Use of Expert Systems in the Mining

[1]Elena Vladimirovna Chekushina, [1]Alexander Egorovich Vorobev
and [2]Tatiana Vladimirovna Chekushina

[1]Peoples' Friendship University of Russia, Moscow, Russia
[2]Institute of Comprehensive Exploitation of Mineral Resources
Russian Academy of Sciences, Moscow, Russia

Abstract: An expert system (ES) is software that incorporates the specialists' knowledge in a certain domain. This software is capable to provide recommendations which normally a human expert would give. The expert would request some additional information if necessary. The software functions at the same level like human experts or even better because it incorporates the collective experience of its authors.

Key words: Expert system · Software · Mining · Modelling · Analysis

INTRODUCTION

Expert systems in mining are widely applied [1-7]. The main advantage of the software is the ability to accumulate knowledge, save it for a long time span, update the information. In this way a company can function even if the qualified specialists are not available. The saved knowledge can be applied to improve the qualification of employees [8].

There are 2 kinds of expert systems: static (Fig. 1) and dynamic (Fig. 2). Static expert systems are used in those appendices where it is possible not to consider the changes of world around occurring during the decision of a problem. The first expert systems which have received practical use were static [9].

The expert system has certain advantages, comparing to the human experts:

- It hasn't any prejudgments;
- It doesn't jump to a foregone conclusion;
- These systems can work systematically, consider all details and choose the best possibility;
- The database can be very large. The data are inserted once and remain in the system's memory for ever. A human has limited knowledge. If some information wasn't used for a long time, it is forgotten and lost;
- These systems don't replace a human expert, they are a tool is his hands.
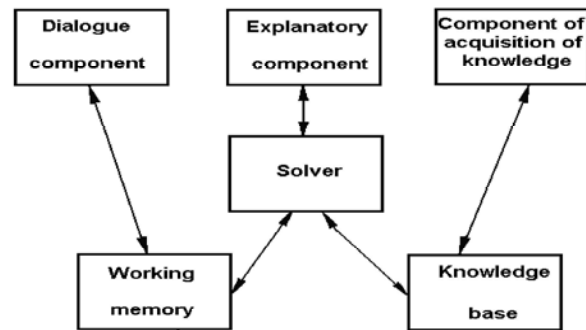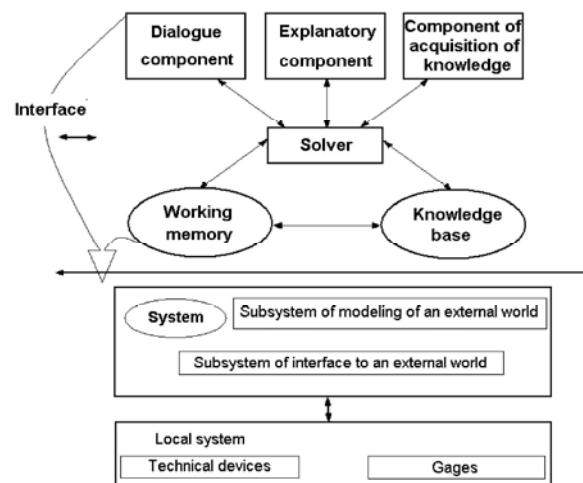

Fig. 1: Structure of static expert system

Fig. 2: Structure of dynamic expert system

Corresponding Author: Chekushina, Peoples' Friendship University of Russia, Miklucho-Maklaja 6, 117198 Moscow, Russia.

Expert systems are designed and created to facilitate tasks in the fields of medicine, process control, troubleshooting of mechanical and electrical appliances, education. Expert systems are indispensable in the following areas:

- Accumulation, elaboration, encryption and distribution of the expert knowledge.
- Effective solving of complex problems, which require the knowledge of several human experts with various specialisations.
- Saving of the most fragile value of any society: collective memory.

Expert systems can be implemented for the problem solving at any stage of the mining process. In the first line they provide the managerial employees with information.

Information is presented in the form of regular and special managerial reports, which include the data about past, present and possible future of a company. Office automation means organisation and support of the internal and external production processes on the basis of computer networks and other modern devices for information processing.

Expert systems found wide implementation in the fields like engineering, processes modelling and engineering analysis.

Executive of low qualification implement the expert systems in automation of repetitive operations.

The expert systems technology is currently applied in the solving of various tasks (interpretation, forecasting, diagnostics, planning, construction, controlling, development, advising and management) in such fields like accounting, oil and gas industry, energy, transport, pharmaceutical production, space technologies, metallurgy, mining, chemistry, education, telecommunications and other. For example, the system PROSPECTOR is widely and effectively implemented in mining for prospecting of mineral resources.

Expert systems can support decision making in the following areas:

- Ecological monitoring of mining sites;
- Analysis and forecasting of the deposits exploitation;
- Management of the mining enterprise;
- Evaluation of geomechanical properties of deposits;
- Geological modelling and planning of mining;
- Forecasting of gas dynamics;

- Operating management of open cast mining with implementation of satellite navigation systems;
- Solving of complex problems of mining and recultivation.

The creation of the expert systems for mining includes the following main technological steps:

- Accumulation of digital information and creation of databases;
- Graphical planning of recultivation;
- Linking of the graphical objects to the attributive databases.

Accumulation of digital information and creation of databases is the most labour intensive step. The minimisation or omission of this stage is unacceptable, because it would lead to the deterioration of decisions quality and quantitative limitation of the solved recultivation tasks.

Expert systems base on the unified methodological principles at any level (region, industry branch, corporation, mining enterprise).

It allows unification and systematisation of program and technical resources, which are implemented in mining. The elaboration of the unified information strategy and technical upgrading of enterprises are possible also.

Expert systems can integrate the decision algorithms of many practical tasks into the unified information environment. It is very important for the design of problem-oriented automated mining systems on the algorithmic basis.

All above mentioned advantages of ES allow their application as alternative to the expensive foreign software by mining, scientific and engineering organisations. This software has as a rule limited set of functional modules, which are "closed" for a user.

The next step of ES designing includes the software development, which allows the system feeding with new information. The new information can be seen in the data base.

The described algorithms provide the effective application of ES for problems solution. The engineering results confirm that the development of the unified computer technology of information accumulation, processing and implementation is possible.

The modern system of the ES implementation in mining can de described as a complex with the following main subsystems:

- Information support includes the system for information classification, technological scheme of data processing, reference data, document management system, generation of various documents;
- Organizational support is the complex of measures and actions, which regulate the management system and connections among structures of a company;
- Hardware includes technical devises and transmission facilities;
- Mathematical support is the complex of methods, rules, mathematical models and algorithms;
- Software includes the programs, which are necessary at any stage of the enterprise operation.

There is a variety of software for information processing currently. They include text processors, tabular processors, databases management systems, automatic design systems, email and others.

Digital technologies are necessary at any stage of mining. Engineering, construction and operation base on the technological, informational, mathematical, software, organisational and legal support [10].

Technical support should provide data accumulation, registration, flow, saving and processing at the right time.

Software makes possible development and operation of the unified data collection, which consists of data stores, sets and bases.

Mathematical system support includes methods and algorithms for the solution of initial problems. The complex of programs and instructions for user and choice of effective software are especially important in software development.

All the above mentioned information technologies are widely implemented in mining.

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