

# The role of innovative technologies in the development of the fuel and energy industry of the Russian Federation

*Dmitrii Antipin*<sup>1\*</sup>, and *Miao Zhiqiang*<sup>1</sup>

<sup>1</sup>Irkutsk National Research Technical University, 83, Lermontov St., Irkutsk, 664074, Russia

**Abstract.** The efficiency of fuel and energy companies depends to a large extent on the level of automation of technological processes, information security, and cost reduction through the introduction of innovative technologies. The article considers the problems of using innovation in the enterprises of the fuel and energy sectors, the analysis of the main indicators of the level of their development. The article offers directions for the introduction of innovations in the fuel and energy complex of the country. The influence of the use of innovative technologies on the process of drilling wells was studied. A model for cost optimization based on the use of innovative technologies to automate the processes of collecting and processing information obtained during drilling was developed.

## 1 Introduction

The fuel and energy industry is one of the system-forming factors of the sustainable national economy whose efficiency depends on the use of innovative technologies. To ensure the competitiveness of the energy industry, it is necessary to introduce innovative technologies at all stages of production processes.

The global fuel and energy market plays a significant role in international trade, which encourages companies to transform the supply chain using digital tools and accounting for related transactions and technological processes. Digital transformation occurs due to the use of modern information technologies, which can improve productivity at all production stages and simplify accounting operations.

The problem of application of modern technologies in the activities of enterprises, including enterprises of the fuel and energy sector is actively researched by domestic and foreign researchers [1-6]. At the same time, an important area for research remains the question of the transformation of technology and its adaptation in modern conditions.

The digitalization of the Russian energy industry has been recently launched; but it has a positive impact on the development of the fuel and energy industry of Russia. Since Russia is one of the main world energy exporters, digital technologies provide new opportunities and obvious economic benefits in all sectors of this industry. Discussion of

---

\* Corresponding author: [dmitrii\\_antipin@mail.ru](mailto:dmitrii_antipin@mail.ru)

new processes by the government and researchers and their implementation in the fuel and energy sector seems to be relevant.

## **2 Materials and methods**

We used a set of methods when conducting research. The first group of methods is theoretical methods. They include the historical method and analogy methods. The second group is empirical methods, including the method of analysis and comparison. In the third group we have attributed mathematical and statistical methods. These methods are used for construction of cost optimization model of drilling, as well as the study of the structure of financial support of their implementation [7, 8].

The statistical data from official open sources, including the Ministry of Energy of the Russian Federation, the Federal State Statistics Service, and fuel and energy enterprises, were used.

It was from the field of energy in our country that the introduction of technologies allowing for the transition to a new technological stage began. For the first time the application of such technologies was tested in the system of management and operation of energy networks. In the fuel sphere application of innovations is actively used for geological prospecting works, as well as in the process of operation of pipelines and reservoirs.

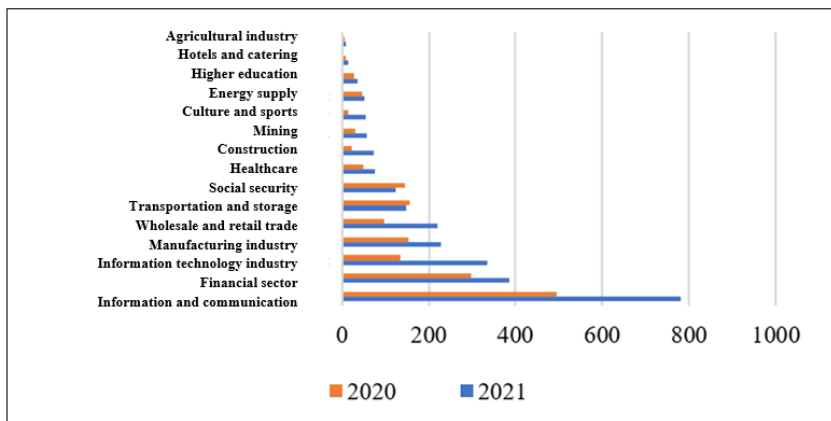
The amount of oil losses is usually proportional to the amount of well downtime; by reducing the amount of response time to well shutdown, the oil and gas company can reduce the amount of oil losses. In this regard, it is necessary to consider the possibility of optimizing drilling operations to solve the problem of reducing non-production time. In order to improve the quality of the analysis of drilling processes, it is necessary to use specialized software designed to automate the processes of collecting and processing information obtained during drilling.

## **3 Results**

Industry 4.0 describes the growing trend towards automation and data exchange in technologies and processes of this industry and includes technologies such as integration, big data, simulation, autonomous work, additive technologies, and cloud computing. The statistics shows that the pace of digitalization in the energy sector is increasing. Figure 1 shows the costs that organizations spend on the development and implementation of innovations. The data of the figure show positive dynamics in this area.

The oil and gas sector has rich experience of using innovative technologies, especially in the exploration and production processes. In addition, the sector retains significant potential for the digitalization to improve the efficiency of operations. At the same time, researchers and practitioners claim that one of the main problems of the oil and gas sector is the need for improving the drilling process. This direction has a significant impact on profits and environmental protection. The cost of drilling is a decisive factor in determining the financial return from the oil and gas industry. Therefore, the use of innovative technologies that can optimize the drilling process is a solution to the problem of reducing non-production time.

Non-production time affects both the speed and possibility of drilling. Such events are a key indicator of the profitability and success of drilling operations. This situation can be caused by various reasons, the impact of which cannot be controlled or reduced.



**Fig. 1.** Internal costs of companies for developing, distributing and using innovative technologies by type of economic activity, billion rubles.

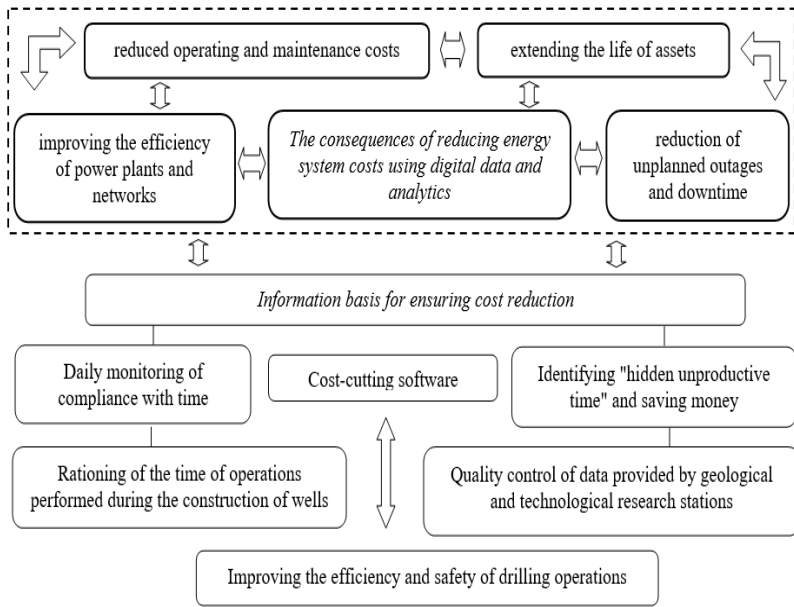
Drilling performance is usually monitored by traditional methods, such as the reporting methodology (well end reports or daily drilling reports). However, innovative technologies may be used to monitor performance as a significant amount of drilling data is captured at any time during ongoing drilling operations. Comparison allows for the identification of the most effective drilling contractor.

The drilling performance of various drilling contractors can be monitored, indicating improvements or decreases in non-production time events. The drilling contractor's personnel should know the reasons why non-production time events occur and how to prevent them. Most of the non-production time indicators are tracked for each well. At the same time, monitoring non-production time is not effective. All available data rather than one key performance indicator (KPI) should be taken into account when benchmarking drilling contractor's NPT performance. Many drilling rigs record a huge amount of data on drilling parameters, which are transmitted to drilling centers. However, engineers cannot use the data for a prompt analysis.

To improve the efficiency of information processing in the organization of drilling processes, it is necessary to use a comprehensive model (Figure 2). These developments are based on the application of special information equipment for drilling.

The model can identify hidden and potential non-production time events, which usually remain invisible in standard technical processes. In addition, one of the most important advantages of the software presented in the model is that the process is automated, which means that a level of optimization can be achieved without support resources. The software can be used to conduct an efficiency analysis, to see comparative results for several drilling crews, drilling intervals and extension operations.

In order to increase oil and gas production on the surface or seabed, wells must be deepened. This process, in turn, leads to an increase in energy consumption. As a consequence, the price of extracted raw materials increases. In this regard, the model proposed in the article is of particular relevance and importance in modern economic conditions.



**Fig. 2.** The cost optimization model based on the use of innovative technologies for automating the processes of collecting and processing information obtained during drilling.

## 4 Discussion

Further research in this area will focus on expanding the use of advanced technologies that will increase the competitiveness of the products offered in the global market. One such area is the use of various innovative applications. In addition, the scope of application of the so-called optical sensors is expanding. They will enable to increase the volume of raw material extraction with the least expenditure of energy resources.

No less important direction in the area under study is the use of automated drilling rigs. They can be used to repair infrastructure facilities that are located on the seabed. In addition, they can be used to monitor pipelines.

The third direction is drones. The efficiency of their application in various areas is very high. In the investigated area, the use of drones is aimed at surveying the work of pipelines over long distances or on the seabed.

Studies by scientists show that the use of modern technology can provide cost reductions of about fifteen or twenty percent. This will undoubtedly have a significant positive effect on the cost of the finished product.

## 5 Conclusion

The study allows for the following conclusions. In the current economic conditions, enterprises of all industries strive to implement innovative technologies into production processes at various stages of the technological process. Fuel and energy companies are no exception. In Russia, investment in innovative technologies is increasing every year. The amount invested last year was more than fifty billion rubles. At the same time, the efficiency of the energy industry is of great importance both for the country and the whole world.

In addition, fuel and energy companies are the engine of economic progress. The process of implementing innovative technologies is an important component of the development of the modern world. The further development of the enterprise, its competitiveness and profit depend on the effectiveness of this process. Currently, only the strongest companies survive. They have time to adapt to the new realities and to modernize the production process. Since the fuel and energy industry of Russia is one of the most important ones, enterprises should strive to maintain their leading positions and keep up with the times, implementing innovative technologies.

## References

1. J. Twidell, T. Weir, *Renewable Energy Resources* (Taylor & Francis, New York, 2006)
2. A. Nechaev, A. Rasputina, *Theory of tax variation calculation*, Materials of the IOP Conference Series “Earth and Environmental Science”, 032010 (2020)
3. Discover Top 10 Oil & Gas Industry Trends & Innovations in 2023, <https://www.startus-insights.com/innovators-guide/top-10-oil-gas-industry-trends-innovations-in-2021/>
4. A.S. Nechaev, O.V. Antipina, *Assessing the innovation attractiveness of areas: Problems and solutions*, Journal of Advanced Research in Law and Economics, **7**, **3**, 561-571 (2016)
5. Gateway to growth: innovation in the oil and gas industry, <https://www.pwc.com/gx/en/oil-gas-energy/publications/pdfs/pwc-gateway-to-growth-innovation-in-the-oil-and-gas-industry.pdf>
6. B. Ibrahimov, *Open Innovation and application to Petroleum Industry Materials of the 18th IFAC Conference “ Technology, Culture and International Stability”* (2018)
7. A. Nechaev, D. Antipin, O. Antipina, Financial and tax instruments for stimulation of enterprises innovative activity, *Problems and Perspectives in Management*, **12**, **2**, 173-180 (2014)
8. Y.N. Barykina, A.G. Chernykh, B. Na, *Energy production as a basis for sustainable development in the BRICS countries*, Materials of the IOP Conference Series “Earth and Environmental Science”, 990, 1, 012016 (2022)
9. Innovation and New Technologies in the Upstream Oil & Gas Industry, <https://www.oil-gasportal.com/innovation-and-new-technologies-in-the-upstream-oil-gas-industry/>
10. A. Nechaev, A. Schupletsov, *Methods for Improving Efficiency of the Innovative Logistics System*, Transportation Research Procedia, **54**, 628-636 (2021)
11. Y.N. Barykina, E.I. Gavrikova, M.L. Tang, *Leasing as a Tool for Financing of Innovative Projects*, Springer Proceedings in Business and Economics, 223-229 (2020)
12. O.A. Krasovskaya, V.E. Vyaznikov, *The lending efficiency in the construction industry*, Materials of the IOP Conference Series “Earth and Environmental Science”, 751, 1, 012152 (2021)
13. O. Antipina, E. Kireeva, N. Ilyashevich, O. Odoeva, *Digitalization of Regional Economies in the Context of Innovative Development of the Country*, Lecture Notes in Networks and Systems, **432**, 224-235 (2022)
14. S.V. Zakharov, M.Y. Ivanov, A.V. Rebrikova, X. Shuiyao, *Special economic zones and the role of construction industry enterprises in their creation*, Materials of the IOP Conference Series “Earth and Environmental Science”, **751**, **1**, 012187 (2021)