**TELE-AUCTION**, a service for SMEs' acquisitions

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Abstract: - **TELE-AUCTION**, an advanced e-application, was built to contribute to the modernization of the enterprises’ procurement activity. By its agency, the supply staff can organize electronic auctions for products / services / works of diverse purchasing values. The optimal choice is made upon mathematical criteria. One uses a Multi-Attribute Decision Making technique. By this technique, the amended generalized prices are conceived and are utilized in auction objects’ ranking. After a short presentation of **TELE-AUCTION** software, the focus is put on the construction and the amended generalized prices’ utilization.

Key-Words: - Decision Support Systems, E-Procurement, Multi-Attribute Decision Making, Knowledge Based Computing, WEB Based Optimization, Internet Computing

1 Introduction

In many European countries, the laws in force, or at least the deontological norms, are stipulating that marchandise goods (i.e. products / services / works) acquisitions, using public funds, must be made in the auction regime. In Romania, Communications and Information Technology Ministry owns a free of charge site for electronic auctions. The site is **m-1-n** site, a conjunction site, which joins together **m** acquirors, one mediator, in this case the National Autority for Informational Society’s Services, and **n** suppliers. The public administration, the national companies, the institutions or enterprises that benefit from public funds for their procurement activities, must use this site for the checklist of products, services and works specified by law. Automatically, a great number of acquirors and suppliers are involved in the system. Therefore, one establishes a propitious climate for electronic auctions in Romania.

It is easy to understand that, for the exceptions from the official checklist, all the above institutions and enterprises must use complementary software, another e-procurement tool. The private enterprises, mostly small and medium enterprizes (SMEs), which are always functioning on the maximization profit principle, are also interested to use such kind of software for good quality products / services / works acquisition at lowest prices [1], [2]. **TELE-AUCTION** software is designed to fulfill this special need [3]. With this specification, it is obvious that this software will equip also a **m-1-n** type site, namely a site of one auction service provider, in this case the National Institute for Research and Development in Informatics, **m** acquirors and **n** suppliers.

The software is realized upon large-scale systems’ principles. The system can manage a large number of “Objects Categories” containing “Objects” in auctions. In addition, it is prepared to support a substantial participation, i.e. buyers / sellers, and the size of the business is not a limitation.

2 **TELE-AUCTION** Presentation

The technical platform was defined as follows: PC equipped with Windows NT / 2000, MySQL Server 5.0, MSVC 6.0, CLIPS and PHP. **TELE-AUCTION** has two functional blocks. The first block addresses the site’s owner and, consequently, works on the Intranet. By means of four functions, namely, “Installation and maintenance”, “Suppliers’ objects dynamic ranking”, “Auctions automatic progress” and “Auction decisions”, the service provider creates the informatics base necessary for developing auctions. The first function is accomplishes by the site’s administrators. At the express demand of the market customs, the configuration and behaviour parameters are set. Also, the maintenance policy, mainly the reorganization of the database, is freezes now. The most important function, the core of **TELE-AUCTION**, is the second, a hidden function that dynamically ranks the competitors’ buying objects for each open auction. This is made using a mathematical technique belonging to the Multi-Attribute Decision Making (MADM) class. The third function is represented by a supervisor program, developed in the dormant technique that automatically establishes the auction progress: opening, closing, deciding, deleting.

The second block addresses the potential products / services / works acquirors or suppliers and, consequently, works on the Internet. They possess two functions, namely “Registration” and “Participation” [4]. The first function is the same for acquirors or
suppliers (see Capture 1 to Capture 4). After the software installation at the auction service provider, for the potential buyers and sellers it is possible to access the e-auction site using Microsoft Internet Explorer / Netscape / Mozilla browsers. They must register in the system and become auction site clients. If they are not members of a Public Key Infrastructure community, then the required formalities are necessary to do.

Capture 1. TELE-AUCTION’s front page

Capture 2. User’s registration
Capture 3. User’s firm

Capture 4. Firm’s bank
The last function is a participation types (buyers and sellers) / time polymorphic one. It maintains a friendly user interface, for every auction, from beginning to end. For all users, context sensitive help is available.

In the following, the steps sequence for an e-auction (preparation, registration, opening, bidding, re-bidding, closing and deciding), using this software, is presented.

To prepare the site for auctions is an easy task accomplish by site’s users in two steps. First, a buyer or a seller who is interested to introduce into the system certain objects category proceeds as in the following. By the agency of controls: Objects Category Name, Add, Mod, Del, he / she can add, modify or delete an objects category in / from a list that becomes ready to access for selection in the future (see Capture 5). Therefore the users can read this list and select one object category.

Capture 5. Objects categories’ management

Capture 6. Objects’ management
Second, only a buyer can define an object that will be both in auction condition. By the agency of controls: Object Name, Measure Unit, Quantity, Planned Price, Add, Mod, Del, he / she can add, modify or delete an object in / from a list that becomes ready to access for selection from now (see Capture 7). Do remark that the planned price, introduced by the buyers, appears afterwards only for the buyers. It represents the convenient acquisition price for the buyer. An object, belonging to a fixed category, is well defined if and only if the following information is presented: first, object name, measure unit, demanded quantity, planned price, as presented above, and second, all object attributes, specified by attribute name, measure unit, min / max (the good choice sense), lower and upper admissible limits, weight (the importance in the framework of all attributes set) (see Capture 8). It is to notice that, for every object, the attribute “price” automatically appears at the top of the attributes’ table, being always the first attribute. It cannot be erased from the table. Therefore, every object has at least one attribute, the implicit one.

The competition procedure is very simple. The object to buy, with their required quantities and attributes, are shown by TELE-AUCTION in a friendly manner. A competitor must fill-in: his object name, the bidden quantity and all required object attributes. He must pay great attention to his object description. Every attribute must be specified with accuracy because the mathematical technique for competitors dynamic ranking will be based on this kind of information. A facility to guide the attributes’ description is present. On the Internet, every attribute is sensitive; by clicking on it, a descriptive text, prepared by specialists in the field on behalf of the buyer, does not allow any involuntary mistake. The incredible situations are pointed out. On the Internet, at any time, it is possible to visualize for the competitors the values of current attributes for every proposed object.

Moreover, during the auction, for a fixed object, the system gives, to every competitor, information about its object’s attributes in comparison with the attributes of the first three ranked objects, other than the fixed object. Therefore, the competitor can improve the object attributes, hoping that his object increases its competitiveness. This facility, of comparative information for re-bidding, is not valid for the attribute “price”. Only five sessions with attributes updating are allowed, but the bidden quantity and the price are free for unlimited re-biddings. One day before the auction
closing, for the proposal that has the bidding price greater than the planned price (considered as an upper limit price), an e-mail informing about this situation is launched and from now a single price updating, is permitted. In the case that, during the auction, the organizer has stated new limits for the object’s attributes, some object’s attributes may become out of limits and, in order to stay in competition, the attributes must be updated. Updates made in response at buyer demand are not counted. Retiring from the auction is possible at any moment. This fact is a normal one and does not influence the competitor credibility for other / future auctions. In conclusion, the auction procedure is very stimulant and a fair concurrence between competitors is expected to take place.
When the auction status becomes closed, no more updates are possible. For the bid object, its final competition characteristics are done. The competitor must wait for the auction result, which appears in three days, when the auction status becomes decided.

The function “Objects ranking and auction decision” shows to managing staff the objects (competitors) ranking. In this context, the current ranking is given in a table containing: object name, offering company, merit, price, bid quantity, value and ordered quantity. With one exception, all the fields are read-only. During three days, the period that is allowed for closed status, ordered quantities column is set free for human intervention. In order to make some corrections, considered very important, the managing staff can intervene in the automatic given results. Therefore, it is possible to ignore the automatic auction decision and make a human one, but the price paid for this action is revealed by the system. It is to notice that all human corrections are registered in a special guarded database table, the envisaged elements being: operator name and position in firm, partner’ company, bid good / service / work, quantity and price, auction time and code.

When the auction status becomes decided, the competitors are informed about final auction results. A complete panoramic view is given. The winner or winners are invited, by automatically launched orders, to sign the economical contracts. Only the economic contract signing is out of the system, mainly because of the bureaucracy accepted as necessary in this field. It is possible that some potential suppliers, although invited as auction winners, ignore this fact. The next ranked suppliers are called. However, the lack of earnestness is penalized. A sophisticated penalty will be computed. This penalty depends on the value of the ignored auction weighted with the amount and value of transactions carried on in the past, the promptness in making due payments, and other elements that prove the competitor’s reliability. For the next auctions, their merit will start from a negative value. Only new winning auctions will erase, in time, this handicap. Wrong specifications of object attributes, in flagrant with the reality, will exclude for good the competitor from the partners list.

Capture 10. Competitor’s data at auction closure
3 Decisional Mathematical Technique

In this section will be shown the mathematical technique and the choice generated with this in order to gain optimality in auctions. One introduces a new economic notion, the amended generalized prices, and shows their use in the suppliers’ offers optimal ranking. For the globalized industrial enterprises, it is a step of outer importance in the activity of orders launching. The industrial enterprises must have, in their information systems, a modern component dedicated to the supply activity. It must be open, via Internet, to worldwide potential suppliers’ offers made after the offers demands’ displaying.

Following the offers submission for buying objects (defined by their characteristics, at least the prices, and the associated quantities), the generalized prices are computed using a MADM technique. In addition, another analysis of the set of buying objects and their suppliers is done using Artificial Intelligence [5], more precisely Knowledge Based Computing (KBC). Sophisticated ratios, characterizing the past buying objects’ reliability at the clients and the suppliers’ commercial behaviour, will serve to determine bonuses / penalties in the generalized prices. The ratios will make a sensible amendment to the generalized prices. At orders launching time, the offers are ranked from the best to the worst using the amended generalized prices. The smaller these indicators are the better associated-offers are considered.

Often ones heard: “This object has cost me more than its price”. It is true that, in the vast majority of cases, the price is not the economic notion to put at the basis of a correct Supply Chain Management (SCM) judgment. In offers’ ranking, is more appropriate to consider the notion of amended generalized price than genuine price that refers only to the costs and profits at suppliers, and the demand – offer balance on the market. None about the relative equilibrium between the buying objects’ quality and price, none about buying objects’ reliability in functioning at the clients and also none of the supplier’s commercial behaviour is expressed by genuine prices. In conclusion, it is economically correct to use amended generalized prices in the order launching. Obviously, the genuine prices are still used in orders editing.

After a remote-made / modified offer and its storage in the TELE-AUCTION database, a procedure is automatically started for ranking indicators’ computing / re-computing, that for all couples object – supplier in the database influenced by this transaction. Ones may run utmost 100 of these procedures at the same time, the rest,
if they exist, are ranged upon the appearing time on a
waiting queue and launched in execution when the
computer power permits. When ranking indicators' computing / re-computing are in progress, a mechanism,
that does not permit the orders launching for objects with
offers processed at this moment, is activated.

**Generalized prices**

For an object $\hat{o}$, present in a certain offer demand with
its associated needed quantity $q(o(\hat{o},i))$, and also present in a
new offer transaction, let be:
- $S(\hat{o})=\{s(\hat{o},i) \mid i=1..I\}$ (I=card(S)), the set of object’s
potential suppliers identified for $\hat{o}$;
- $O(\hat{o})=\{o(\hat{o},i) \mid i=1..I\}$, the set of potential suppliers’
objects $o(\hat{o},i)$ with the corresponding offered quantities
$q(o(\hat{o},i))$. Thus the object $\hat{o}$ represents the consistent
class of objects $o(\hat{o},i)$;
- $A(\hat{o})=\{a(\hat{o},j) \mid j=1..J\}$ (J=card(A(\hat{o}))), the set of those
attributes which are considered being of outer
importance for the $\hat{o}$ object’s good description and being
presented as compulsory to fill-up. The price is
considered the first in this set, therefore $a(\hat{o},1)$
represents the price. Associated, there are present the
attribute’s interval $\{lo_a(\hat{o},j), up_a(\hat{o},j)\}$ of standard
values, the good appreciation sense $sense_a(\hat{o},j)$, which
may take two values, max or min, depending on the fact
that $a(\hat{o},j)$ the greater it is the better is considered or the
smaller it is the better is considered respectively) and the
attributes’ absolute importance: $0<imp_a(\hat{o},j)<1$,
Sum($imp_a(\hat{o},j)$) $j=1..J=1$;
- $O(\hat{o})\times A(\hat{o})$, the characteristics $i,j$-matrix, its generic
element being $c(\hat{o},i,j)$ and representing the value of the
attribute of the object $a(\hat{o},j)$ for the object $o(\hat{o},i)$.

In the following, ones compute / re-compute, for each
object $o(\hat{o},i)$, the indicator $gp(\hat{o},i)$ that was named
generalized price. By the method presented below, the
generalized price is built taking into account the
distance to the ideal, but in other possible methods
(TOPSIS, TORDIM, ONICESCU etc. [6]) the generalized
price may represents another thing. Here is, in pseudocode,
the method that belongs to the Pareto methods’
class, method chosen for its brevity:

```plaintext
FOR i=1..I
  gp(\hat{o},j)=0
ENDFOR
FOR j=1..J
  d_a(\hat{o},j)=up_a(\hat{o},j)-lo_a(\hat{o},j)
  IF d_a(\hat{o},j)=0
    d_a(\hat{o},j)=1
  ENDIF
  FOR i=1..I
    IF sense_a(\hat{o},j)="max"
      THEN
        IF d_a(\hat{o},j)=d_a(\hat{o},j)+q(o(\hat{o},i))*wtrco(\hat{o},i)
          ELSE
            IF d_a(\hat{o},j)=d_a(\hat{o},j)+q(o(\hat{o},i))/wtq(o(\hat{o},i))*wtrco(\hat{o},i)
          ENDIF
        ENDIF
      ENDIF
    ENDIF
ENDFOR
ENDFOR
```

Amended generalized prices

The generalized prices may be computed upon the
previously defined method or a similar one. With this
specification, this is a step without alternative. But to
amend the generalized prices is upon the policy of the
local decision makers and the available information
stocked in the information system’s database and
possible to synchronic replicate in the TELE-AUCTION
statistical warehouse. It is considered as the facts base
and, in the same time, the knowledge base of a mini expert
system because encloses both the facts and the
expert knowledge through the agency of a production
rules set. The production rules are expressed by local
experts in the well known general format: IF $cond_1 \land cond_2 \land .. \land cond_n$ THEN $act_1$, $act_2$, ..., $act_k$.

Thus, this component is very flexible. The inner engine
mechanism, which is the forward chaining, performs the
productions system’s processing. The strategy
controlling the order in which the rules are fired is the
depth strategy. For illustrating the use of the expert
system in a particular case, let suppose that, for an object
class $\hat{o}$, ones find in the statistical warehouse, for
$wo(\hat{o},i) - o(\hat{o},i)$ object, the following facts: $wtq(o(\hat{o},i))$ – total quantity supplied in the past, $wtrco(\hat{o},i)$ – total
cost with object’s reliability problems at the clients,
$wtlc1(\hat{o},i)$ – total cost for 1 to 10 days delay in
supplying, $wtlc2(\hat{o},i)$ – total cost for 11 to 20 days
delay in supplying, $wtlc3(\hat{o},i)$ – total cost for 21 to 30
days delay in supplying, $wtncs(\hat{o},i)$ – total cost for not
supplying incidents. All those costs are normalized; this
means that they in natural expression are divided by total
production costs. In a simplified presentation, the generic
forms of the rules classes, which are at the basis of the
KBC, are those presented below:

```plaintext
IF o(\hat{o},i)=wo(\hat{o},i) \land wtrco(\hat{o},i)>0 THEN
  gp(\hat{o},i)=gp(\hat{o},i)+q(o(\hat{o},i))/wtq(o(\hat{o},i))*wtrco(\hat{o},i).
```
IF \( o(\hat{\sigma},i)=wo(\hat{\sigma},i) \land wtlco(\hat{\sigma},i)>0 \) THEN \( gp(\hat{\sigma},i)=gp(\hat{\sigma},i)+q(o(\hat{\sigma},i))/wtq(o(\hat{\sigma},i))*wtlco(\hat{\sigma},i) \).

IF \( o(\hat{\sigma},i)=wo(\hat{\sigma},i) \land wtlc2o(\hat{\sigma},i)>0 \) THEN

\[ gp(\hat{\sigma},i)=gp(\hat{\sigma},i)+q(o(\hat{\sigma},i))/wtq(o(\hat{\sigma},i))*wtlc2o(\hat{\sigma},i) \]

IF \( o(\hat{\sigma},i)=wo(\hat{\sigma},i) \land wtlc3o(\hat{\sigma},i)>0 \) THEN

\[ gp(\hat{\sigma},i)=gp(\hat{\sigma},i)+q(o(\hat{\sigma},i))/wtq(o(\hat{\sigma},i))*wtlc3o(\hat{\sigma},i) \]

IF \( o(\hat{\sigma},i)=wo(\hat{\sigma},i) \land wtnsco(\hat{\sigma},i)>0 \) THEN \( gp(\hat{\sigma},i)=gp(\hat{\sigma},i) \).

IF \( o(\hat{\sigma},i)=wo(\hat{\sigma},i) \land q(o(\hat{\sigma},i))>q(o) \) THEN \( gp(\hat{\sigma},i)=gp(\hat{\sigma},i)-0.02 \).

IF \( o(\hat{\sigma},i)=wo(\hat{\sigma},i) \land q(o(\hat{\sigma},i))<wtq(o(\hat{\sigma},i)) \land wtrco(\hat{\sigma},i)+wtlco(\hat{\sigma},i)+wtl2co(\hat{\sigma},i)+wtnsco(\hat{\sigma},i)=0 \) THEN \( gp(\hat{\sigma},i)=gp(\hat{\sigma},i)-0.05 \).

When the process of rule firing stops, the following transfer is made:

FOR \( i=1 \) TO \( \imath \) DO

\( agg(\hat{\sigma},i)=gp(\hat{\sigma},i) \)

ENDFOR

If the users have working knowledge of artificial intelligence, they can extend the rules set by adding rules on their own, as conceived for the plant’s specific supplying politics.

The first five production rules are penalties and the rest are bonuses. They amend the generalized prices obtaining amended generalized prices \( agp(\hat{\sigma},i) \), which are stocked in the database. It is to notice that, in the absence of a warehouse stoking the statistical information for amended generalized price computing, the generalized prices will be stocked in the database as result.

Amended generalized prices’ use

The offers entity, in the database, being ranked ascending upon the key representing the amended generalized price, it is always ready for the operation of orders launching. For every buying object, at every moment, ones can launch the supply orders. To fulfill the necessary quantity, frequently ones appeal to more than one supplier offer. The statistical record of the offers accepted or not, makes it possible that reconsider rejected or postponed offers, in the case the necessity requires. Moreover, on this basis, the Marketing Department can conduct market surveys. As a remark, even if a buying object may seem to be mathematically optimal, for personal reasons in decision-making or for reasons of never wishing to abandon a traditional partner, a lower-level object may be picked out. It is worth knowing that, in conformity with the plants policy and market situation, buying objects’ prices may fluctuate in time or even more, may be artificially increased by suppliers if the market tends to run short of these.

However, having a tool like TELE-AUCTION it is possible to keep in hands the situation and to make mutually advantageous business.

4 Conclusions

Extending worldwide the business of an enterprise is one of the globalisation commandments. Another one is to promote mutual advantageous business. To support these, the Internet created the base for a new range of applications. In our days, e-applications undergo a fast development. Web enabled optimization is a new trend in treating the complex business problems. TELE-AUCTION is capable to support mutual advantageous business. This is possible by making use of advanced optimization techniques. The strong point of TELE-AUCTION software consists in the fact that the competitors ranking is automatically made using a MADM mathematical technique.

TELE-AUCTION software contributes to the modernization of the procurement activity. Its capabilities related to genuine business make it suitable to contribute to the invigoration of the commercial climate. With this software, the enterprises may become more active on the world market and savings in the acquisition process may represent appreciatively 25-30% from the total cost.

References


