

# WHERE DECISION SUPPORT SYSTEMS AND MACHINE LEARNING TECHNOLOGIES MEET

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## **Abstract:**

*The use of computers in any domain is a widely recognized fact and it has been impossible not to ask whether the computers' capacity to learn wouldn't increase their utility. The answer would be that as the learning capacity increases, the impact it determines is spectacular. The aim of the intelligent technologies approach in developing decision support systems has been the use of human reasoning to find solutions for complex decision problems, but also to gain extra knowledge within the organization, in order to increase the quality of the management process. The idea that intelligent systems could solve tasks that were until recently considered to be exclusively human has drawn the researchers attention, and the number of applications in the artificial intelligence field has increased and being materialized in new technologies. One of these technologies, determined by the interest in systems that are capable to learn similarly to the human beings is the Machine Learning technology. Machine Learning technologies based systems do not eliminate human intuition, but a collaborative approach between the human being and the machine is preferred, and this would be an important reason to use these technologies for the development of modern decision support systems.*

**Key words:** decision support systems, Machine Learning, artificial intelligence

**JEL classification:** D80, M15

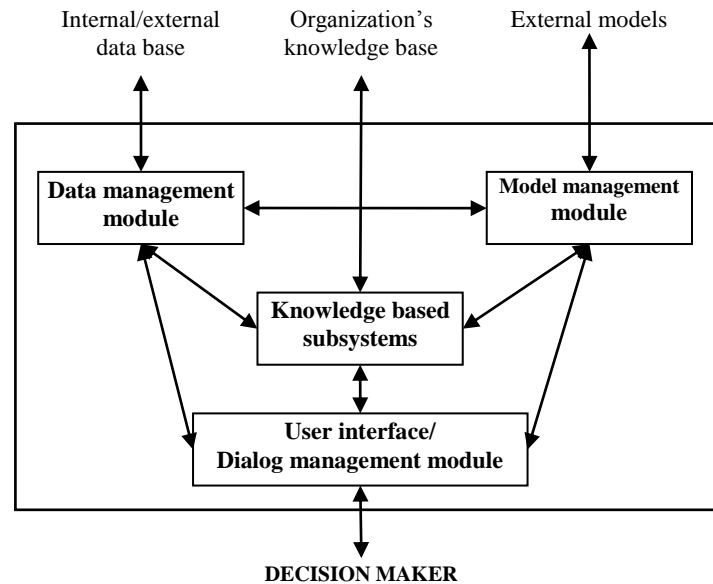
The success of any organization depends in many ways on the decisions of the persons from different management levels, and in the current economic and social conditions making decision has become a difficult task. If initially decision making was considered in management theory an exclusive human activity, as a result of the increase of data quantity and the difficulties in managing and processing it, the decision process is supported by information and communication technologies. This fact has led to interdisciplinary approaches within the decision study, and to the computer based decision support systems.

The role of the decision support systems is to support managers in their approach of the complex environment and in the situation regarding to which the decision has to be made. An important step in accepting these systems, which lead to their development in time, has been the understanding and acceptance of the idea that these instruments do not intend to replace the human decision maker, but to support and assist him.

Given the development of the knowledge society and the knowledge based organizations, the management problems' complexity has been increasing, and the computer based decision support systems have been developed using artificial intelligence based solutions. The aim of the intelligent technologies approach in developing decision support systems has been the use of human reasoning to find solutions for complex decision problems, but also to gain extra knowledge within the organization, in order to increase the quality of the management process.

Nowadays, the components of decision support systems are very much like the ones identified by Sprague in 1982 (Figure 1): user interface; knowledge based subsystems; data management module; model management module.

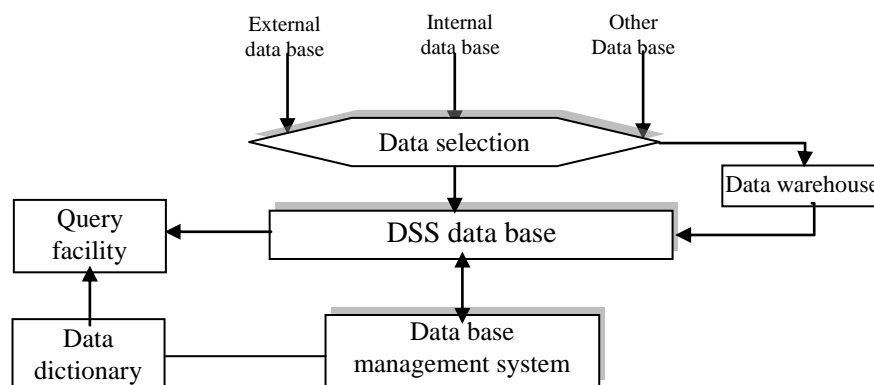
The user interface is a component that provides the communication between the user and the decision support system. The proper design of this component is really important, as it is the only one the user actually deals with.



**Figure 1.** Decision support systems' components  
(Adapted after [Lungu03])

The data management method is a subsystem of the computer-based decision support system, and has a number of subcomponents of its own (Figure 2.):

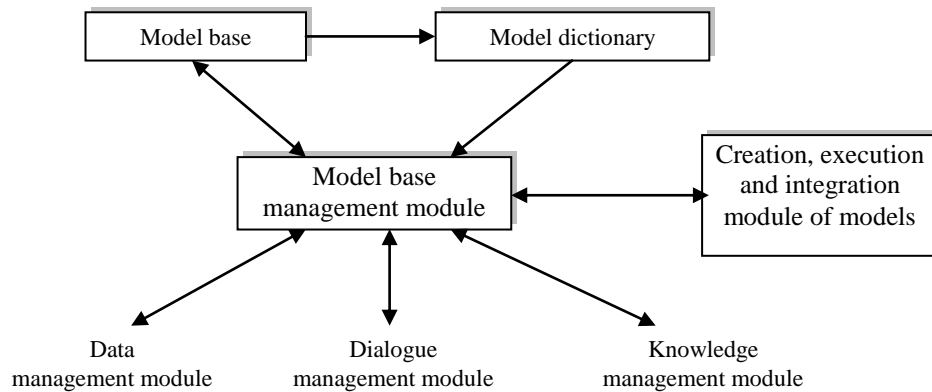
- the integrated decision support system database, which includes data extracted from internal and external sources, data which can be maintained in the database or can be accessed only when is useful;
- the database management system; the database can be relational or multidimensional;
- a data dictionary, implying a catalog containing all the definitions of database data; it is used in the decisional process identification and definition phase;
- query tools, assuming the existence of languages for querying databases.



**Figure 2.** Data management module  
(Adapted after Turban 2001)

The model management module consists in the following components (Figure 3):

- the model base, that contains the quantitative models that offer the system the capacity of analyzing and finding solutions to problems [Zaharie01];
- the model base management module, that is meant to create new models by using programming languages;
- the model dictionary, that contains the models' definition and other information related tot hem;
- the creation, execution and integration module of models, that will interpret the user's instructions according to models and will transfer them towards the model management system [Zaharie01].



**Figure 3.** Model management module  
(Adapted after Turban 2001)

Computer based decision support systems are developed in order to solve a certain set of problems, so each of them will contain different available models, according to the organization's needs. So part of their components may be more or less developed in certain cases.

The use of computers in any domain is a widely recognized fact and it has been impossible not to ask whether the computers' capacity to learn wouldn't increase their utility. The answer would be that as the learning capacity increases, the impact it determines is spectacular. The ways to determine computer to assimilate knowledge and be used in new domains is a great challenge, especially that algorithms that would make this happen have already been found and implemented and have lead to development of programs that have proven how useful they are. As a consequence, there are applications for speech recognition, hand writing recognition, medical diagnosis etc. that are based on these algorithms. Also, these algorithms are very efficiently used in Data Mining problems, in order to obtain knowledge from large databases.

It is appreciated that the Machine Learning field will have a major importance within the computing technologies. As interdisciplinary nature, Machine Learning field is highly connected with artificial intelligence, statistics, predictions, philosophy, psychology etc.

Some Machine Learning based techniques tend to eliminate the need of human intuition for analyzing the data, while other adopt a collaborative approach between man and machine. Human intuition cannot be completely removed since the system designer has to specify the mode of representing data and the mechanism used to search the data. Machine learning is similar to an attempt of automatize the parts of a scientific procedure.

Machine learning refers to modifications within the systems executing various tasks related to the artificial intelligence domain, tasks involving recognition,

diagnostic, planning, robot control, prevision, which can only be completely defined through examples, by supplying the input data and the expected results. It is desired for the results to be able to be deduced given that an input data series exists, but there is no well-defined input-output function, only by approximating the implicitly relations. It happens many times that the correlations and links are “hidden” into the huge amount of data, but with the help of machine learning technologies, these can be extracted.

There are often designed systems that do not work efficiently in the area they are used, because some particularities of the work manner could not have been well specified when they were built, so the Machine learning methods come in handy in these cases. Information can be various and create new knowledge flows, which could cause the reimplementation of the artificial intelligence systems, but given that this is not a practical solution, it appears that the machine learning technologies could handle these situations well.

In order to understand the Machine Learning concept, we will consider a few definitions given by important authors in this field:

- „Machine Learning is a science of the artificial. The main study object is represented by specific algorithms that are improving their performances through experience” [Langley 96];
- „Machine Learning assumes studying software algorithms that improve automatically by experience” [Mitchell 97];
- „Machine Learning means to program computer in order to optimize a performance criteria using previous data or experiences as example ” [Alpaydin 04];
- „Machine Learning is a domain of artificial intelligence aiming to study methods to program computers in order to be able to develop the learning activity” [Dietterich 2003].

Machine Learning also refers to those modifications within systems that solve tasks where artificial intelligence is involved, as forms recognition, diagnosis, planning, robotics, prediction; the modifications refer to the improvements of the existent performances, or to the appearance of new functionalities.

If it is to mention the reasons for the Machine Learning technologies represent an important research domain, the following statements would make the point:

- solving some tasks cannot be described in an algorithm, but suggested in examples;
- Machine Learning methods have often been used to determine relations in huge amounts of interconnected data;
- Machine Learning methods can improve existing systems, that were developed without completely knowing the real conditions and environment;
- in some situations there is a large amount of knowledge related to certain problems and it is hard to predict all the situations, while a system that is capable to learn would have the capacity to assimilate more than any human subject would be able to transmit;
- systems need to adapt to the environmental changes, and Machine Learning methods could facilitate that;
- learning methods can perceive new events, so there is no need to redesign systems in order to optimal respond to the new knowledge.

The Machine Learning field is looking for the answer to the question “how to make computer based information systems that are improving their performances through experience, and which are the fundamental laws that lead all the learning processes?”.

The idea that intelligent systems could solve tasks that were until recently considered to be exclusively human has drawn the researchers attention, and the number

of applications in the artificial intelligence field has increased and being materialized in new technologies. One of these technologies, determined by the interest in systems that are capable to learn similarly to the human beings is the Machine Learning technology.

Still, Machine Learning technologies based systems do not eliminate human intuition, but a collaborative approach between the human being and the machine is preferred, and this would be an important reason to use these technologies for the development of modern decision support systems.

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