

THE IMPROVEMENT OF MANAGEMENT IN AGRICULTURAL EXPLOITATIONS USING DECISION SUPPORT SYSTEMS BASED ON DATA MINING TECHNOLOGIES

A. MUNTEANU, A. COJOCARIU
Cristina Ofelia STANCIU

Universitatea „Tibiscus”, Timișoara
e-mail: a_munteanu@yahoo.com

The management process within the agricultural exploitations is going through important changes due to the large amount of data that exist within any organization. This large amount of data can no longer be handled by human individuals and the involvement of information and communication technologies in this field is a must. A series of decision support systems are not just simple integrated computer tools, as they embed artificial intelligence techniques, thus resulting intelligent decision support systems. If for the structured, programmable decisions things are pretty distinct, as there is a preset algorithm for solving the problem that can be applied every time, the non-structured decisions, for that there is no preset algorithm for their fundamenting, the system must be able to reproduce a similar way of thinking to the human one, issue that can be achieved through artificial intelligence techniques, especially since this domain of artificial intelligence is developing very fast and is leading to spectacular outcomes. For the data to be useful, one must extract information and knowledge, and this is the phase that Data Mining technologies become very useful in finding patterns by using prediction techniques. Data Mining proves to be highly important throughout the decision-making process from an efficiency point of view as well as from a time-consuming one. Data Mining technologies, due to their characteristics, are very suitable to analyze large amount of data. Data Mining is aiming to discover patterns within data sets, while other analytical technologies, such as queries, statistical analysis systems are not able to, and OLAP tools are based upon verifications, which prove to be limited.

Keywords: *agricultural exploitations, decision support systems, intelligent systems, Machine Learning, Data Mining, OLAP tools .*

The management process within an agricultural organization that is developing its activity in competition and ever-transforming economical, technological and social parameters conditions, has been through a number of crucial modifications, thus being imposed the usage of computer technologies as decision support systems that can determine an efficient focus of physical effort, in other words, *working smarter*.

By decision support computer system we describe a computer instrument that has a goal of supporting managerial process through sustaining the decision-

making process. [4] In the previously mentioned conditions, using a decision support computer system on the agricultural production management level can be implicitly noticed, as a part of the whole managerial system.

The decision-making process is an assembly of activities performed by one or more individuals facing an event that creates multiple action possibilities, pursuing the choice of the best option, matching the deciders' scale of values [4].

MATERIAL AND METHOD

The decision-making process is considered to be a part of a larger scale process, the process of solving a problem. The decision-making process refers to choosing one of more given options of action, while the process of solving a problem has a wider definition, definition that includes first the realization of the problem's existence, the interpretation and diagnosis of the problem and later the implementation of the solution considered to be the proper one.

The decision-making process consists of a number of stages and phases, and the structure of the decision-making process derives from this number and from the succession of these stages. Figure 1 depicts the three main stages of the decision-making process, each of them containing one or more phases.

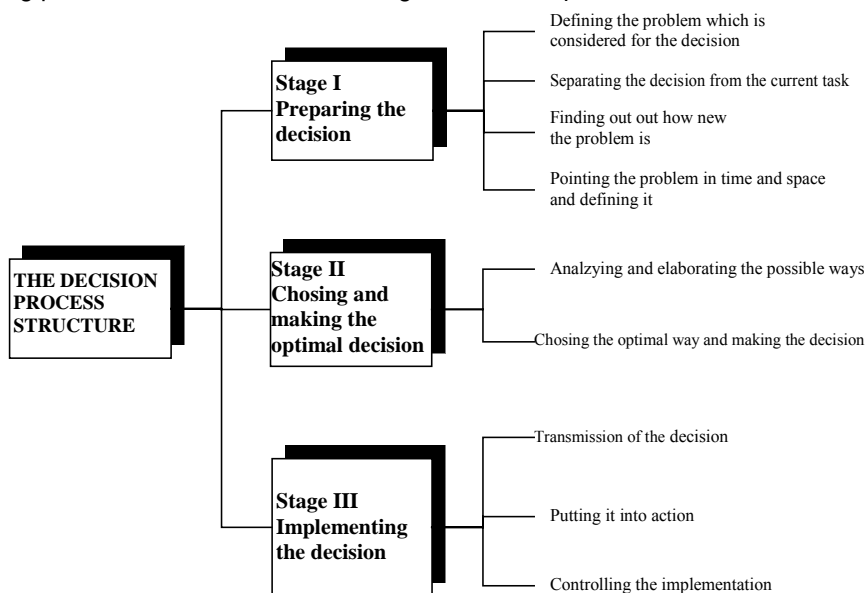


Figure 1. **The structure of the decision-making process**
(from: ZAHARIE, D., et al., 2001)

The agricultural field of work must be gifted onwards with increased attention because this is playing a vitally important game within the rural activity, the population coverage in the rural areas, the environment management etc., thus decision support in this particular field of work must be sustained at least as strong as in any other. It must be well understood that decision support computer systems, likewise computer instruments, can significantly improve the quality of decisions and implicitly come with performances in the entire agricultural section.

Designing a decision support system is not quite easy, for this purpose being necessary to precisely determine the deciders, the decisions they are responsible with and the necessary information for fundamenting these decisions. In this process occurs the difficulty of gathering all this information, especially because the complete information in most fields of work cannot be found as a centralized whole. Thus the necessary effort for designing and developing decision support systems is considerable.

In order to obtain the best outputs, the agricultural producers must have in mind a series of variables, like: the market requests, costs, elements and resources of the agricultural production etc. Lowering production risk can be achieved by a correct organization and usage of available information, through decision support systems, since information remains the main resource for increasing the production, given that, for example, the fact that out of environment protection reasons, using pesticide is more and more limited through legislation.

RESULTS AND DISCUSSION

The interest for computer-based solutions of the ones involved with agricultural activity, to be more specific, of managers of agricultural exploitations, is not as high as expected, given that the funding these have access to are barely enough for performing daily activities, as most of the times buying a computer system and a software package is out of the question, even if these would bring along a significant efficiency increase of activities within agricultural organizations. It can safely be stated that a decision support system in the agricultural field of work cannot confirm its utility unless it brings its contribution to maximizing the income of agricultural exploitation.

If it were to seek out the main motives the agriculturists avoid decision support systems, these would be:

- lack of computer systems within agricultural organizations;
- the limitations of decision support systems and even the wrong solutions they can offer if the used data bases are not updated;
- the complexity of these systems, given that supplementary training is required for their usage;
- the impossibility of assuring complete input data for the systems to work on;
- the blurriness of the benefits such a system can offer.

These motives that harden the usage of the decision support systems may be resolved if the ones developing such a system would adopt a user-focused approach, by encouraging implication of the future possible users in the system development process, this actually being one of the secrets that would apply to any successful computer system.

The process of development decision support systems must be aware of the particularities of each organization, because these affect the design and implementation of complementary software components. The conclusive element in building a decision support system is represented by the capability of future users to distinctly explain the input elements and what is there expected from the

system. Many times the attempts to build computer systems of any kind fail exactly because of the users, as these often have impossible requirements, without a strong touch of reality, plus they have the tendency to add various modifications without foreseeing the impact these changes can have upon the structure of the system as well as upon the afferent costs, that can considerably increase. Also, modifications to requirements of a computer system will determine the forward shifting in time of the date the product will be ready. This is why the new tools for developing software systems offer larger flexibility, meaning they permit a deeper collaboration between the future users and the developer, the outputs being the faster and more efficient system development.

There are already decision support systems that are successfully used in economic developed countries, although even these still prompt some limitations, like the ones related to the amount of available information or to the lack of talent or know-how that a good manager can dispose of in making the right decision.

Decision support systems don't necessarily take the shape of a complex and hard to design and develop computer system. For example, there is the decision support system known as *Agland*, successfully used in the U.S.A., system that can increase efficiency in terrain usage within an agricultural exploitation. The system uses a few Microsoft Excel worksheets with some relations between them, based on some buttons. The user is prompted with a menu that allows entering new information, new rules and retrieving the solutions to different problems.

Another used software tool is DSSAT (Decision Support System for Agrotechnology Transfer), that proves itself useful to managers in agricultural organizations when making operational and tactical decisions, developed by the International Consortium for Agricultural Systems Applications.

The NADSS (National Agricultural Decision Support System) represents a collection of decision support computer tools that permit risk prediction like those related to climate indicators, duration and intensity of precipitations etc.

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Figure 2 shows the elements that must be found within the decision support system of an organization that is using high technologies. According to the organizations complexity, some of the elements may or may not be present.

Data Mining technologies, due to their characteristics, are very suitable to analyze large amount of data. Data Mining is aiming to discover patterns within data sets, while other analytical technologies, such as queries, statistical analysis

systems are not able to, and OLAP tools are based upon verifications, which prove to be limited.

The collecting of data that reflects an organization’s activity has become vital in order to achieve competitional advantage. The medium and large companies have made investments into computer based systems that collect data and are able to manage very large data bases. The main task these systems have to successfully fulfill is knowledge discovery that follows after the reasoning upon the information that results from the collected data.

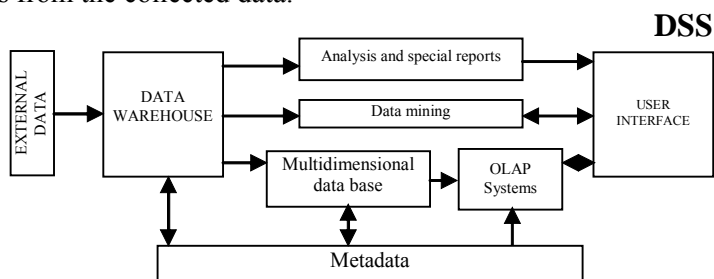


Figure 2. The elements within the decision support systems of an organization that is using high technologies

The large amount of data is outrunning the human processing capacity, also in order the decisions to be correctly grounded, systems that are using Machine Learning technologies are required. These systems allow the discovery of patterns at the very level of unprocessed data, providing different results that can be used within the decision support systems but can also be used by the human analyst.

The Data Mining process consists in four important phases: data collecting, data preparation, pattern discovery and pattern analysis. Data collecting phase involves overtaking data from different sources, and considering that this data could be heterogeneous, the preparation phase will normalize the data and represent it in structures, in order to facilitate the data use. The data identified after certain characteristics during the previous phase is extracted and afterwards formatted, so the data will be represented in the form that the Data Mining application requires. The discovery of new patterns follows from applying Data Mining technologies upon the selected data.

Patterns established by Data Mining technologies that are generated using prediction techniques prove themselves to be highly important throughout the decision-making process because they bring to light various aspects that can lead to an improvement of the decision-making process, from an efficiency point of view as well as from a time-consuming one.

Regarding software systems designed for Data Mining, these have been divided in two categories: Data Mining tools and Data Mining applications. The Data Mining tools offer techniques that apply in any situation and for every given problem. Data Mining applications are the ones “encapsulating” Data Mining techniques within an applications designed for solving a specific problem. This

separation does not imply that one of the categories is less important and requires less of the organizations' attention.

Data Mining tools must ensure some level of flexibility and a great accuracy in order to improve the efficiency of Data Mining applications. Given the fact that existing data differ from one organization to another, it is difficult to develop a technique that would help acquire the optimum results for any given organization. Data Mining tools are flexible from this point of view and allow combining of techniques in order to improve the accuracy of the desired outcome.

CONCLUSIONS

Nowadays, computer based information systems that are using Data Mining technologies are able “to learn” from the previous behavior of the considered elements, and based on the knowledge following from the “learning process” they are able to make hypothesis which they will be testing. The knowledge that proves to be valid and useful can be integrated within the decision support systems from agricultural exploitations, in order to be useful to the decision makers and assist them in making the right decision.

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