drawn through the intersection points of the price lines with the reference value, the obvious conclusion that the preference for offer A is higher than for offer B becomes clear. So far the model is correct. Then, via the corrected prices and new preference lines, the value of the extra performance of the offers can be calculated. Although initially both extra performances were given the same bonus, they do not lead to the same extra value. If this exercise is done the other way around, and the price correction is determined via the extra value, then the price corrections are not equal; the difference stays. Hence it appears that there is some discrepancy between the price correction mechanism and the value price model.

Mapping of Fictive Procurement When Preference is Based on V-P

Mapping the fictive situation into the value price model under the assumption that preference is based on value minus price results in Figure 8.

FIGURE 8
Price Correction Mechanism Mapped in V-P Model



The value of offers A and B is constructed via the assumption that complying with the programme of requirements has got a certain value. In this case the reference value is approximated by the lowest price, which is the price of offer A, V_{Ref} in Figure 8. There are other methods for approximating the reference value, such as the average of the prices of all bids, a price estimation based on historical data, simply taking the budget, or the method of asking a price for an offer that just barely meets legal requirements, but in this case for clarity it is chosen to adhere to the lowest price method. Both offers have a bonus of 10, which is subtracted according to the price correction mechanisms, see the thick grey arrows in figure 8. Following the iso-preference lines upwards from the intersection points of the corrected prices and the reference value, the value of offers A & B becomes clear, which is 60 for both. It becomes clear that for the preference it makes no difference if the bonuses of 10 are added to the value dimension or subtracted from the price. In other words –P equals +V, which makes sense if preference is based on value minus price. Please note that the height of V_{Ref} has no influence on the distance in preference; if another approximation for the reference value is taken, the distance in preference for offers A and B remains the same. V_{Ref} cannot be established by the mapping process. It can even be concluded that applying the price correction mechanism is a way to avoid to establish the total value; only the optional value needs to be defined.

DISCUSSION

Selection of Suitable Preference Type

In order to explore what type of preference system (V/P or V-P) forms the basis of the price correction mechanism, a fictive procurement has been mapped in both types. It seems more likely that with current price correction mechanisms, preference is based on V-P rather than V/P, because the mapping in the V/P model results in a discrepancy. The fact that public clients and their advisor choose for this type is understandable from a practicality point of view; only the optional value needs to be determined. However, from a theoretical point of view the decision for the V-P preference type seems strange, because it has been argued that for works it is better to apply the V/P main type. Using V-P could lead to the potentially strange situation in which expensive bids with moderate additional value are favoured over offers with a lower price but a higher

value-price ratio. It is therefore recommended to develop award mechanisms in which preference is based on the value price ratio. In that way suppliers will be better stimulated to find the offer with the highest value price ratio.

Consideration About How the V/P Type Could Be Made Suitable

The discrepancy that appeared in the mapping in the V/P model would not exist if the bonus was relative to the price; in that case the assumption that preference is based on V/P would be more realistic. However, as practice (see table 1) shows, the extra performance of an offer is not made relative to the price of that offer, but to the lowest price of an offer or the average price of all the offers. So it can be concluded that with current price correction mechanisms, preference is not based on the value price ratio.

Determination of Value of Complying with Minimum Requirements

The hypothesis that current price correction systems implicitly define the obliged value seems plausible because the result of mapping the bids of the fictive procurement in a two dimensional model gives a more realistic and insightful impression of how bids compare than a one dimensional picture. However, V_{Ref} can not be established by the mapping process. Additional assumptions are necessary in order to do that. The lowest price of all offers seems like a good approximation for the reference value, but some other approximation could have been taken as well, for instance the average of all price bids. Both are used in practice. Also a method was encountered that defined the basic value by making an estimate of what an offer that just barely meets minimal legal and functional requirements would cost, for the award of *service* contracts. That method is now being applied for *works* as well, but at the time of writing this paper additional information about that award mechanism is not yet available. But its existence can be seen as a step forward in the development of EMAT award mechanisms because it has been argued that preference should be based on V/P rather than V-P and in order to do that, it is necessary to define the total value rather than optional value only. The European norm of value management (NEN 2000) also indicates that preference should be based on a ratio.

CONCLUSION

Current price correction mechanisms are an implementation of the V-P preference determination main type rather than the V/P main type. Furthermore it can be concluded that applying the price correction mechanism is a way to avoid the need to establish the total value; only the optional value needs to be defined. It is however recommended to develop award mechanisms in which preference is based on the value price ratio. In that way suppliers will be better stimulated to find the offer with the highest value price ratio.

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