
Decision Making on the Internet: Approach of Verbal Decision Analysis

Verbal Decision Analysis in the Internet Age

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ABSTRACT: Existence of the Internet provides a new opportunity to develop Decision Support Systems (DSS) of a new type: they are to support decisions not only for one Decision Maker but for many people visiting the Web. To be helpful and attractive for people such systems must have specific characteristics. The paper is trying to demonstrate that the approach of Verbal Decision Analysis is a promising way to construct DSS meeting some special requirements needed for effective decision making on the Internet. Two examples of DSS are given: DSS for the choice of the best configuration of CAD/CAM system and DSS for knowledge acquisition in big corporations

KEY WORDS: multiple criteria decision making, verbal decision analysis, CAD/CAM system choice, decision support systems, knowledge acquisition in a corporation

1. Introduction

The Internet created new possibilities for a human being in different fields of his/her activity in everyday life. There are new opportunities in decision making. Many business and private problems can be solved now via the personal computer connected to the Internet.

It is possible to find practically everything on the Net. Thus the problem of selecting from the set of alternatives the best one becomes more urgent for the Buyer. Thus the problem of the analysis and selection of an optimum policy of behaviour in the market becomes more urgent for the Seller. It is possible to say that the problems of the theory and methods of decision making where the specialists in this area were engaged for many years have gained a new light.

In the paper we consider some practical problems requiring specific tools for its solution on the Internet. Then we present the possibilities of Verbal Decision Analysis (VDA) for multiple criteria choice problems. Giving examples we demonstrate how to solve some problems using VDA tools (Larichev and Moshkovich, 1997).

2. Practical Examples

2.1. Example 1: expensive purchasing

As is known, the Internet is now overflowed by proposals for selling different goods. In the case of frequently purchased goods (products, books, etc.), the analysis of data arrays on sales can help to establish representative features of the particular groups of buyers and define a policy of sales, oriented at these groups.

Quite different is a case of expensive and rather infrequent purchases. In this case a buyer does need a support in decision making. The support is needed to elicit preferences of a customer, to analyse all numerous alternatives with allowance for budget and other limitations. One of the practical examples of such problems is selection of an automated design engineering system (CAD/CAM/CAE systems) (Afanasiev and Chugunov, 2001).

These expensive systems are indispensable for effective activity of many firms. The IT executives of firms, as a rule, are crowded with information and cannot always take into account all the features of the firm, make a justified selection from a set of proposals.

A decision support system (DSS) therefore is needed. DSS helps to set relative priority among the problems to be solved with the aid of CAD/CAM system and, sorting out the numerous alternatives, makes a choice without violation of the given budget limitations.

2.2. Example 2: decision making in big corporations

Nowadays many corporations have branches located in different countries or at long distances within the same country. From time to time important decisions are to be made on the basis of the best manager experiences. The organisation of meetings in the central office of a corporation is a costly decision.

The different solution of a problem is DSS development that can provide a corporation chairman with the possibility to state a problem for all valuable managers of a corporation, collect the variants of solution and some estimates of these variants.

Thus in a way effective decisions would be developed on the basis of the decision maker's preferences and suggestions of a corporation's best managers.

3. Features of decision making problems on the Internet and requirements to DSS of a new type

As is known and usual for decision making problems, the situation is characterised by availability of a decision maker (DM), consultant in decision making problems and DSS, used by the consultant in the process of a problem analysis (Keeney, 1980).

In case of decision making on the Internet one of the three components of this representative situation - the consultant, is absent. Therefore the additional requirements to effective DSS on the Internet are to be put forward:

- the dialogue DSS-User must be easy and clear. All problems should be described in a simple and understandable language without using any quantitative indicators unknown to the User. In the same way graphical representation of information should be applied (Lotov et al., 2001)
- the dialogue DSS-User should be psychologically correct. This means, that capabilities and limitations of a human information processing system must be taken into account (Larichev, 1992)
- any advice given by DSS should be accompanied by explanation in a language understandable to the User. This means, that any transformations of information obtained from the User should be "transparent" and clear.
- DSS should have intellectual features: it should comprise the knowledge of the past solutions.

4. Approach of the Verbal Decision Analysis

The approach of the Verbal Decision Analysis meets many requirements from those formulated above (Larichev and Olson, 2001). It is possible to formulate the main features of this approach as follows:

- psychologically valid measurement of factors which are important for decision making
- psychologically valid way to elicit information to construct a decision rule giving the possibility either to rank the multiple criteria alternatives, or classify them, or select the best one. A mathematical foundation is provided for the mode of using DM information for the construction of a decision rule
- possibility of checking the decision maker's consistency; errors and contradictions are presented to DM for analysis and correction
- possibility for gradual development of a decision rule
- possibility for getting explanations.

The first, the third and partially the fourth features of VDA have a psychological foundation. The second one has both a mathematical and psychological foundation. The fourth and the fifth VDA features concern organisation behaviour.

At present, the family of VDA methods oriented at different practical problems is designed. Here we mention some of them:

- methods of ranking multicriteria objects: methods ZAPROS I, II, and III (Larichev, 2001).
- methods of multicriteria objects allocation into several classes, ordered on quality: methods ORCLASS (Larichev and Moshkovich, 1997), CYCLE (Larichev and Asanov, 2000), SAC (Larichev et al., in press).
- methods of selecting the best alternative from the given set: PACOM (Larichev and Moshkovich, 1997) and ASTRIDA (Berkley et al., 1991).
- method of multicriteria assignment problem solution (Larichev and Sternin, 1998).
- method of multicriteria objects bin packing (Larichev and Furems, 1987).

The development of DSS for the Internet allows claiming not only many from these methods, but also combinations of different methods could be used.

5. DSS for CAD/CAM system choice

In order to make a prudent choice of CAD/CAM system DM should perform a large volume of analytical activity: it is necessary to define, what system and what configuration will increase best off all the efficiency of the firm's activity. In most cases this problem is extremely difficult. DSS for CAD/CAM system choice is under development in the Institute for Systems Analysis.

5.1 The statement of the problem

There are two main characteristics for the firm profile. The first one is a set of business processes to be automated (for example, product design, product documentation preparation, co-operation with suppliers, etc.). The second one is the budget the firm is able to spend on CAD/CAM system installation and support.

The core and the modules of CAD/CAM system are characterised by their functionality and the price. For automation of each business process there exists a corresponding CAD/CAM module. One should note that a module could be used to realise more than one business process.

The problem is to select the platform and the configuration of CAD/CAM system, which is able to meet the needs of the firm best off all, provided that the imposed budget limitations are not exceeded.

5.2. The main ideas of the problem solution

The principal scheme for DSS under consideration is given in Fig. 1.

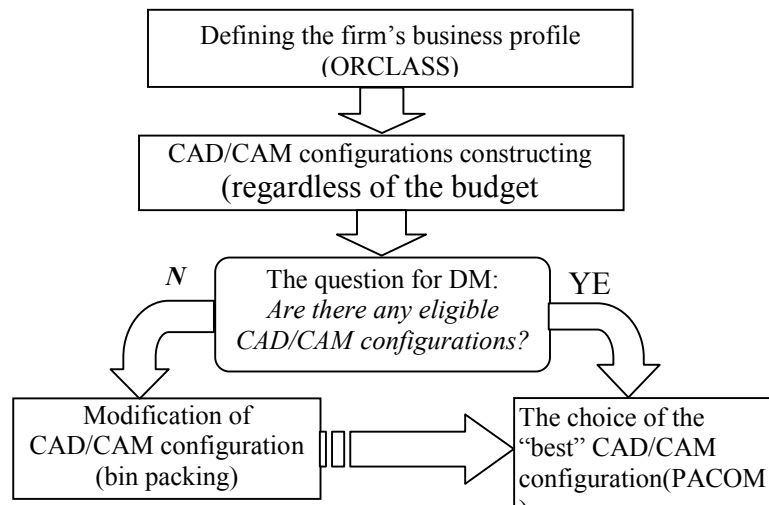


Figure 1. Block-scheme for the DSS algorithm.

First of all, the combination of business processes crucial for the given firm should be specified with the aid of DM. By definition we treat a business process as "crucial", "critical" or "key" process if its quality of implementation has a strong influence on the efficiency of the firm's activity.

The degree of the firm's readiness for automation essentially influences a set of eligible CAD/CAM systems. There is no point to install a large-scale CAD/CAM system for the firm without automation experience and well-qualified staff. The classification of the firm's degree of readiness for automation could be implemented by the method ORCLASS (Larichev and Moshkovich, 1997).

There is a relationship between the set of CAD/CAM modules and the set of business processes. On the basis of the correspondence between the set of business processes and the set of modules specified by the expert, configurations for all CAD/CAM platforms included in the list of those potentially eligible by DM are constructed. Each configuration is to realise the maximum number of key business processes.

At this point DM can make a choice of the best CAD/CAM configuration from those constructed. In case if none of the configurations available at the given stage satisfies DM, the configurations can be modified and presented to DM again.

On the basis of expert information about the number of the key business processes covered by CAD/CAM modules it is possible to rank the modules of each CAD/CAM system by their importance for the particular DM.

In order to find the best combination of the modules satisfying the budget limitation for every particular CAD/CAM platform, DSS module for multiple criteria objects bin packing (Larichev and Furems, 1987) can be used. Thus, the "best" CAD/CAM configuration without exceeding the budget limitation can be constructed for each CAD/CAM platform from the specified list. The last step is to make a choice of the best one. The method PACOM (Larichev and Moshkovich, 1997) can be used.

Finally, DM (a representative of a firm) visits the web-site of DSS for the choice of CAD/CAM system, gives the characteristics of the firm and makes a final choice among several good alternatives.

At the all stages of the process the usual language is used without any transformation into marks or scores. The preference elicitation processes are within the bounds of human information processing system possibilities. At every stage of the process an explanation of choice can be provided on the basis of previous information given by DM or experts.

6. Decision making in large corporations

It is possible to develop DSS of general nature to find effective decisions in a big corporation on the basis of a decision maker's preferences and experience of the corporation's best managers working at different locations. Let us note that the most important for corporations are so called unstructured problems (Simon and Newell,

1958) verbally described in the language of DM and his staff. That is why VDA approach is quite effective tool for such problems.

From a methodological point of view one has here a new type of decision making problems. It combines the features of individual and collective decisions. DM (the head of corporation) has his personal perception of a problem and ways of its solution. But he wants to include the experience and intuition of other leaders of a company into decision process.

The new DSS “VETCHE” is developed for the purpose. It includes the working place for DM and those ones for the participants in decision process.

The process of a problem solution can be presented as a sequence of three stages (see Fig.2).

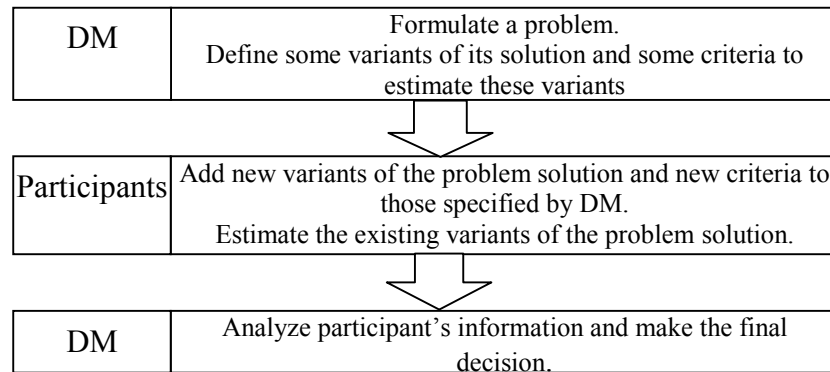


Figure 2. The scheme of “VETCHE” DSS algorithm

6.1. Stage 1. A problem definition by DM

At this stage DSS allows DM to define the problem of importance for a corporation and give a commentary explaining its essence and importance for the corporation. All definitions can be done in a verbal way, in the language accepted by the executives of the corporation.

Then DSS asks DM to nominate some possible alternatives for problem solutions and to reveal some criteria for them. Some of them can be made obligatory for evaluation for every participant at the stage of personal alternative evaluation. It is possible to add a commentary for each alternative.

In the dialogue DSS-DM the initial structuring of a problem is demonstrated as a set of verbal presentation of alternatives, verbal description of criteria having ordinal verbal scales of estimates and a set of commentaries to present this structure to the participants.

As the output of the first stage each participant receives the task to analyse the problem together with a preliminary list of alternatives and criteria.

6.2. Stage 2. A problem solution by a participant

At this stage a participant should analyse the problem proposed by DM for the analysis; add new alternatives of the problem solution; add new criteria of alternatives evaluation; add his personal commentaries on alternatives and criteria; order the criteria by the personal importance in the evaluation; give the evaluation to obligatory alternatives and evaluate his/her own alternatives on the set of criteria given as obligatory by DM and additional criteria added by himself/herself; check and correct the order of alternatives on each criterion scale.

After receiving a participant's information DSS tries to rank the alternatives. The ranking of the alternatives is performed on the basis of the participant preferences. Taking into account the relatively small number of the alternatives, the procedure of pair-wise alternative comparison seems to be a reasonable one.

The following rules are used in pair-wise alternative comparison:

Rule 1. If the alternative A_i has by all criteria estimates not worse than the alternative A_j and at least for one criterion the estimate of A_i is better than that of A_j , then the alternative A_i is more preferable for a participant.

Rule 2. If alternative A_i has more preferable estimates for more important criteria than alternative A_j does, then alternative A_i is more preferable for a participant.

Rule 3. In the cases when Rules 1 and 2 could not be used, the alternatives are incomparable.

On the basis of the rules a graph can be constructed on the alternative set. One can select the sequences of kernels for the graph in the same way as it is proposed in ZAPROS method (Larichev, 2001). For example, the first kernel includes non-dominated alternatives from the initial set. The second kernel includes non-dominated alternatives from the graph received by the elimination of alternatives of the first kernel, etc.

One could assign to each alternative a rank corresponding to the number of kernel for this alternative.

As the output of the second stage each participant sends to DM the results of his/her personal analysis.

6.3. Stage 3. The final analysis to be done by DM

At this stage DM receives all information from the participants. DSS tries to help him to find a collective decision for the participants.

In case the best alternative cannot be selected, DM can analyse all the data from the procedure participants. He can analyse the commentaries given by the participants, look for new ideas and points of view. Finally, DM makes his own choice using the PACOM method (Larichev and Moshkovich, 1997) or the decision can be made according to one given by the participants.

We would like to stress that all analysis is done in the language natural for DM and participants without any transformation of estimates into scores or marks. Only simple for DM pair-wise comparisons of estimates are used in the framework of PAir-wise COmpensation Method (PACOM). The explanations of choices made by participants are provided by their commentaries. The suggestions given by participants reflect their experience in the solution of similar problems.

As a result of the third stage there is either the best alternative for the participants or detailed analysis of different participants positions (Larichev et al., 2002).

7. Conclusion

In this paper we presented two systems which are to demonstrate a number of methods for DSS application in the Net.

The first DSS presented is available for *any user* who is interested in CAD/CAM; the support in choice of CAD/CAM configuration is treated on the basis of the set of key business processes to be specified by DM. The possibility to modify the configuration of interest is available. The system uses advantages of the Net and at the same time it provides an individual support for each particular user according to DSS ideology.

The second way of Verbal Decision Analysis implementation is illustrated by the system, which provides the possibility in special information exchange via the Net in terms of the particular community. From our point of view the joint problem solution via Internet is the promising way to collect the knowledge. Managers share the experience and practical knowledge while solving important problems together. DSS can collect the results of decision processes, analyse them and present as examples during next attempts to solve important practical problems.

The need to support personal and business decision making on the Internet creates the serious challenge to existing tools in Decision Making field. To meet these growing requirements it is necessary to develop decision methods and DSS helpful and attractive for people.

The approach of Verbal Decision Analysis is a promising step in this direction.

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