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TRANSITION TO ADVANCED MARKET ECONOMIES

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SESSION 13

DECISION SUPPORT SYSTEMS

Part 13A

DECISION SUPPORT FOR PURPOSEFUL MANAGEMENT SYSTEMS IN TRANSITION TO ADVANCED MARKET ECONOMY

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A configuration of intelligent decision support systems constructed in an interface with program packages for elicitating preference analysis is presented. This paper concerns a prescriptive approach, as an alternative to the normative and descriptive approaches, for choice problems while we intend to develop more disciplinary DSS for practical use. This approach is also checked for improving managerial decision making under the highly technical and informative social conditions. As a result, a way to form a "constructive" purposeful system as a managerial system is discussed. The discussion includes multicriteria evaluation and its extension to group and fuzzy decision environment. An example for organizational decision making is presented and discussed.

DEVELOPMENT OF AN EXPERT SYSTEM FOR THE ANALYSIS OF FINANCIAL STANDING OF AN ENTERPRISE

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The aim of the paper is to present a proposition of the expert system for analysis of financial standing of an enterprise. It includes four areas of research:

- financial liquidity analysis,
- debt analysis,
- profitability analysis,
- activity analysis.

In the system the blackboard architecture has been applied. The system is being currently built using a blackboard expert system shell called BB-POL.

The BB-POL has been designed as a tool for a knowledge engineer, supporting him in describing of both the problem and problem solving method and in generating a blackboard expert system. It has been written in C language and has been implemented on IBM PC/AT.

DEDUCTIVE AUTOMATED REASONING IN DECISION SUPPORT ALGORITHMS

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Petri nets-based analytical approach is presented for analytical mathematical description of the rule-based knowledge basis (KB) representing the system in question and experience with its operation or its dynamical behaviour. Especially, logical Petri nets (LPN) and fuzzy-logical Petri nets (FPN) are used in order to obtain the uniform description of the KB structure and dynamics in the following form

$$x_{k+1}=x_k \text{ or } B \text{ and } u_k,\ K=0, N,\ x_{kK=0}=x_0$$

where x_k is the state vector of the KB statements, u_k is the state vector of the rules evaluation and B is a matrix expressing the structural properties of the KB. The natural inference mechanism of the LPN and FPN dynamics development is utilized in order to obtain the uniform mathematical description of the process of deductive automated reasoning in analytical terms as follows

$$u_k=\text{neg}\ (F^T \text{ and } (\text{neg } x_k))$$

with F being a part of the matrix B (i.e.B=GT or F where expresses the structural connections oriented from the statements to the rules and G expresses the structural connections oriented from the rules to their output statements). T symbolizes the matrix or vector transposition.

Such an approach creates the substantial kernel of the decision support algorithm. It must be said that or, and, neg are the vector logical operators in bivalued logic or in fuzzy-logic.

AGRIPLEX: A HYBRID EXPERT SYSTEM FOR AGRICULTURAL PRODUCTION PLANNING IN FUZZY ENVIRONMENT

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Under market economy conditions it is important for managers in agriculture to take into consideration the daily changes of different factors and to optimize utilization of resources in order to obtain greater quantity and better quality products with less expenditures. This leads to gaining maximum profit. Land is the basic means of production in agriculture and its fertility, size limits and topographic situation are of significant importance for the solution of the problems what, how much and how to produce. Answers to these questions should be sought having in mind the influence of a variety of imprecisely estimated factors.

Applying fuzzy optimization models in production planning under incomplete information leads to necessity of building a systems of inference rules. Such rules are used in linguistic information processing oriented models. Implementation of these models is connected with modelling of user language on the basis of object-oriented expert information.

In this paper a description of a hybrid expert system for agricultural production planning built by the authors is presented. The system is aimed at supporting users in solving decision making problems of the following types: what crops, on what types of land in which areas are to be cultivated. The system handles uncertainty factors that influence the basic production characteristics: yields, prices, climatic factors, possible agrotechnical limits of cultivating definite crops, etc. The structure of the AGRIPLEX is explained. Interaction with the user is illustrated on a real-life example.

SAFE - A KNOWLEDGE-BASED SYSTEM FOR PREVENTION OF INCIDENTS

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It is well known that human errors are responsible for 60-80% of all accidents which occur when people (air traffic controllers, manufacturing supervisors, ship captains, etc.) interact with highly complex industrial and technical systems. Unfortunately, there has been no effective method of evaluating and reducing the level of risk linked to human shortcomings - a method which would allow effective investigation of accidents which have already occurred and prevent future disasters.

By means of frames and of a special modal logic a mathematical method was developed which make it possible to describe and analyse the contents of human errors taking into account conscious and unconscious motives and technical, organizational and social spheres. The method allows to classify human error using casual analysis. This method is essentially different from traditional statistical methods of human error rates which do not consider the causes of the error but deal with the resulting consequences only. On the basis of this theoretical research a unique computerized analysis technique was developedwhich is the fundation of the SAFE (System for Analysis and Forecasting Errors) project.

SAFE is an expert system utilizing causal analysis of human errors which can increase the reliability and safety of person-machine systems. It penetrates to the primary reasons and performs a computerized causal analysis from which concrete recommendations on how to prevent future errors can be developed. SAFE guides the investigator in the gathering and analysis large quantities of data and does not permit important information to be ignored either unintentionally or deliberately.

SAFE involves data bank with information about errors and their causes which allow the comparison of individual errors within a single or similar person-machine systems. Such properties of SAFE provide for revealing of common inherent tendencies among various types of errors and for the development of wellfounded recommendations to prevent future errors. SAFE forecasts the probability of an accident occurring within a functional system or a system which is in the development stage.

The described expert system has been developed for use by accident investigation commissions, safety officers, insurance companies and all others who analyze questions of safety and risk.

At present time Aeroflot is implementing SAFE to analyze flight crew and air traffic controller errors.

EXPERT DECISION-MAKING SYSTEM BASED ON DISTRIBUTED KNOWLEDGE BASE

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The "Azerex" expert system has been suggested which is a system of decision-making support with distributed structure in the systems of organization and social-economic control, characterized by geographical and functional distribution of knowledge and decision-making persons, different expert estimations on one and the same problem,and collective decision-making in real time. Principles which have been used when developing a system are based on the fuzzy relation model of knowledge representation and processing, in accordance with it each object is described by a triad: plurality of properties, plurality of time and spatial responses. Conformity of properties, time and spatial object responses is represented by three-dimensional relation model of fuzzy relationship. It has been noted that fuzzy relation model has some advantages in case of distributed processing, namely: compact and adequate presentation of knowledge in various network nodes, high processing rate of presented knowledge, possibility of physical distribution of a knowledge base CKB, localization of processing, casy knowledge input."Azerex" system provides possibility of automatic formation of rules "condition-action" on the basis of relational model of knowledge representation which can be used as independent KB for specific applications. The system includes a block of KB adaptation in accordance with consequences of decisions made. The System is realized on the basis of IBM PC AT using MS DOS medium, it can be efficiently used in various systems of organization and socio-economic control, e.g. when planning scientific research projects.

INTEGRATIONAL TECHNOLOGY METHODOLOGIES AND ARTIFICIAL INTELLIGENCE

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New insights into creative and higher mental processes have been obtained recently from the study of artificial intelligence. It is possible now to look at the integrational technology (IT) of the industrial production process from a fresh perspective which may enable us to start developing new generations of new technology methodologies. During 70's and 80's the dominant Artificial Intelligence paradigm was that of knowledge-based on the information processing theory of mind. It postulates that intelligence is a capacity for solving problems. Problems are represented by modelling, the relevant part of reality in terms of sybols and solved by the rule-based symbolic computation. Key concepts are knowledge acquisition and representation, and a sequential, localised symbolic processing, governed by the mathematical logic. The knowledge-based paradigm has enriched our understanding of new technology and provided a basis for novel computer-aided manufacturing tools.

The paper represents the conceptual principles and problems for automation of integrational technology, the base of which was systems with knowledge. Features of complex informatization factories are discussed. Attention was given to the instrumental facilities in the creating expert systems (ES) and to the problem development IT. Mathematical support for artificial-intelligence-based robotic systems and knowledge formalization on the basis offuzzy categories are reflected.

The questions of user relations with ES and question/answer dialogue were distinguished. The basis of ES is informative logic model of a diagnostic situation. Principles of designing ES are formulated. The components of the knowledge base is described. ES is coded in TURBO-PROLOG in MS/DOS for execution on the IBM PC/AT microcomputer.