Decision making system for gas mining company

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Abstract

An approach is considered to develop a system that supports the decision-making of day-to-day management tasks for decision makers in order to reduce the energy costs of the hydrocarbon production process at the oil and gas producing enterprise and improve the environmental safety of this process. The architecture and principles of building such a system are discussed.

Keywords: decision support system, expert system, analytical module, prediction module, hydrogen sulphide

1 Introduction

Gas mining industry is known as a heavy industry in the economy that plays a vital role on an energy market. Gas mining is also an area, where large amount of data is produced and it requires utilization in further analysis. Currently, gas wells are well equipped with monitoring, control and regulation systems associated with machines, devices and vehicles. Application of knowledge in the subject area and the results of data analysis can improve the performance of operators and supervisor significantly. But, as a rule, these automated process control systems are installed on local facilities and serve only the main production process, namely, the extraction of hydrocarbon raw materials, while not affecting the transport services and carrying out planned and emergency repairs. In this regard, such systems can not provide the decision maker (the person making the decision) with the necessary information about all the processes affecting the efficiency and environmental safety of the enterprise.[1] Monitoring companies strive to gain a competitive advantage in equipping their systems with the means of development, modeling and analysis of data. This is a strong motivation for considering the DSS presented in this article.

2 Goals

The main goal of this study is to show on the example of gas mining company Karachaganak Petroleum Operating b.v. where decision making system is needed. There is a well-founded need to implement a Decision Support System (DSS) [2] that integrates various aspects of the operation of a gas well in order to maintain production continuity.

In Karachaganak [3], DSS is required for:

1. Management decisions;
2. Monitoring of natural hazards;
3. Prediction of the concentration of hydrogen sulphide.

The decision support system will integrate data from various monitoring systems and contains an expert system module that can use the knowledge of an expert in the field and an analytical module that can be used to diagnose processes and devices and forecast natural disasters.

3 Tasks of management decision support systems

Decision-making is everyday activity of a person, part of his daily life. In most cases, it consists in generating possible alternatives to solutions, evaluating them, and choosing the best alternative. The contradictory nature of the requirements, the ambiguity of the assessment of situations, the mistakes in the choice of priorities greatly complicate decision-making. Uncertainties are an integral part of decision-making processes. To reduce the problem, characterized by uncertainties for exactly the goals cannot be in principle. For this, it is necessary to "remove" uncertainties. One of such methods of withdrawal is the subjective evaluation of a specialist (expert system), which determines his preferences [4].

Computer support for the decision-making process is based on formalization:

- methods for obtaining objective (measurable) and subjective (given by the manager or expert) initial and intermediate assessments;
- algorithmization of the decision-making process itself;
- situation analysis;
- developing a solution.

It consists in assisting the leader in the decision-making process and includes:

1. Assistance to the leader in the analysis of the objective component, i.e. in understanding and assessing the current situation and the constraints imposed by the emerging situation;
2. Revealing the manager's preferences, i.e. in the identification and ranking of priorities, taking into account the uncertainty in the manager's assessments and the formation of his preferences;
3. Generation of possible solutions, i.e. forming a list of alternatives;
4. Assessment of possible alternatives, based on the manager's preferences and constraints imposed by the external environment;
5. Analysis of the consequences (forecast) of the results of decisions;
6. Support for negotiations in the adoption of an agreed group decision;
7. Choosing the best, from the point of view of the manager, option [5].

4 System architecture

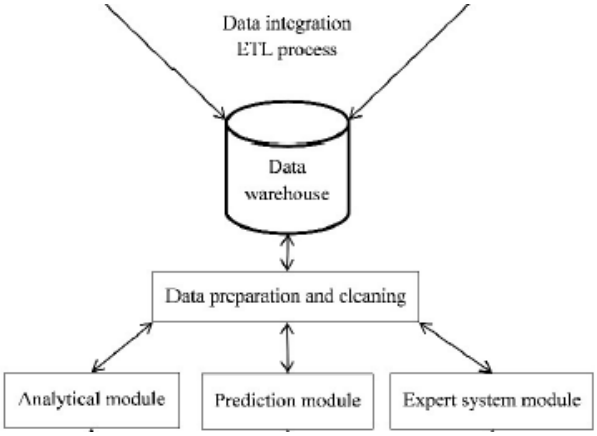

FIGURE 1 Architecture of the decision support system

The analytical module is designed for data analysis (off-line) and for the report on identified significant dependencies and trends. The results generated by this module are stored in the repository only when the user accepts them. Thus, this module supports decisions about what is interesting from the point of view of monitoring and forecasting. It also provides additional information that can be used to enrich the knowledge of the expert system or that can be used for comparative analysis. The module supports identification of changes and trends in controlled processes and tools, and allows you to compare the work of the operator and the dispatcher.

The prediction module is designed to perform incremental (online) training in forecast models or applications of classification and forecast models that create an analytical modular system for measuring time and horizontal indicators, the measured selected sensors. This module also tracks the trends of incoming measurements. The created predictive models are adapted to the analytical process based on the incoming data stream and models derived from historical data (in the analytical module). The module provides interfaces that allow you to select quality standards and their thresholds that provide a minimum forecast quality. If the quality of the forecasts satisfies the conditions set by the user, the forecasts will be considered as values provided by the soft sensor. They can be the following, for example, an expert system, but they can also be representatives of the monitoring system dispatcher [6].

Module of the expert system for on-line and off-line diagnostics of machines and other technical equipment. It is also directed to monitoring processes and support in accordance with the technical conditions, as well as improper execution of the process. Qualification decisions based on the use of classical inference, based on strict rules and facts or probabilistic reasoning, based on trust networks. The system also contains a knowledge base editor that allows the user to define such rules and network.

5 Hydrogen sulfide concentration prediction

The content of hydrocarbons and hydrogen sulphide is influenced by many factors: [7]

- atmospheric pressure;
- wind direction;
- temperature;
- traffic congestion

6 Conclusions

An approach to the development of a decision support system for daily management tasks for decision-makers at an oil and gas producing enterprise is proposed. The developed system provides solutions to support decision-making by the dispatcher and process operator. This system is complete, as it provides tools that can be applied to the storage, processing and preparation of data, as well as the identification of models based on expert knowledge (expert system) and models based on the results of both historical and online data analysis. Computer support for decision-making enables the leader to easily process large amounts of information in real time, allowing him along with objective assessments and accurate mathematical methods, to use his subjective, inherent methods of analysis, generation and evaluation of possible solutions, using all the power Software to implement their management style.

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