ROLE OF DIGITAL TECHNOLOGIES IN THE DEVELOPMENT OF OIL AND GAS INDUSTRIES. ECONOMIC ISSUES OF THE IMPLEMENTATION

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ABSTRACT

Currently, the priority growth areas for the oil and gas industries in Russia are the development of hard-to-recover oil and gas reserves, the development and implementation of innovative technologies for the exploration and production of hydrocarbons in the hard-to-reach regions of Eastern Siberia and the Arctic shelf. Solving these problems calls for intensifying the implementation of information technologies in the oil and gas complex. In the oil and gas industry, there is a global trend towards digital transformation. Companies are mastering a number of key technologies to determine their competitive advantage in years to come. Information technologies allow production cost optimization as well as improvements of workflow, logistics and financial operations efficiency. In particular, the article notes that the use of modern digital technologies can significantly increase the speed and efficiency of geophysical research in the oil and gas complex. Examples of the successful use of IT solutions by domestic oil and gas companies have been provided. Economic and institutional challenges that limit the introducing national software for carrying out geophysical activities in the oil and gas complex have been identified. Prospects for the development of information technologies in other areas of the oil and gas complex, i.e. processing and transportation of oil and gas — have been reviewed.

Keywords: *oil and gas complex, geophysical researches, software, digital technologies, import substitution.*

INTRODUCTION

One of the important prospects for further development of the IT infrastructure in the Russian oil and gas industry is the automation of the full range of activities related to oil and gas development, production, transportation and processing. The key challenge of the industry is to implement the idea of a “digital field”, that is to develop a unified system to control the oil reservoir and control the oil extraction process.

The concept of a “digital field” is implemented provided that a variety of technologies are comprehensively employed, and it implies the following:

- all types of equipment at the field are standardized, their uninterrupted operation ensured;

- information about any workflow enters information systems on a real-time basis;

- all physical objects and assets are equipped with sensors that continuously transmit information to control systems, thus eliminating data corruption, errors, or human factor [1];

- the readings are promptly processed by analytical systems, thus enabling the mining operator to make informed decisions in a timely manner.

Currently, technology-based methods of parametric and structural identification are widely used. IT system includes hardware and software immediately developed for the implementation of operational control over the consumption parameters used in the engineering networks industry.

Scientific and technical progress in the oil and gas complex and geological exploration is currently manifested in a significant increase in the processing and interpretation of digital data. Increasingly severe geological conditions of oil and gas bedding, as well as more intense development of hard-to-recover reserves, and a growing number of horizontal wells have toughened the requirements for accuracy and speed of processing geological and geophysical information, and for detailing the geological structure of complex reservoirs. The main goal pursued by information technologies in the oil and gas complex is to reduce the cost of extracting the amount of oil and gas required to the minimum. Furthermore, the development of information technologies makes it possible to increase labor productivity, the rational use of natural resources, and to ensure the smooth operation of equipment.

It is geophysical research that the process of digitalization in the oil and gas complex began with. The search and exploration of new hydrocarbon deposits on the continental shelf of Russia have necessitated a significant amount of marine geophysical research, in particular, 3D seismic survey [3]. This required the employment of the latest technical means and efficient personnel both for the performance of these activities, and for the interpretation of the data obtained.

The use of state-of-the-art software, digital methods of processing geophysical data makes possible the replacement of traditional approaches based on correlation and regression analysis. Currently, digitally implemented algorithms can be successfully applied to simulate oil and gas deposits.

PROBLEM STATEMENT

Currently, Russia experiences a serious lag in the creation of domestic computer systems in the oil and gas industry, but active government support may provide opportunities to accelerate the development of large-scale service business as a necessary component of information technologies.

The use of digital algorithms plays a crucial role in the improvement of interpretation of the results of geophysical research. Artificial intelligence provides allows for automated integration of various geological and geophysical information to be subsequently included in digital models of deposits.

Need for digitalization increases with the increase in the volume of geophysical data and the number of similar operations. The following points also encourage the companies to use high technologies:

- competition in the oilfield service industry and the reduction of the work schedule determined by customers;

- the need to improve labor efficiency, which requires that the exploration company focuses on the development and implementation of new algorithms, as well as on the automation of labor of the professionals, while maintaining and/or improving the quality of work performed.

RESEARCH QUESTIONS

A striking example of a company that successfully implements Instrument 4.0 in all business segments in the oil and gas complex is Gazprom Neft. In the exploration segment, the company takes advantage of artificial intelligence to analyze huge volumes of initial geological information and create a digital image of a deposit. This makes it possible to predict the quantity and quality of reserves, form a strategy for the development of deposits, and assess risks in an unbiased manner. To address this challenge, a unique project "Cognitive Geologist" has been created, aimed at applying cognitive algorithms and intelligent big data processing technologies. The program allows for speeding up the exploration cycle by reducing time and labor [1].

In addition, in order to comprehensively analyze, process and integrate into a model the available geological and geophysical information about a deposit, Gazprom Neft has designed special decision-making IT platform, viz. digital workplace for geologists GeoMate [3]. The program ensures speeding up the process of making a decision about where to drill wells, how many reserves are recovered, and what changes in the deposit geology occurred, taking into account the updated figures.

It should also be noted that an important technological solution was the generation of a geological exploration database at Gazprom Neft. This "search engine" can handle digital data in the field of exploration and extraction in any programs used by the company. This development has centralized the control over exploration in all divisions of the company, and reduced time and labor costs for searching and verifying data [1].

At present, there are also much smaller enterprises engaged in the development of new digital technologies in the field of geophysics. In particular, VRS Geo Technology, LLC has developed and successfully employ the technique of high-resolution seismic to study thin-layer oil-bearing areas [5]. The technique allows clarification of the boundaries of oil and gas deposits according to the outer contours of oil and gas bearing areas; an in-depth comprehensive geological and geophysical interpretation of the results of processing geophysical data using HRV-Geo technology, geophysical research into well logging and drilling; a preliminary estimate of hydrocarbon resources based on high-resolution seismic data.

It should be noted that the use of information technology also provides means to the solving of critical production problems in transportation and processing of oil and gas.

The application of information technologies for the transportation of oil and gas has ensured a high level of security. This was made possible by a comprehensive and fully automated calculation of cyclic and static strength, vibration strength and seismic resistance using computer. Implementation of IT technologies in oil and gas transportation allows for accurate pipeline modeling on-the-spot and the development of measures aimed at optimizing the operation of the entire pipeline system. Special software provides an opportunity in a short time to compile a report or to obtain statistical data necessary for making adjustments to the laying of the pipeline so that it runs in the areas with normal environmental conditions.

Efficient oil and gas processing is almost impossible without monitoring or recording devices, computing or information-measuring equipment, or self-adjusting devices. Studying and monitoring of oil and gas processing contribute to the development of more efficient methods for processing raw materials at new oil and gas refineries.

However, despite the given examples of successful use of digital technologies for performing geophysical activities by Russian companies, it should be noted that Russia seriously lags behind in the creation of domestic computer systems [4]. Today, when economic and political risks increase, Russian subsoil users and service companies are not ready to make long-term investments in computing capacities or perpetual licenses for specialized software with long-term payback periods [6].

It should be recognized that under the economic sanctions that become tougher, the largest domestic companies tend to disregard sanction risks and continue to purchase foreign software and IT solutions. According to experts, the dependence of Russian exploration companies on imported programs, technologies and equipment remains at 90% [7].

In the author's opinion [2], this problem is systemic in nature and is related neither to the quality of domestic software, nor to the costs for its production or promotion. The current system obstacles hinder the extensive use of domestic software and IT solutions, as well as make the largest oil and gas companies unperceptive to scientific and technological progress.

These obstacles can be divided into 4 categories:

1. Monopolism on the part of oil and gas corporations. Monopoly abuse in the fuel and energy complex of Russia is historical and is intensifying due to the differential rent received from the production of hydrocarbons in favorable conditions. It also increases with the overwhelming predominance of a corporation in a particular region, as well as in the acquisition of production and service companies [2]. In this situation, the most unprofitable contracts are put on the free market under discriminatory conditions for contractors. Meanwhile, foreign companies can either press their contractual conditions, or refuse the contract. Thus, the monopolies will receive additional benefits at the expense of their own

contractors. Independent contractors who are not affiliated with corporations have significant difficulty in surviving in the market.

2. Inefficient decision-making system within the largest oil and gas corporations, based on the deprivation of production managers from the right to dispose financial resources and make procurement decisions. In this case, risk are managed according to deviations, with the events that have already occurred taken into account.

3. Lack of interest in financing and consuming domestic innovations by the IT industry [3]. Effective decisions in the field of innovation can be made if corporations define and set problems, finance research and implementation of developments while preserving the independence of research, education and engineering organizations. In Russia, large corporations seek to provide solutions to their problems on their own, while independent contractors have significant difficulties in reaching the commercial stage at a minimal cost.

4. The lack of leverage on the promotion of decisions and state policy within the largest oil and gas corporations, including those with state participation, on the part of ministries and agencies, as well as other public structures; the lack of a coherent government policy to promote and support domestic software and IT solutions in the oil and gas complex. It should be noted that the mechanisms of influence of public authorities on the introduction of domestic software in the oil and gas complex are ineffective [2]. This inefficiency has the following reasons:

- the lack of interest of corporations in import substitution in the IT industry;

- the lack of a state mechanism of protectionism and support in the IT industry, while in the defense industry and agriculture such mechanisms are in place;

- the lack of permanent professional sites for the development of solutions and policies in the field of software and IT technologies;

- the lack of a clear system of software standardization and certification, as well as a system of assessment of software compliance with the problems to be solved;

- insufficient state control over the use of unlicensed programs.

CONCLUSION

Information technology in the oil and gas complex can be widely used at all stages, namely, oil and gas exploration, extraction, transportation and processing. Expenses for IT are becoming one of the major expenditure items of the leading companies, which improves utilization of deposits and an increase in production growth. Oil service companies make a significant contribution to this process, offering solutions to the challenging task of automation of all information processes and improvement of their effectiveness.

Obviously, the use of information technologies will allow the automation of production processes on a fuller scale, as well as the “training” of industrial equipment to receive and process inconsistent or incomplete data obtained from

different wells, and then synthesize them into a single piece of information that ensures more efficient development of an oil or gas deposit.

The task of cost reduction in production, transportation and processing of hydrocarbons provides an opportunity to ensure the automation of basic processes in the design and technological control over exploratory drilling, the calculation of drilling parameters, and management of geological and geophysical data.

Today, special attention is paid to the development of special-purpose databases and software for geological exploration and production, the systems of three-dimensional design and automated monitoring of oil refining facilities being developed and implemented.

The technologies of construction of "intelligent" injection and production wells, creation of operations control centers on a real-time basis, construction of fiber-optic systems for collecting and transmitting information are most sought after by the Russian oil and gas companies.

However, it should be particularly emphasized that people in the "digital" oil and gas have remained one of the most crucial assets of companies. In this context, their activities are becoming more creative and intellectual.

In view of the foregoing, for solving economic and institutional problems associated with implementation of digital technologies in the oil and gas complex, it is possible to arrive at the following conclusions and formulate the following recommendations:

1. It is necessary to assess the consequences of the almost complete dependence of geophysical studies in the oil and gas complex on foreign software and IT solutions.

2. Effective import substitution program in the field of software for geophysical activities should be developed by the expert community and industry-leading enterprises.

3. It is extremely important to create a system of domestic software standardization and certification, as well as to develop modern regulations and state industrial standards in this area.

4. It is necessary to develop financing mechanisms and quotas for the procurement of domestic software and IT solutions.

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