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IMPROVING THE MANAGEMENT IN ORGANIZATIONS BY USING EXPERT SYSTEMS

ÎMBUNĂTĂŢIREA MANAGEMENTULUI ÎN ORGANIZAŢII PRIN UTILIZAREA SISTEMELOR EXPERT

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Abstract: *This paper presents a short overview of expert systems (ES) and decision areas and also examines the literature about ES generators and ES applications in enterprise management. Further there are highlighted problems that arise in multi-criteria decision analysis, when there is a high level of variance in the parameter structure. Finally are discussed the latest achievements that overcome these limitations in the proposed framework, consisting in a hybrid system. It is a fuzzy-ES with a high level of completeness in variable inclusion for achieving a cost-benefit analysis of enterprise information system investment. Future prospects and scope for research in this area are also briefly discussed.*

Keywords: *Expert system, decision analysis, intelligent support systems, fuzzy logic*

INTRODUCTION

The development of Artificial Intelligence (AI)-based applications has begun to cover most of activity domains. The designers of such applications try to imitate as trustily as possible the human reasoning and also the human cognitive processes. All these applications use algorithms based on a human decision system. Humans gather experience only when they put themselves questions about inner and outer facts and phenomena, which they store in their memory. Following these processes, intelligent applications try to gather experience and, based on this experience, to make decisions in the domains and actions they were required.

Important tools for decision analysis are considered to be Expert Systems (ES), which play a key role in enhancing productivity, improving quality and increasing profits while minimizing costs and capturing expertise in many business environments. One of the key issues in the use

and exploitation of classical ES is the rating of the value of investment in such systems. All traditional models deal mainly with quantifiable variables, while in practice there are many qualitative/ incomplete/ vague and imprecise variables. There have been made attempts to outrun these limitations by using other techniques, such as intelligent techniques, the real options model and knowledge value model. The purpose of this paper is to present an overview of ES and the different decision areas in ES, to examine the literature about expert system generators and expert system applications in enterprise management and also to present a new research consisting in a hybrid system, namely a fuzzy-expert system for achieving a cost-benefit analysis of enterprise information system investment.

MATERIAL AND METHOD

A short literature review of organizational decision making shows that rapid business decision-making often requires collaboration across organizations and cultural norms. Decision making in production and operations management could be classified into two major domains: strategic and operational/tactical. Table 1 (adapted from Jayaraman & Srivastava 1996) shows decision making classification in management activities:

Table 1

Unstructured	Semi-structured	Highly structured
Strategic		Operational
Product desugn	Facility location	Short-term capacity planning
Process design	Facility layout	Distribution*
Process choice	Project management	Scheduling
Quality planning	Job design	Quality control
	Aggregate planning	Inventory control
	Long-term forecasting	Maintenance
	Long-term capacity planning	Short-term forecasting
		Purchasing*

Notes:
* Can also be strategic

Strategic planning and decision making:

- Implies a longer time horizon, less certainty, less structure, poorely defined information requirements
- Focuses on the whole organization

- Is generally characterized by unstructured to semi-structured conditions

Operational planning and decision making:

- Implies a shorter time horizon, more certainty, well-structured, well-defined information requirements
- Is generally characterized by semi-structured to well-structured conditions

Most organizational decision making involve multi-criteria analysis where situations are structured, but most of them semi-structured and unstructured. Big problems arise when there is a high degree of variance in parameter structure. Then the main task is to bring all variables to the same metric.

The most general method to design ES is the use of ES generators or shells. Except the well-known ES generator Clips, literature is abundant in Exsys applications. Exsys Corvid is an ES generator developed by EXSYS Inc., the first company that brought practical expert system development to the PC in 1983. With Corvid it is possible to convert complex decision-making processes into a form that can be easily incorporated into a Web page.

Corvid offers interactive tools for top-level knowledge access and dissemination. Expert knowledge of how to solve a problem is often scarce and valuable - it can be a company's greatest asset and key competitive differentiator. Expert systems capture this knowledge and allow its dissemination to others. Most other approaches to knowledge distribution just provide people with information, and rely on them to read, understand, and convert it to usable knowledge on their own - in effect, self-teaching themselves to be an expert.

Corvid provides an object-oriented structure that makes it easy to build systems using methods and properties of variables, while not requiring the developer to change the way they think and describe their decision-making steps and logic. The result is a very flexible and powerful development environment that can easily be learned.

RESULTS AND DISCUSSIONS

Traditional capital budgeting models for establishing the value of investment in information systems assume that all costs and benefits are known and they rely on cash flow measures. But these assumptions are not

often met in the real life. That's why some researchers (Benaroch and Kauffmann 2000) proposed the real options pricing model, as an attempt to overcome the limitations of traditional models. Intelligent and soft computing techniques are now outspread, being capable to model human reasoning in a simple, not complicated, framework. Other researchers (like Cochran and Chen 2005) present examples of such intelligent techniques.

The use of fuzzy logic has become very popular in dealing with uncertainty and imprecision in decision making. Obviously, there is a high level of uncertainty management in intelligent systems and that's because human reasoning and decision making is fuzzy/vague.

There also have been made attempts to combine fuzzy logic with Analytic Hierarchy Process (AHP) and/or ES technologies, such as artificial neural networks and case based reasoning.

In a linear model of evaluation of alternatives a_i(i=1,2,..,n) based on a set of variables v_j(j=1,2,…, m), each variable is assigned a weight w_k($0 \leq k \leq 1$) in the decision process. Thus the global variable (G) of a decision alternative (Uzoka 2009) is the sum of its values at the mth criteria/variables ($v_1(a_i)$,…,$v_m(a_i)$), which is given as:

$$G(V_j, k) = \sum_{j=1}^{m} k_j v_j \text{ , with } \sum_{j=1}^{m} k_j = 1 \text{ and } k_j \geq 0$$

The main point in this decision process is to determine the values of the scaling constants k_j, knowing that this parameter will reflect the decision makers' values and trade-offs. The difficult part in weight estimation is the setting of the confidence factor of such estimates.

The development of any fuzzy logic based application needs three main stages, which are:

- The *fuzzification*, a stage during which selected membership functions are assigned to input variables, according to particular criteria and, based on these values, there are defined the liguistic values corresponding to the input values and there is also a pass from the crisp to the fuzzy representation.
- *Applying of the fuzzy rule set* for establishing the degree of truth for each of the rules built previously, based on human expert knowledge or based on special techniques to extract these rules.
- *Defuzzification*, which uses the degrees of truth established in the previous stage for each rule and applies them to the

consequences of these rules for coming back from the domain specific to fuzzy values in the universe of discourse associated to the output variable /variables.

Uzoka 2009 developed a fuzzy expert system, following all these steps, trying to overcome the drawbacks of traditional models. So, Uzoka made use of modelling unstructured variables and used also linguistic values in the evaluation process. He adapted for knowledge acquisition and analysis the model specified in (Cochran and Chen 2005), including derivation of variables, linguistic rating of features, aggregation of weights and aggregation of decision makers' ratings.

The designed and implemented ES architecture consists of:

- a *knowledge base* with frame based knowledge representation,
- an *inference engine* with forward chaining strategy, because the cost-benefit analysis is data driven,
- the *user interface*, based on a menu-driven facility with also an explanation facility for explaining the reasoning behind the expert systems decision process and
- the *knowledge management module*, with knowledge acquisition program, gathering and updating knowledge through knowledge engineering workstations from experts via knowledge engineers.

One of the main contributions of the proposed system to existing literature is the fact that this framework recognizes the skew towards qualitative variables and suggests the qualification of quantitative variables using fuzzy linguistic variables.

In the near future it is likely to have a large increase of hybrid intelligent systems, like fuzzy expert systems.

CONCLUSIONS

Today's decisions are complex, combining hard facts with experts' intuition. Faced with uncertain and unpredictable business environments, organizations have been turning to AI and ES to develop systems that can provide the bases for future competence and efficiency. With the advent of powerful, inexpensive ES shells, like Exsys Corvid for example, the development of small ES increased, including specific domains of operations management.

There is a high level of uncertainty management in intelligent systems due to the fact that human reasoning and decision making is fuzzy,

involving a high degree of vagueness in evidence, concept utilization and mental model formulation. The adoption of a fuzzy expert system could be a successful attempt to overcome the shortcomings of traditional methods, using mainly quatifiable variables. This hybrid system uses fuzzy logic in addressing imprecision and uncertainty in group decision making.

In the very near future it is likely that the majority of the ES developed will be embedded systems, that form a part of the overall software package. Hybrid ES, like fuzzy ES are an example of such an approach.

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