Digital technologies as a tool for improving production and technological activities and information security in Fuel and energy complex

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Abstract. The article considers the features of using digital technologies in organizations of the fuel and energy complex (FEC). The characteristic features and main problems in the production and auxiliary processes of the oil and gas industry are identified. A study and analysis of the use of blockchain technology based on a variety of distributed registry in the fuel and energy sector, in particular for the oil and gas industry. The encryption algorithm used in blockchain technology is considered. The most relevant models for the application of projects based on distributed database subtechnology in production, trade in oil and natural gas, document management, logistics, with an assessment of the effect of digital technologies in the degree of influence on information security have been developed.

1. Introduction
A feature of the world economic system in the first quarter of the XXI century is the widespread digitalization of production and management processes in all areas of social production, including the extraction and processing of primary energy resources. The development of innovative information technologies contributes to the transformation of traditional methods of processing large amounts of information, which increases the efficiency of business-processes, allow you to form a competitive environment in all corporate areas, while ensuring the stability of the system itself, as well as reducing transaction costs, along with increasing the speed of business operations. The use of blockchain technology, based on the use of distributed registry methodology, allows implementing a reliable and transparent data management system for all participants in production and management processes, and is currently quite widespread around the world [1].

Despite the fact that initially modern information technologies developed in the banking sector, oil and gas companies actively use them in the exploration of oil and gas fields, conducting engineering and survey work, drilling wells, organizing logistics processes, making payments to consumers. At the same time, the reliability of the created information systems, as well as the efficiency of their functioning, is of particular importance.

2. Materials and methods
The authors, based on the study and processing of publicly available information, formed an idea of the degree of penetration of information and digital technologies in the production and economic activities of oil and gas companies, whose distinctive features are the large volume of property assets used, the importance of controlling the production, distribution and transportation of primary energy
resources, and the high cost of investment IT projects. It should also be emphasized that these companies are characterized by specific problems (high operating costs, a constantly decreasing percentage of oil production at existing wells and the need to develop new fields not only to increase the production of hydrocarbon resources, but also to maintain previously achieved positions, as well as the instability of global industry markets and a fairly high tax burden on business).

In order to overcome the existing problems, the largest Russian oil and gas market players are developing not only in the direction of improving production and technological activities, but also introducing methods to improve the efficiency of energy resources production through the development of the following information and digital technologies [2]:

- artificial intelligence-used for managing logistics systems;
- algorithms for processing unstructured data (Big Data) in order to provide decision support in management activities;
- augmented reality is a tool for remote consulting, which allows employees working in remote fields to interact with experts, and managers to make more effective management decisions;
- digitalization of the field allows using modern technologies to virtually simulate all stages of field development, which, of course, reduces management risks.

Nedeco oil and gas company is the founder of the Bank, which provides it with comprehensive services using modern efficient banking decisions, such as [3]:

- mobile applications for remote cash flow management (online payment services, online transfer services);
- cloud sales registers and smart terminals, as well as mass payment services.

An example of such cooperation is the partnership of the all-Russian regional development Bank and Rosneft.

3. Results
The main products of financial technologies that are becoming widespread in the Russian oil and gas industry are.

Blockchain technology, which is a continuous chain of data blocks, where each subsequent block is linked to the previous one through a set of records, which allows you to perform any operation with contractors and partners faster, cheaper and more reliable.

The principle of blockchain as a sub-technology of distributed registries is to add information to each block containing data about operations with a time stamp, which is designated as a hash sum, i.e. values in hexadecimal form, which is also a digital signature. The hash function is necessary for compressing the original generated text of information into a short block of data. Then these blocks are built into a sequential chain of blocks. Visually, the block chain can be represented as follows figure 1.

A large array of data in the process of interaction between functional elements determines the optimal conditions for using blockchain technology. Based on the block chain, you can develop a single network for digitizing all major processes and automating them.

The oil-producing ecosystem is quite extensive, complex, geographically dispersed, but at the same time it is characterized by stable relationships of its participants and a large number of tasks in the field of production management.

Artificial intelligence that allows you to perform many operations in oil companies more efficiently and, most importantly, reliably. These are, first, smart wells and smart fields, which are innovative developments based on digitalization of production processes that can independently adapt to changing conditions. In addition, "smart well" or "smart field" is able to diagnose the system, which
allows timely repair of technological equipment and ensure a more complete utilization of existing production capacity [5].

Figure 1. The hierarchy of blocks in the blockchain mechanism.

Smart – contract: an algorithm designed for entering into and executing contracts based on the fulfillment of all the conditions specified in it, which reduces the risk of errors and increases the speed of business transactions. The oil and gas sector is characterized by a large number of contractors, which implies the conclusion of a large number of contracts. When a person controls the execution of contracts, there is a possibility of technical errors and even abuse. Smart contracts, being self-executing, allow you to exchange assets without resorting to services, although they can be changed with the consent of the parties in respect of all amendments to the contract.

Big Data – technology that provides storage, processing and use of large volumes of information, which is especially important for oil companies that are engaged not only in production, but also in transportation to consumers of energy resources of the required quality.

Non-banking services that provide remote access to digital services.

As the main advantages of the ubiquitous spread of digital technologies, it is customary to highlight:

- reducing the risk of fraud and money laundering;
- improving the efficiency of companies by reducing transaction costs.

In General, the wider use of digital technologies should contribute to achieving the goals of the «Energy strategy of the Russian Federation until 2030», so as:

- increase the oil recovery rate by 5-10% in «digital fields»;
- reduce operating costs at digital fields by 10%;
- reducing capital expenditures on «digital fields» by up to 15% [6].

At the same time, digitalization of all components of the main production and management processes is impossible without improving information security systems, since in recent years the number of hacker attacks has been growing in direct proportion to the development of information technologies, which leads to significant losses and losses for oil and gas companies. According to estimates of Russian law enforcement agencies, the damage from the negative impact on the information resources of companies engaged in oil and gas production may amount to about 1.2% of GDP. The attacks are mainly aimed at extracting information about personal data and information about customers and transactions as in figure 2 [7].
Unauthorized theft of information, expressed in the form of espionage, is usually aimed at obtaining technical information containing information about the features of the organization of technological processes, as well as production accounting data in order to actually determine the capabilities of companies to participate in certain investment projects.

Considering the side of information security, the block hierarchy described in figure 1 is also provided with encryption, that is, it is supplemented with cryptographic protection. In order to determine how the blockchain technology contributes to the protection of information and prevents its theft, let's turn to the simplified scheme for implementing cryptographic protection, shown in the figure 3.

When initiating an operation, two key types are generated in the distributed registry system: a secret key and a public key. The public key is determined from the paired secret key and passed to the rest of the network participants for verification of the electronic signature. A digital signature, as mentioned earlier, is a hash function of generated information. Then the initiator of sending information encrypts the information sent by the hash block with a secret key. The generated number pair is a digital signature. The result of implementing the blockchain encryption algorithm is to transmit a message to the recipient along with a digital signature.

Thus, the described encryption algorithm applied to each generated block in the chain defines the blockchain technology as a fairly effective tool to prevent hacking by cyber attackers. With the expansion of the use of digital technologies, the need to use blockchain technology is steadily growing in parallel with the growth of cyber threats, which requires timely and rapid implementation of
measures to prevent them or minimize the possible consequences associated with the «leak» of information.

4. Discussion
As noted earlier, the widespread digitalization of production and management processes that accompany oil and gas production has made it possible to switch to new technologies, despite the previously skeptical attitude to the idea of distributed registries. In particular, major international oil traders Mercuria and Trafigura have distinguished themselves by using blockchain projects to optimize business processes in resource trading, increasing the efficiency of transactions in hydrocarbon and gaseous raw materials and ensuring digital control of document flow. In an attempt to compete with existing crypto currencies, the company R Fintech has created its own virtual currency Bilur, the value of which is tied to oil assets. Prospects for the use of blockchain technology determine limitless opportunities, forming a modification vector for optimizing and reengineering ongoing processes in vertically integrated oil and gas companies, followed by the creation of new business models based on technologies built on continuous sequential chains of blocks.

It should be noted another advantage of the use of technology distributed register – cyber security. Cyber risks are a set of risks associated with a destructive impact on information systems and networks through the implantation of malware, which, in turn, have a negative impact on both infrastructure technologies and the information security of the company as a whole [8].

In recent years, the number of hacker attacks has been steadily increasing, which leads to significant losses and losses, the value of which, according to Russian law enforcement agencies, can be about 1.2% of GDP. At the same time, experts identified the main channels of cyber attacks on fuel and energy facilities through malware table 1.

| Types of malware                                                                 | Frequency of implementation |
|----------------------------------------------------------------------------------|-----------------------------|
| Attacks on fuel and energy complex                                               | 40.2                        |
| Attacks on organizations that produce equipment and components for the fuel and energy complex | 36.4                        |
| Ransom ware                                                                      | 11.7                        |
| Miscellaneous                                                                    | 11.7                        |

The wider spread of distributed registry technology automatically ensures the safety of data on decentralized network nodes, while adding cryptography to the blocks of information, which ensures a high and reliable level of protection of commercial information.

5. Conclusion
Every business process in oil and gas companies requires infrastructure technologies that allow controlling the accuracy and reliability of the characteristics of the extracted and sold raw materials, facilitating and solving problems of speed of operations, as well as automating most of the procedures related to confirming the reliability of the results of production and economic activities and ensuring the guarantees of contracts. At the same time, the introduction of technologies that increase the efficiency of processes in companies must be accompanied by information security, since the development of digital technologies increases the risk of unauthorized interference and information leakage, which can threaten not only the reputation, but also, often, the very existence of the company.

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