

PROSPECTS FOR THE APPLICATION OF DIGITAL TECHNOLOGY IN FIELDS IN AZERBAIJAN**Karimov K.,***associate professor, Azerbaijan State University of Oil and Industry,
honorary oil worker,***Dadashova N.,***teacher, Azerbaijan State University of Oil and Industry***Safarli Z.***assistant, Azerbaijan State University of Oil and Industry*<https://doi.org/10.5281/zenodo.11094837>**Abstract**

In the article, the problems of digital technologies in the extraction of large volumes of natural hydrocarbon reserves in the oil fields of Azerbaijan, which are in the final stage of development, are explained. In this field, the scientific research of foreign scientists and the experience of leading oil companies was examined and the importance of applying digital technologies in the future of the oil fields of the republic was explained. Given the progressive depletion of easily extractable reserves in oil fields, alongside the complexity of mining conditions and the need to address complex tasks with novel methods and technologies in search, exploration, and development, modern technologies play a crucial role. It is noted that the technological development of oil and gas companies is accompanied by a sharp increase in the popularity of information and the expansion of the use of information technology. This is favored by the rapid development of information systems and new discoveries in information production, such as Internet of Things, "digital deposits", and other progressive technologies, which, in turn, can create potential for increasing the efficiency of developing companies in the oil and gas complex.

Keywords: smart deposits, digital technology, hydrocarbon reserves, innovation, digital transformation

Introduction

More than 50 fields are currently being developed in Azerbaijan. The development of difficult-to-extract reserves is important because their share of the total structure of hydrocarbon reserves is 60%, and oil production, in turn, decreases annually. In the conditions of progressive depletion of easily extractable reserves of oil fields, SOCAR (Azerbaijan Republican State Oil Company) must solve increasingly complex tasks in the field of improving methods and technologies of oil field exploration and development. Possible progress in this direction is based on the use of advanced domestic and foreign technologies, among which a prominent place is occupied by information technologies (IT). In the conditions created, it is digital solutions that are becoming priority directions in increasing the efficiency of oil companies.

Today, practically all leading oil and gas companies worldwide base their development strategy on digital transformation as the main focus. Digital transformation is a significant competitive advantage; it contributes to increasing the profitability of oil and gas companies and enhances their stability on the market.

The tasks of the research in the article are the study, analysis of literature and practical work of leading foreign companies in the field of technical and economic substantiation of oil and gas projects in the conditions of digitalization, identification of current problems and directions of improvement of oil and gas projects in the conditions of digitalization, implementation of modern digital technologies for oil and gas production facilities.

For this purpose, we have determined the following objectives:

- analysis of theoretical foundations of digitalization and digital transformation;

- analysis of the world experience for the introduction of digital technologies at SOCAR oil and gas fields;

- definition of advantages and disadvantages of digital technologies implemented in oil production.

It should be noted that the importance of using modern digital technologies is directly related to the potential of oil and gas production. It is for this reason that leading companies implement digital technologies in different production chains. Many foreign experts are convinced that digital technologies will stimulate the growth of oil production in the world by 30 to 50%. This can be achieved by introducing innovations not only in technological terms, but also by making quality management decisions [1]. Digital technologies in the oil and gas industry are mainly aimed at solving the following questions:

- increase in oil output (КИН);
- reduction of operational and other costs [2, 3].

Along with the positive trends in the development of digitalization in the leading companies of the oil and gas industry in Azerbaijan, there remain a number of unsolved problems that complicate the formation of digital platforms, namely:

1. Dependence of SOCAR on foreign technologies, equipment, software and investments.
2. Domestic and foreign oil companies operating at the republic's fields on land and sea do not finance digital projects for implementation.

For example, in the USA, the Rocky Mountain Oilfield Testing Center, a technological training ground, is financed by the US Ministry of Energy [4]. This landfill is engaged in the improvement of the system of extraction of highly saturated oil. Such a solution has proven to be very effective and is well-suited for use in Azerbaijan, particularly for deposits at a later

stage of development [5]. The main question here is how to transition to an intellectual approach to solving production tasks and improving the quality of process management.

Every year, the number of digital deposits in the world is growing. Now the companies "BP", "Shell" and "ExxonMobil" are leaders in the segment of introduction of intellectual technologies in the oil and gas industry. From a practical point of view, the digital transformation in the oil industry is divided into two stages:

- automation and telemechanics for the purpose of permanent remote control and management;
- introduction of automatic management of industry in "real time" mode [6,7].

Methodology, rationale for implementing digital technologies in oil and gas fields: Intelligent technologies have different areas of management (production, financial, labor, operational management, regular management, business processes and others. The main directions of digitalization of the oil industry are: big data; digital duplicates (creation of an integrated location model); IoT (internet of things), 3D printing, and smart materials [8,9,10].

"Smart sites" are also called "intellectual" or "digital". In the sources of literature, you can find a considerable number of definitions of this term, however, they are all similar in essence:

- the intellectual deposit is a dynamic system of interrelated technologies that provide an increase in the economic efficiency of all elements of production and management of oil and gas assets;
- digital location (IQM) is software that includes a set of applications that allow you to describe the behavior of the location on a computer.

Many foreign oil companies already have the experience of implementing digital technology at oil fields. Modern technologies that use information systems have their own names in each company:

- Shell, «Умное месторождение» (Smart Field);
- Chevron, «Интеллектуальное месторождение» (i-Field);
- BP, «Месторождение бесплатно» (Field of future);
- Petro, «Smart Operations» (Smart Operations);
- Statoil Hydro, OLF, «Integrated Operation» (Integrated Operations);
- Halliburton, "Operations in Real Time Operations";
- Schlumberger, «Smart Wells» (Smart Wells);
- CERA, "Digital oil field of future (DOFF)";
- Cap Gemini, "Intelligent field optimization and remote management (INFORM)";
- ADCO, «Integrated Asset Operation Model (IAOM)» etc.

Despite the difference in names, the new management technologies are, in essence, close and identical in terms of their goals and tasks to be solved in real time:

- accelerated processing of all information;
- modeling of multiple production scenarios;
- maximization of production and achievement of high coefficients of extraction of hydrocarbons;

-choosing a rational variant of development and performing work on optimization of production.

In foreign oil companies, works of an analytical and applied nature appear, which summarize ten years of experience in using CM. Attempts are being made to generalize the technological and economic results achieved, and requirements are formulated for the creation of an integrated business management system based on digital technologies. In Azerbaijan, publications on these issues are limited, and we are currently observing only the initial stage – the implementation of 'pioneer' projects, typically within the framework of joint ventures.

The interest in smart technologies in the oil and gas industry is not simply related to fashion trends, but to the real problems facing mining companies today. In Azerbaijan, most of the developed fields are at the final stage, but oil reserves are disappearing in hundreds of millions of tons. Especially if we are talking about the Azerbaijani oil reserves, the time of "easy oil" is behind us. Unique deposits, the development of which began about half a century ago, are now at the stage of declining production. And this trend will only intensify.

Today it is obvious to everyone that if we do not start developing new fields, then in the near future there will simply be nothing to extract in Azerbaijan, and accordingly, there will be nothing to export. Promising reserves in the sense of reservoir geology, for the most part, can be classified as "hard-to-recover." At the same time, it is clear that, given the sharp drop in oil prices, production cost indicators are beginning to play a decisive role. If previously the inefficiency of an oil and gas producing company could be at least partially covered by a price of \$80 per barrel, then in the foreseeable future we can hardly count on something like that. To remain profitable, SOCAR must inevitably reduce costs and improve its efficiency. And intelligent technologies will help solve this problem.

Determination of the conditions for the development and use of CM in the republic:

For highly profitable development of oil and gas fields, it is necessary to create smart oil and gas complexes - with a high degree of automation, unmanned production complexes, intelligent control systems for technological, energy, transport production processes (smart transport, energy networks, water use, supply and marketing of oil, gas and petroleum products).

The digital transformation of the fuel and energy complex (TEC) of Azerbaijan is not a tribute to fashion, but a vital necessity. This is especially true for oil production, which is becoming more and more difficult to extract every year. Especially in conditions when environmental requirements are becoming stricter and all countries are beginning to take measures to reduce their carbon footprint. The primary goal of digitalization is to increase efficiency, thereby reducing costs, including energy consumption, and minimizing emissions into the atmosphere. Digitalization is one of the most obvious ways to reduce our impact on the environment."

According to expert estimates, in recent decades the oil recovery factor (ORF) in oil production in Azerbaijan has been steadily declining, and currently, it does not exceed 30 percent. One of the reasons is the gradual

development of areas with maximum oil recovery. For operating fields, digitalization can become a real “second wind,” says an expert from VYGON Consulting. Central heating will allow optimizing the well stock, eliminating unprofitable ones, increasing the efficiency of equipment operation and repair, and selecting optimal technologies for increasing oil recovery. According to our estimates, in the next 10-15 years, thanks to the development of artificial intelligence, oil recovery factor could increase by 5 percent. The introduction of digital solutions in general will reduce exploration and production costs by 20-25 percent and operating costs by 10-15 percent for comparable categories of reserves and assets.

Barclays expects even greater returns from digital technologies, believing that they will enable global oil producers to increase the oil recovery factor by 10 percent and reduce production costs by the same amount. This will save about \$150 billion annually.

Large oil producing companies in the world and in Azerbaijan consider digital technologies as one of the main conditions for successful business, sustainability and competitiveness. The key effects of their implementation are reducing the cost of production, transportation, refining and marketing of oil, optimizing key business processes, increasing the efficiency and quality of decision-making,” notes Dmitry Pilipenko, Deputy General Director of SAP CIS. - BP, a pioneer in the implementation of digital solutions, estimates the effect of them at 2-4 percent.

Among the technological solutions that are now being actively implemented and helping to increase production, experts highlight a digital twin of the field. “Thanks to this technology, it is possible to test the location of a well in different formations and see how its flow rate will change,” explains Anton Ablaev, director of acceleration for the oil and gas direction of the cluster of energy efficient technologies of the Skolkovo Foundation. It is important to choose the option that will ensure better economic efficiency and achieve the planned goals. The expert cites the example of the Salym Petroleum field, where all wells have pressure sensors and downhole pressure gauges, which are collected several times a minute and fed into the digital model of the field. The efficiency of its development increases by 3-7 percent, and this is not the limit, according to Anton Ablaev. According to the company’s estimates, the use of innovative information (AI) methods can increase the enterprise’s oil production by more than 50 tons per day.

Digital support will be especially useful when developing hard-to-recover reserves (TRIZ) of oil. Currently, their share in production is small - less than 5 percent, but in the total volume of proven reserves, it is more than 60 percent. In our opinion, in 10 years almost all oil produced in Azerbaijan will be classified as TRIZ, and the cost of production will increase significantly. Most of the hard-to-recover reserves can be developed using digital solutions, and modern methods of interpreting the results of geological exploration and reservoir modeling make it possible to improve the quality of design and engineering.

All key economic and industry forums have been discussing “smart” technologies in the fuel and energy sector, including in the oil exploration and production segment (upstream). In the upstream, this term primarily refers to the introduction of a complex of digital technologies into operational processes, rather than just the now popular blockchain. Digital technologies have always accompanied the upstream; in this sense, it was smart before. For example, the development of vector computing stimulated the use and interpretation of 3D seismic (reserve prospecting technology). The introduction of one of General Electric’s software developments became the first big data analysis tool and the basis of the modern concept of a digital field. Here are just a few examples of the use of digital solutions to increase upstream efficiency:

- BP, together with Silicon Microgravity, is developing highly sensitive, small-sized sensors that allow engineers to better control reservoir development parameters based on data analysis. The positive effect is estimated at a 2% increase in production rate, and a 5% reduction in downtime and drilling costs;

- Seven Lakes Technologies is testing Field Data-Gathering Workflow solution technology. It allows you to reduce equipment downtime by 50%, and reduces production losses from 5 to 2.5%;

- Shell’s experience shows that the transition to a “smart” field can increase the oil recovery factor by 10%.

In conditions of low oil prices, technologies like these become especially important, so all leading companies are increasing investments in digital developments. An Accenture study conducted in 2022 showed that 36% of surveyed oil and gas companies are already investing in big data technologies and analytics, 38% are going to do this in the next 3-5 years. Only 16% of respondents are currently investing in artificial intelligence methods, but in the near future 23% will allocate a budget for such developments.

In the scenario of successful development of digital technologies, the number of technically extractable traditional resources will increase, and their cost will decrease. This factor, even in the face of growing demand, will squeeze expensive projects out of the supply curve and have a negative impact on the price of oil.

According to BP estimates, as a result of the development of all technologies, technically recoverable reserves can increase by 35%, and production costs can decrease by 25%. According to the April forecast of the World Bank, the price of oil by 2030 will be \$66/barrel in nominal terms. A 25% reduction in costs could bring the price below \$50/barrel, and an increase in supply from even cheaper traditional reserves could lead to a drop below \$40/barrel.

Conclusions

1. The results of the study, as well as the recommendations developed, can be used in the preparation of industry documents to justify the feasibility of introducing and using digital field technologies and modern methods aimed at increasing the productivity of oil and gas operations, reducing costs in individual elements of the oil and gas chain, and increasing the reliability and environmental efficiency of oil and gas operations.

2. The use of intelligent technologies in the field allows us to take a step forward compared to the use of traditional automation systems. The “smart” system provides the company’s responsible personnel with all the necessary information in real time and allows them to adequately and almost instantly respond to changes in parameters, flexibly adapt to changing conditions, and achieve maximum production volumes.

3. In the current economic situation and in the context of falling production, the introduction of “smart field” technologies is becoming a critical condition for maintaining the competitiveness of oil-producing companies. Moreover, the use of smart technologies in oil and gas production can take the industry to a new level.

4. The main problems in the implementation of smart technologies are: insufficient funding from companies and the state, the lack of a large number of qualified specialists, the lack of a uniform standard for the use of digital technologies, commitment to traditional mining, and a number of other problems.

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