Decision-making support systems: actual implementations, limits and requirements

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Abstract

This paper tries to presents limits of the actual decision-support systems that stands at the origin of the unachieving an informed decision-making process.We discuss the requirements, actual implementations and limits of it based on two facts: the distinction between data and knowledge and the distinction between decision-support systems and knowledge-based systems.

Keywords: decision-support systems, knowledge, bounded rationality approach, creativity

Introduction

Decision modeling is a topic widely discussed in scientific literature. Decision models must be an interface between "action knowledge" that belongs to decision-makers and information that describes the organization. Information availability constitutes a key issue in implementing the first phase of decision making: information (documentation) on the possible decision alternatives. Information may not meet the decision-maker's meaning, but he will know what meaning to give depending on the context, to characterize, if any.

Providing information is the scope of business information systems implementation. Decision modeling is a concern to formalize problems solving and involves knowledge modeling. Most often, the computer based science proposes the decomposition of a problem into smaller problems and implement functions. The decision-maker uses functions and formalizes the structured part of the decision problem. Artificial intelligence seeks to discover the functions and, thus, to provide knowledge to decision-makers. The decision-maker uses the discovered knowledge to create new knowledge and proposes an approach to modeling decision based on its own logical inferences.

Decision modeling approach limits

Decision modeling constitutes a rational approach affected by the boundaries identified by theories of human behavior. Rational approach is offered by economic and mathematical tools used in microeconomics: demand estimation, bid estimates, production estimates in terms of existence of perfect and imperfect market. Theory of human behavior seeks to demonstrate that the rational behavior is influenced by factors that action on decision-makers' choices.

First of all, any decision problem involves obtaining qualitative information and the presence of risk and uncertainty. For any decision-maker the assessment of alternatives becomes a simple problem as long as the decision-maker solves the balance between information and risk.

Decision situations characterized by risk are considered to be those in which the model outputs can be estimated on the basis of the statistical evidences on similar cases and in which the risk of not achieving the proposed model withdrawals. The approach is focused on the use of probabilities. Decision

situations characterized by uncertainty are considered to be those that can be estimated from the model outputs but no records or past experiences to judge the certainty of the model output.[1]

Reducing uncertainty is closely connected with providing information. The best known approach is the qualitative or quantitative assessment of factors by transposing numeric variables in symbolic variables, an approach based on uncertainty reasoning in expert systems modeling and fuzzy decision modeling.

Obtaining qualitative information may be the result of simulations, the estimates (statistical) obtained from experience, reasoning from cognitive or brainstorming sessions.

We believe that the idea of providing creativity to the decision model and that the between model and decision-maker constitutes basic elements in designing intelligent behaviors, beyond the incorporation of knowledge which is equally important. As long as the model does not interact with decision-maker (in the sharing of common meanings), it will not have intelligent behavior, as many techniques, methods and algorithms should be implemented.

The intersection of rationalist paradigm and the bounded rationality paradigm is represented by the decision tree method. Conforming to the rationalist paradigm, the decision tree allows utilities and risk decision alternatives modeling. Conforming to the bounded rationality approach the decision tree constitutes the model of inferring certainty and knowledge to make decisions.

People make decisions based on reasoning and symbol, in terms of bounded rationality of lack of information as the computer-based science is sought to provide models for assisting decision makers. And here are two approaches. The first approach considers possible helping decision makers by providing information (information on forecasts, simulation, and optimization) through the implementation of decision models using mathematical and statistical information technologies to assist decision[2]. The second approach considers possible helping decision makers by providing information in the form of tips and advice obtained through the implementation of decision models of human reasoning with intelligent technologies. Differences between the two types of technologies are the subject of much debate sufficiently interested and interesting.

Decision-making support systems: actual implementations, requirements and limits

It is assumed that technologies are designed to improve decisions. Computer-based applications developed for this purpose incorporates decision analysis, expert knowledge and / or simulations. Success was limited, different aspects of decision's environment, unstructured, uncertainty, and dynamic evolution causes rejection of static models supplied by all three technologies.

In our view, the aim of assisting decision makers of technology applications is identical. Practically, the recommendations and solutions offered by intelligent technology applications constitute information for decision makers, that he/she is free to follow or not. We do not believe that the stated purpose would be to replace decision-makers because it would be impossible. Evaluation of applications using the Turing test, just to demonstrate the "intelligence" exhibited by a machine may even cause harm, especially in decision-making purposes. A decision-maker will not use the recommendation provided by

[1] Drury, C., *Management Accounting for Business Decisions*, Second Edition, Thomson Learning, 2001, p. 222

[2] Conforming to the *Webster's Third New International Dictionary od the English Language Unabridged*, A Meriam – Webster, vol. III, S-Z, Encyclopaedia Britanica Inc., 1993, p. 2348 technology means hardware, software, comunication protocols

an IT solution, whether intelligent or not, only after analyzing the proposed solution, primarily due to the decision-making responsibility that exists. We believe that this "rush" to demonstrate an application of intelligence, just because of financial interests expressed by their manufacturers, is pointless.[3]

Also in our opinion, the concept of "intelligence" in computer applications are used too easily, so we see a profusion of confusion. It is understandable that every scientist wants to label products obtained as intelligent and the manufacturer names its products “intelligent”. Eventually, the goal is the emergence and integration of technologies and functionalities, while the outcome will result in “intelligent” products and solutions.

The principal differentiation that scientific literature treates referres to to disticnction between data and knowledge, reasonings and algorithms at the conceptual level and at the implementation level. Both technologies borrowdes techniques one from another and, therefore, we assist at the techniques incorporation into technologies, so the distinction between information technologies functionalities and intelligent technologies functionalities is also pointless. Altough we will present some differences in the meaning of providing the interest announced by the present paper.

At the conceptual level, the researchers that promotes business information technologies models data. The researchers that promotes intelligent technologies are concerned with providing a conceptual model of knowledge.[4] Finally, at the phisical level of implementation representing knowledge is realized trough variables declaration which consistes in representing data. The conceptual model of knowledge and the distinction between knowledge and control presents interest due to the reasoning human approach. Knowledge and data must be formalized but in the situation of representing a knowledge model the acces to the pieces of knowledge is easier to realize and, therefore, the model redefining is simplier.

Data models are implemented usually with structured languages and, therefore, the acces to data structures is realized by accessing the index files. Knowledge conceptual models are not implemented with structured languages and, therefore, ther is a need of formalisms to represent knowledge by roles specifications.

At this moment knowledge must be explicitely represented because only in that way the mapping between knowledge and information can be realized.

At the level of the IT application development methodology, both types of applications are well supported. As regards intelligent solutions, the acquisition and knowledge representation approach has been dropped for developing methodologies, considering the development of such solutions during knowledge management organizations, which is not less. [5] Concepts and applications are different, but very close to the vocabulary of object-oriented methodologies. Knowledge representation techniques remain possible to be used in the conceptual model building phase along with diagrams when systems developers have no other tools and knowledge modeling techniques.

Artificial intelligence researchers argue that knowledge-based systems provide knowledge derivation of goal / solution makers / users. This is very true and signifies a notable difference from the

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[3] Generally, Intelligent Business Solutions is understood by terms of Data Mining, Business Intelligence and are considered intelligent because they realize business analyses, interpretations and forecasts. The techniques used are often statistical ones, they extract knowledge from data and therefpre they are supposed to be intelligent.

[4] Newell, A., *The Knowledge Level*, Artificial Intelligence, vol. 18, no. 1, 1982, pp. 82–127 cited by Gašević, D., Djurić, D., Devedžić, V., *Model Driven Architecture and Ontology Development*, Springer, 2006, pp. 41-42

[5] CommonKADS development methodology proposes the knowledge-based systems development during knowledge management projects.

black box of decision support systems. We believe that the distinction between knowledge and control is particularly useful in the conceptual modeling phase (which refers only to the modeling concepts), due to good cooperation that takes place between users and editors to specify knowledge structures, but also in the design phase because knowledge separation of control on knowledge uses makes it easy deployment and maintenance.

Conclusions

Our attempts with the two types of modeling technologies led us to the following conclusions:

- Modeling decision was very easy with expert systems technology because of the possibility of defining the purpose, rules of use of input data in the same way human reasoning processes;
- Decision-making model developed with such technology offers a solution respecting the decision model proposed by H. Simon;
- The developed decision model present the human intelligent behavior proposed in the modeling phase, instead the major disadvantage is that the resulting model is static, which it reduced the level of "intelligence" drastically. Any model we tried to develop did not present the learning ability to adapt and reach the end state by itself. This is the end user perspective, however, that uses the expert system and notes that he/she can not develop the system provided. There are two problems: 1) when the knowledge base has considerable expertise user receives a characteristic of "intelligence", 2) when the knowledge base is the prototype of the system the problem area seems "small." Expert systems generator available to an expert in the field is an ideal tool in specifying qualitative inference and visualization factors (evaluated on the basis of quantity or specify by an expert) and quantitative (extracted from a database);
- The only way of expression, but limited intelligence has been proved when using neural networks;
- We want to note that information present, in our view, meaningful data or meaningful in addition to other understandings and the human way of understanding and of the information perception is carried by reasoning (seen as retrieval) and mapping on the knowledge available. The easiest would be considering a child which in order to perceive information he/she must learn either from parents or through experience (trial and error). Only after a period he/she is able to collect information. Interestingly, over the years, we have all the memories that start from the surrounding reality has begun to provide meaning for us. Our opinion is supported by theory authors D. Kahneman, P. Slove and A. Tversky.[6]

Computer-based implementation of decision models should be realized in a system that: 1) examine the current status of the system to sense alarm condition, 2) to conduct simulations of “what if?” and 3) provide solutions to the problems of answers simulations “what if?”.

In terms of learning activity, a computer model may include learning algorithms. A neural network model type or genetic algorithm contains an automatic learning algorithm that describes the behavior data stored in the database. Both models of data mining and neural network models and genetic algorithms operate on small data sets. Automatic learning algorithms of data mining technology are taken

[6] Kahneman, D., *Maps of Bounded Rationality: a Perspective on Intuitive Judgment and Choice*, Nobel Prize discourse, december, 2002, <http://nobelprize.org/nobel_prizes/economics/laureates/2002/kahnemann-lecture.pdf>

from artificial intelligence and uses to discover relationships and to develop a model to be used in making predictions.

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