INDUSTRIAL ECONOMY AND ORGANIZATION OF INNOVATIVE ACTIVITY

ECONOMÍA INDUSTRIAL Y ORGANIZACIÓN DE LA ACTIVIDAD INNOVADORA

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ABSTRACT:

The transformation of industrial structures in resource-rich developing economies presents crucial challenges for achieving sustainable growth and avoiding dependence on these resources. Azerbaijan's mining sector, and particularly its oil and gas industry, is a prime example of both the potential opportunities and the inherent complexities of resource-based industrialization. Despite the sector's strategic importance, contributing approximately 67% of the country's industrial output, significant gaps remain in the regional implementation of innovative technologies and in how systematic approaches could optimize production efficiency while minimizing environmental impact and resource depletion. Against this backdrop, this research examines Azerbaijan's oil and gas sector through a quantitative analysis of official statistics (2019–2023), focusing primarily on production dynamics, structural transformation, and the potential role of digitalization and artificial intelligence in addressing operational inefficiencies. Comparative analysis, evaluation of ownership structures to identify patterns in production volumes, and documentary analysis were used for this purpose. Substantial volatility was found in the sector due to various factors, as crude oil production decreased by 19.6% (7,353,800 tons) between 2019 and 2023. Critical inefficiencies include natural losses of between 0.1% and 0.3% in oil production and between 24.9% and 31.2% of gas destined for non-commercial uses. It was also identified that factors such as technological obsolescence, measurement inaccuracies, and inadequate loss control mechanisms are among the major contributors to these inefficiencies. Therefore, although companies in the non-state sector increased by 23.5%, their contributions to added value are not as significant due to the aforementioned volatility.

RESUMEN:

La transformación de las estructuras industriales en las economías en desarrollo ricas en recursos naturales presenta desafíos cruciales para lograr un crecimiento sostenible y evitar la dependencia de estos recursos. El sector minero de Azerbaiyán, y en particular su industria de petróleo y gas, es un excelente ejemplo tanto de las oportunidades potenciales como de las complejidades inherentes a la industrialización basada en recursos naturales. A pesar de la importancia estratégica del sector, que contribuye aproximadamente al 67% de la producción industrial del país, persisten importantes deficiencias en la implementación regional de tecnologías innovadoras y en cómo los enfoques sistemáticos podrían optimizar la eficiencia de la producción, minimizando al mismo tiempo el impacto ambiental y el agotamiento de los recursos. En este contexto, esta investigación examina el sector de petróleo y gas de Azerbaiyán mediante un análisis cuantitativo de las estadísticas oficiales (2019-2023), centrándose principalmente en la dinámica de la producción, la transformación estructural y el papel potencial de la digitalización y la inteligencia artificial para abordar las ineficiencias operativas. Para ello, se utilizaron análisis comparativos, evaluación de las estructuras de propiedad para identificar patrones en los volúmenes de producción y análisis documental. Se detectó una volatilidad considerable en el sector debido a diversos factores, como la disminución de la producción de petróleo crudo en un 19,6% (7.353.800 toneladas) entre 2019 y 2023. Las ineficiencias críticas incluyen pérdidas naturales de entre el 0,1% y el 0,3% en la producción de petróleo y entre el

24,9% y el 31,2% de gas destinado a usos no comerciales. También se identificó que factores como la obsolescencia tecnológica, las imprecisiones en las mediciones y los mecanismos inadecuados de control de pérdidas se encuentran entre los principales contribuyentes a estas ineficiencias. Por lo tanto, si bien las empresas del sector no estatal aumentaron un 23,5%, su contribución al valor agregado no es tan significativa debido a la volatilidad mencionada.

Palabras clave: Estructura industrial, Producción de petróleo y gas, Economías basadas en recursos, Inteligencia artificial, Digitalización, Innovación, Azerbaiyán.

INTRODUCTION

The analysis of how socio-economic development shapes industrial organization is very relevant to understand modern economic systems (Zhou et al., 2023). As nations deal with globalization and domestic development, the organization of production and service sectors has become a hotspot to achieve nations growth goals while meeting societal needs. The relationship between industrial structure and economic development has been a central concern in development economics since the works of Chenery (1979) and Kuznets (1966), who demonstrated that structural transformation—the reallocation of economic activity across sectors—is intrinsically linked to income growth and productivity gains. This transformation is not merely a technical process but rather a complex interplay of institutional arrangements, policy frameworks, and historical trajectories that vary significantly across different national contexts. This link becomes especially complex in resource-rich economies, where nations must manage the simultaneous problems of using natural resource endowments for economic growth while avoiding the dangers of resource dependency and the so-called "resource curse" phenomena (Wang et al., 2023). Therefore, a country's development trajectory and capacity to achieve sustainable, inclusive growth are significantly shaped by the strategic choices made regarding industrial organization, such as whether to prioritize import substitution or export-oriented strategies, how to balance foreign investment with domestic capacity building, and how to make sure that resource extraction contributes to broader economic diversification (Anser et al., 2025).

The theoretical foundations to address industrial organization in developing economies draw from multiple analytical frameworks, including structuralist economics, institutional economics, and more recent approaches emphasizing value chains and global production networks. Structuralist perspectives emphasize the importance of addressing production bottlenecks, building forward and backward linkages between sectors, and managing the terms of trade between primary commodities and manufactured goods. Institutional approaches,

meanwhile, highlight how governance structures, regulatory frameworks, property rights systems, and coordination mechanisms between public and private actors shape industrial outcomes (Gollin & Kaboski, 2023; Lin & Wang, 2020). Understanding how these various factors interact requires a multidimensional analytical approach that considers not only economic efficiency but also social equity, environmental sustainability, and long-term structural resilience. In this regard, it is important to recognize that cultural practices, and everyday life form the basis for the creation of numerous and diverse production (service) configurations. The formation of balancing planes such as "demand-supply" and "needs-satisfaction" acts as a purposeful set of activities including specific regulations on a sectoral scale, effective management formations, and "landscapes" of lawful organization. The resolution of the controversial points in question and the narrowing of the scope of influence of complex situations as much as possible confirm the presence of fundamental traces in the evolution of industry.

A central challenge facing developing economies is the strategic balance between import dependency and domestic production capacity (Cherif & Hasanov, 2024). The selection of meeting domestic demand at the maximum possible level as one of the important goals is among the important foundations of activities carried out in the country and its regions by various methods (marketing surveys and monitoring, clarification of the actual supply-demand balance in exchange venues, preparation of information bases on the implementation status of various State and other programs, etc.). At the mentioned level, along with imports, the organization of domestic production (service) activities plays a specific role. Meeting the demand requires clarification of the type-composition expressions of the products produced and intended to be produced, as well as the services provided.

Considering the Republic of Azerbaijan, in the period after the regained independence, the specialization of regions within the country, the assessment of natural resources and their use opportunities at appropriate levels, the constant improvement of the elements of economic regionalization in the modern era, and the implementation of purposeful concentration processes taking into account the realities of product production act as a set of steps taken in the direction of planning, management, organization, and regulation, which are intended to be implemented as a single system. However, the transformation of industrial landscapes requires not only technical advancement but also careful consideration of their broader societal and environmental implications. The experimental implementation of various progressive stages in the production of created industrial entities, in the work and services performed, have created the basis for the formation of different economic configurations in the areas and directions of the

economic system. In addition, the use of specific general and special economic tools and means, methods, and mechanisms at the scale of industrial enterprises, along with other factors, requires an assessment of the impact of the ecological environment (factors) on the lifestyle of the country and its citizens in general.

In this study these multifaceted considerations are addressed. The article's focus on the industrial sector, and more specifically, the country's mining sector. By analyzing the mining industry as a case study, this research contributes to the broader understanding of how resource-based economies can optimize their industrial structures while maintaining environmental sustainability and meeting domestic demand.

DEVELOPMENT

Industrial field at historical and theoretical levels

Industry plays a unique role in the economic system of developed or developing countries. The position it occupies and the effects it has on specific economic systems have been quite substantial, and in some cases, it has influenced the direction and trajectory of these systems, holding a decisive position in the specialization of countries. Industry, which began its progress in world history with the emergence of the first manufactures in England in the 16th century, has undergone deeper divisions in subsequent periods. In modern times, there is a fairly broad and multi-level classification of industry. The leading sectors—mining and processing industries—are established in areas and directions of activity that are rich in constituent elements.

As noted in a previous work, the formation of the foundations of industrial methods of mining in the middle of the 19th century had a significant impact on the development of Baku, the capital of Azerbaijan, in subsequent periods. The drilling of the first oil well in 1847, the expansion of oil well usage between 1848 and 1855, and the initial steps toward mass production in this area strengthened industrial tendencies in Bibiheybat, Balakhani, Surakhani, and other such areas. The substantial real impact of economic factors at that time significantly influenced the issue in question. Such circumstances primarily led to the formation of "Baku oil-mining workers" among the population. The gradual instillation of industrial work methods in workers and the increase in their specialization levels facilitated the use of increasingly improved methods of activity in the field of oil extraction (Bagirov, 2023, p. 89).

As a result of the multilateral impact of the former Soviet era on the oil industry, conditions were created for conducting research and exploration work in the Caspian Sea waters belonging to Azerbaijan, along with onshore areas. It is precisely as a result of this that a literal "oil school" was created in the capital, Baku. These steps, which were initiated between 1948 and 1967, later created conditions for training many foreign representatives from Africa, Asia, and other countries as specialists. During that period, more than 18 thousand individuals were educated in Azerbaijan and returned to their countries as specialists (Bagirov, 2023, p. 109).

As stated in the work by Karimov and Zeynalova (2024), the financial resources formed in Azerbaijan created conditions for many foreign representatives to come to our country and act as entrepreneurs. The activities mentioned above gave rise to the creation of an army of oil millionaires. Along with local representatives such as the Taghiyevs and Nagiyevs, the Nobels, Rothschilds, and other representatives began to be recognized due to the oil resources of Azerbaijan (McKay, 1984; Seits, 2023; Tolf, 2020). On the other hand, the industries that formed in Azerbaijan in the twentieth century and became dominant in the economic system (Karimov and Zeynalova, 2024, p. 147).

The Azerbaijani oil industry, which has a two-century-long historical development path, has also played the role of a practical school for the former Soviet Union. Thus, the "educational-practical activity" tandem created in the country established the foundation for the formation of highly qualified personnel in the mentioned direction and has constantly improved it. The oil production and refining processes that improved over time created conditions for cities such as Baku and Sumgayit to become the country's oil industry "pillars" in the 1950s-1970s. It was during this period that creating more than 20 economic entities with direct and indirect connections became possible.

The modern era is witnessing the country's mining industry, especially the oil and gas sector, passing through numerous stages of development. Starting with the conclusion of the "Contract of the Century", the "oil and gas-centered" contracts, which are now quite diversified and cover different areas and directions of activity, have paved the way for changes in the requirements for flexible response, progressivity, fiscal basis, and other systems and indicators in the positions of the relevant sectors of Azerbaijan, as well as in the intensity of the use of innovative steps. As a logical result of numerous restructuring and improvement, transformation, diversification, and other such processes, "oil" activity is manifested, on the one hand, in the breadth of the variety of products and, on the other hand, in the breadth of the area of scientific research. Optimization of production sizes and volumes in the oil and gas sector, enrichment of cross-border trade relations for relevant products, as well as activation of East-West and North-South traffic corridors, have created conditions for the expansion of transport and logistics capabilities and the transformation of countries into cargo transportation "hubs" (Kashapov et al., 2023, p. 256).

Industrial activity: real situation and problems

Industry is one of the important components of the economic system, playing an important role in the processes of creating fixed assets (including means of production). It contributes to the creation of product abundance in the country and its regions, both as an independent sector and in an integrated manner with other sectors (for example, in the form of agro-industry or construction industry). The implementation of consistent and purposeful observation and research processes allows for an objective assessment of the relevant sector. As a result of "horizontal" and "vertical" research, it becomes possible to present systematic thoughts and considerations about the real quantitative and qualitative indicators of the sector.

In general, generalized sectors occupy one of the leading places in industrial divisions. The mining sector (especially oil and gas), which constitutes the main source of state budget formation, creates conditions for the industry to play an important role in the country's economic system. Mining, which represented 69.6% of the industry in 2019, has fluctuated in its relative share in subsequent years. After 2019, this fluctuation occurred within the interval [-8.6; +5.0]. The existence of a 13.6% interval between the minimum and maximum points ($X_{max} = 74.9\%$ and $X_{min} = 61.3\%$) also testifies to the fact that other industrial sectors have had higher development rates over the years.

Comparing the beginning and end years of the dynamic's series, a decline of 2.9% is confirmed. However, taking into account the specific weight of 2022, the decline in the result of 2023 in the mining industry is 7.9%. The second sector that plays a specific role in the industrial sector in terms of specific weight is the processing industry. This sector, which hosts numerous directions, combines food, light, chemical, automotive, and other directions. Its share has increased from 25.1% in 2019 to 27.4% in 2023. This indicates that the growth rates of the processing industry are higher than those of mining. Although the third and fourth sectors in the structure of industry—"electricity, gas and steam production, distribution and supply" and "Water supply, waste treatment and processing"—do not have large weights in general terms, they increased by 0.4% and 0.2% in specific weight in 2023 compared to 2019, respectively.

Another researcher with whose ideas we agree is Duffie (2022). Based on the provisions of his work, regulatory theoretical studies for dynamic production systems in industry are distinguished by specific forms of manifestation. Organized research sheds light on many issues, of which it would be appropriate to pay attention to the following important points:

- A systematic approach to industrial and production activities is a testament to their progress;

- To what extent does the technical and technological progress of industrial units respond to a more progressive satisfaction of local demand and compliance with international experience?

- Along with the positive aspects of the activity, the negative aspects should also be clarified so that assessment of real results at different levels, in different situations, and in structural configurations can be achieved;

- Clarifying the possibilities of the set of ecological factors and components in the formation of activity and the living environment in general, etc. (Scharmer, 2019).

To transfer the ideas about the above to the "theory-practice" level, it would be appropriate to refer to a number of tabular indicators. It is clear from Azerbaijan statistical data that fluctuations were observed in the value-added indicator created by the country's industrial sector in 2019-2023. Thus, the sequential change in the corresponding dynamics was manifested as follows: a decline in 2020 compared to 2019 of 27% (1 - 24732.6: 33885.9); an increase in 2021 compared to 2020 of 61.6% (39956.6: 24732.6); an increase in 2022 compared to 2021 of 72.0% (68732.6: 39956.6); and a decline in 2023 compared to 2022 of −27.6% (1 – 49759.2: 68732.6).

In turn, clarification of the form of ownership to which the decline belongs shows that "non-state ownership" acts as the main source of the cause. The 22.1% (1 – 67296.0: 86383.4) decline observed in the results for industrial output was possible given the following situations: the specific weight of industrial output under state ownership increased by 9.3% (11664.4: 10670.7), while the decline was realized only at the expense of the share of non-state ownership—26.5% (1 – 55631.6: 75712.7) or 20099.1 million manats (75712.7 – 55613.6). Within its composition, the decline was due to the share of foreign ownership by 32.8% (1 – 42544.6: 63343.1) or 20798.5 million manats (63343.1 – 42544.6).

Mining – a leading industry sector

The study of the leading directions and trends within the industrial sector, as well as the status of their groups, also remains important. As is clear from official statistics, the mining industry occupies the first place in this list. If we pay attention to its status by constituent elements, we can observe the following groups:

1. Crude oil and natural gas production;

2. Mining of metal ores;

3. Provision of services in the field of the mining industry, etc.

Ensuring inclusive and sustainable activities relies on the capabilities of all constituent factors and implies their targeted use. The establishment of inclusive development is distinguished by its decisive impact on the practical use

of advanced industrial systems and subsystems. On the other hand, the local application of various options and variations for the purpose of implementing diversification measures and works with rich configuration content is also constantly maintaining and developing its importance. In order to ensure the completeness of the mentioned picture, the definition of strategic goals both in the field as a whole and in its units, as well as the initiation of necessary refinement work, requires the achievement of higher and safer results at the "economic system - society lifestyle" level and other similar levels (Magret and Mackmilan, 2022, p. 176).

Taking into account the requirements and elements of the ecological environment in the organization and implementation of industrial activities is being praised for its specifications. The emergence of the diversity of content in the results draws attention to the following realities in 2023 compared to 2019:

• Although there were improvements in the absolute indicators (69 units) and growth rates (20.9%) of enterprises operating in the mining sector, these increases were attributable to the non-state sector (72 units and 23.5%). As a result, there was a decline of 3 units or 12.0% in the number of enterprises belonging to the state sector.

• The increase in the number of individual entrepreneurs (328 people or 36.4%) does not necessarily indicate that things are going smoothly. Although the number of employees in this sector increased by 7.3%, the increase in industrial output by 2.9% in terms of specific weight (69.9% - 67.0%) is, we believe, a logical result of many organizational planning and perspective forecasting activities.

• The decline in specific weights also reflects the non-state nature of the republic's industry. This is also observed in the sector (1.9%).

• Although the comparable time indicators show an increase of 12.26 billion manat (45117.5 – 32857.5) or 37.3% (45117.5: 32857.5) in the value of final products, works and services in the mining industry, the result obtained confirms a decrease of 19.6 billion manat (64745.3 – 45117.5) or 30.3% (1 - 45117.5: 64745.3) compared to the results of 2022 (Bagirov, 2023).

It should be noted that in the observed years 2019-2023, there were increases in the prices of products, works, and services of the mining industry ranging from 13% to 78%, taking into account the types, which once again confirms the decrease in product production volumes in natural terms.

In order to develop the mentioned idea, the approach expressed by Russian scientists Arkhipova and Kuchmaev (2021). In their work "Development of Modern Economics: Problems, Trends, Prospects" is also interesting. As a result of observations and monitoring, it became clear that there are also setbacks in meeting high technical and technological requirements for mining enterprises, which, along with direct economic indicators, lead to the presence of defects in the full-fledged use of natural resources that form the raw material base of the activity, and to waste volumes exceeding the established norms (in some cases by more than 50%). Direct contact of toxic waste with water sources in local areas also testifies to the decline in environmental indicators. The fact that the situation in question is most clearly observed in the production of crude oil and natural gas throughout the country requires the elimination of artificially occurring effects caused by objective and subjective reasons, in addition to natural losses (Arkhipova and Kuchmaeva, 2021, p. 214).

The relevant picture also makes it necessary to carry out observations and research in the direction of improving the situation regarding ecological factors. Expressing opinions and considerations about it justifies the necessity, essence, and importance of repeated reviews in the direction of mobilizing opportunities in areas of activity that are distinguished by a large specific weight in environmental pollution, thereby creating necessary turns in issues such as protecting the natural balance and soil quality.

The main purpose of using statistical information is to improve the efficiency of leading economic, organizational, and other factors in the oil and gas sector, as well as to ensure their application in a manner coordinated with the goals of inclusiveness, and to work in accordance with the requirements of the principles of innovation and progress in modern terms. In turn, the specifications of production and further processing processes also determine the establishment of direct activities on technological foundations and the necessary professional choices. On the other hand, the necessary information aims to clarify the following directions based on a comparison of the quantities of 2019 and 2023:

a. Although the number of enterprises operating in the field of crude oil and natural gas production increased by 3 units or 9.7%, a decline of 1 unit or 2.9% was recorded in these indicators compared to 2022.

b. In the context of the time periods examined, the increase in the number of enterprises was mainly possible in the non-state sector (4 units or 18.2%).

c. Although there is an increase in industrial output, works, and services worth 12.9 billion manats or 44.0%, when the same comparison is made with the results of 2022, it confirms that the result of 2023 is 20.2 billion manats or 32.4% lower.

d. Although the share of crude oil and natural gas manufacturing as part of the total industrial product produced in the country increased by 0.3% (62.6% - 62.3%), the volume of related non-state expressive activities within the non-state sector of the republic decreased by 1.8% (72.1% - 73.9%) (Bagirov, 2023).

It is also necessary to take into account the relationship, influence, and dependencies between indicators, based on the characteristics of the research objects. For example, the increase in the number of enterprises in the field of oil and gas production, while it should have resulted in an increase in the quantitative and qualitative expressions of industrial output, led to a decline. It is not by chance that regular fluctuations were observed in the industrial production index compared to the previous year, which, along with the general picture of decline (99.9% → 97.7%), testifies to a specific picture of growth (94.3% → 105.7%).

From the summary of the information, it is clear that in 2019-2023, a consistent decline was observed in the volumes of crude oil production in the Republic of Azerbaijan. The volumes of losses and specific use should also not be overlooked. The calculations show that:

- If in 2019 the commodity part of total oil production was 99.8%, then in 2023 the level of this indicator was equal to 99.7%, which represents an inefficient progress of 0.1% in the growth rate.

- In turn, crude oil production in 2023 decreased by 7,353.8 thousand tons or 19.6% compared to 2019, which is due to numerous objective and subjective reasons. Among them, financial, organizational, planning-forecasting, and other oriented activities come to the fore (Bagirov, 2023).

Although the ratios between the total and commodity indicators for different time expressions of the dynamic series testify to a further decrease in the deviation volumes in crude oil production, the issue being judged and the problems it may create can lead to a variety of results and conclusions, as well as to the adoption of different, including inclusive, decisions when approached from different prisms. For example, commodity oil production decreased by 19.7% in 2023 compared to 2019. When the comparison is made, it testifies to the inefficient use of 0.1% (19.7% - 19.6%). This confirms that there are more losses in the actual volume of oil produced than in the actual use.

On the other hand, the presence of "fluctuations" is observed in the dynamics table expressing oil production. Thus, in a sequential comparison of the consecutive results of 2019-2023, the following four results emerge: 8.0% (decline), 0.2% (increase), 5.6% (decline), and 7.7% (decline). A similar situation is observed in the volumes of commercial crude oil. In addition, the specific weight interval between the "total - commercial" volumes of oil production fluctuates between 0.074% and 0.132%, which indicates that the average expression of the deviation is equal to 0.0995%. The result obtained can also be evaluated as a source of unproductively used reserves.

Conducting similar studies in the natural gas sector has, on the one hand, been a concrete direction for analysis and, on the other hand, serves to move on to generalizing opinions on the progress in the oil and gas sector of the republic. Studies show that compared to 2019, in 2023, there was an increase in the volume of total gas production of 12,886.9 million cubic meters (48,497.2 - 35,610.3) or 36.2% (48,497.2: 35,610.3), while the average annual increase is 3,221.7 million cubic meters (12,886.9: 4) or 9.1% (36.2: 4). During the "horizontal" studies, the average annual growth rate of the commodity natural gas indicator was 2,975.0 million cubic meters or 12.13%, respectively. The specific weights of the total commodity quantity in the period covering 2019-2023 were 14,250.4 million cubic meters or 36.8%.

Innovative development – as one of the foundations of economic progress

Along with the concepts of social and economic environment, the participation of the ecological environment in the formation of innovative foundations generally ensures the transition of the organization of activity to new stages. While the lack of an unambiguous assessment of the relevant processes, on the one hand, arises from the specifics of the object (activity) involved in the study, on the other hand, it leads to the formation of different states and situations. In this regard, the configural structures of factors that cover both current time periods and those that differ in their relevance to prospective periods can be used as an example (Swan, 2017, p. 93).

The provision of experimental approaches in terms of the tandem of "innovation and inclusiveness" testifies to the establishment of an organized theoretical and methodological base. The study of the product of creative thinking in theoretical and methodological aspects is accompanied by a number of special moments. What the object of innovation consists of determines the different working components to be selected and the progressive steps to be taken in relation to it. Among them, the following should be especially emphasized:

- the object selected for innovation, its character and properties;

- meeting the need (demand) for renewal, as well as necessary goals;

- methods, mechanisms and tools of reproduction to be used at the level of "creative thinking - object of application";

- ensuring the transition to more advanced stages of use, the forms that are considered appropriate to apply in such situations, etc. (Kashapov et al., 2023, p. 74).

Although theoretical and methodological aspects are considered the first stage of innovative research, they do not mean its positive full-fledged conclusion. Since in the mentioned direction it is possible to encounter the influence of numerous factors, this also depends on the specifics of the activity. Among the issues of particular interest at the moment, natural loss norms are of great importance.

The presence of large-scale losses during the extraction of crude oil and gas condensate is conditioned by the participation of numerous factors. For example, safer implementation of oil production requires the condition of reducing the impact and pressure of associated gas in the relevant processes. Similarly, in the implementation of gas production, we witness that quite large volumes of the total gas mass extracted from the ground are out of technological control. In many cases, the corresponding socio-economic indicator is estimated at 0.02% - 0.08% of the total mass of natural gas extracted. On the other hand, taking into account the scope of the problem also affects its investigation on a more limited level (Porter, 2011, p. 212).

In the current situation, the importance of bringing into economic circulation the part of the product that cannot be controlled in the overall volume (in oil production) or in the economic turnover (in gas production) remains. Taking into account the characteristics of each of the mentioned directions requires the application of individual approaches to them.

First of all, we consider it appropriate to focus on oil production, which is considered the leading economic and financial direction of the country. Indeed, as official statistical information confirms, there was a decline in commercial oil production by 7,375.3 thousand tons or 19.7% in 2019-2023. The fact that the picture shows a decrease in the volume of crude oil production by 1/5 should be assessed as the result of the influence of numerous objective and subjective factors. As indicated in the work by Petrenko and Novikova (2019), it is necessary to pay special attention to the following:

- poor operating accuracy of measurement and fixation equipment used in production processes;

- change in the orientation of investment processes, loss of their main goals, and ensuring that their volumes are concentrated towards possible minimization levels;

- justification of the use of progressive, internationally proven technologies in production activities, and the practical implementation of relevant processes;

- applying more modern forms of digitalization and artificial intelligence that are progressive in meeting production needs and organized in terms of their area of use;

- elimination of the weakness of resorting to progressive tools, mechanisms and means in the field of natural loss norms;

- preparation of special activity projects in the field of oil production, involvement in evaluation operations of quantitative and qualitative parameters of multi-stage fractionation processes for oil products in terms of efficiency and optimality, complementarity and mutual coordination, and harmony criteria;

- specifying optimal production and processing volumes for crude oil and oil products, studying their interaction with necessary economic indicators (e.g., quality, price, etc.);

- activation of the use of necessary experimental tools, means and mechanisms for recycling loss volumes in oil production and subsequent refining processes;

- justification of the implementation of sequential steps in the "innovation - digitalization - artificial intelligence" framework (subject to environmental requirements);

- creation of a DATA base adapted to the "time-space" tandem in order to provide systematic information on crude oil and gas condensate. This base can be distinguished by its individual relevance to directions in terms of its layout, or it can be in a way that combines directions on one plane (in the form of individual blocks);

- addressing "artificial loss" volumes in calculation and finalization operations, bureaucratic obstacles and limited opportunities for activities such as procrastination, etc (Ustyuzhanina and Komarova, 2022, p. 194).

It is clear from technical and economic research and calculations that among the production, social and other requirements of the modern era, there are no objects that can exist in a stable state and maintain their tranquility for a long time. In this direction, there is a need for the manifestation of an efficient configuration of the following characteristics:

a. the needs of society require constant renewal;

b. the deeper interference of electronic computing machines and devices in our lives over time;

c. the desire of the vast majority of people to continue their lives with a sense of comfort despite their lack of technical skills;

d. neutralizing the impact of material and spiritual factors that negatively affect their lives to the maximum extent possible;

e. the need for innovation, digitalization, the emergence of progressive objects that are created, "inanimate", but equipped with "conscious" abilities, and can approach their actions from the point of view of choice and modernity, etc (Prakhova and Khoroshavina, 2019, p. 115).

Along with oil production, similar activities carried out in the gas sector are also of particular importance. From the study and analysis of official statistical data, it is clear that:

• compared to 2019, the increase in commercial gas production in 2023 was 11,900.1 million cubic meters or 48.5%;

• in the comparable period, the volume of gas directed to private use decreased from 31.2% to 24.9%, which was possible due to two factors - a decrease in the

volume of gas supplies without compensation to the Azerbaijani state (4.9%) and the implementation of more productive and economical activities during production (1.4%);

- compared to 2019, increases were observed in both gross profit (12.7%) and net profit (12.4%) from natural gas reserves in 2023, which is 4.9% and 5.2% higher than the profit from the production and transportation of crude oil (Bagirov, 2023).

The comparative calculations obtained confirm the existence of higher costs in the oil sector. The study of the mentioned items, on the one hand, necessitates the preparation of special programs to bring a clearer picture of the increasingly complex technical and technological environment. Although these programs usually exhibit the leading aspects of the structure, general activity, and production in a summarized manner, they do not fully meet the modern specifications of the units. That is, the digitalization of activity should meet the needs of the "form - content", "economic sector - administrative territory" and other important, unified pairs. In their preparation, references to norms, regulations, and standards, taking into account the sectoral specifics, manufactured products, and other characteristics, should not be left out. The importance of multi-level (derivative) matrices, whose use has become relevant in digitalization processes in modern times, is also undeniable. In international practice, there is a wider appeal to ensuring activities that meet the "Bradis traditions" of calculations, which are evaluated as at least "degree of accuracy = 0.0001" (Chernyshev and Kantieva, 2022, p. 203).

The digitalization carried out in the direction of "object ↔ unit" in the oil and gas sector in the current period creates conditions for the emergence of clearer views in these spheres. Quantitative-qualitative studies of the relevant processes require the study of the necessary components of the "supply-supply", "production-extraction-processing", "sales-exchange-other realization", "marketing activity" systems and their subsystems in a mathematical-economic tandem selected with optimal dimensions and structures. The steps in question (structure, activity trajectory, involvement in recycling, etc.) are characteristic both for office computer programs (Microsoft Word, Microsoft Excel, Microsoft Power Point, Microsoft Publisher, Microsoft Access, etc.) and for specific industrial programs. The application of the following program groups as part of the second group of computer programs meets the requirements of digitalization:

1. Programs that serve the design and technological modeling of oil and gas fields. Among them, it is considered appropriate to apply AutoCAD, SAP General MM/SD, SAP (2000 and 2020), Tekla Structures and others, which are constantly being updated. Taking into account the intellectual capabilities of these programs,

specific design-technological modeling is being carried out (Bagirov et al., 2022, p. 51).

2. Estimates – programs with planning content. Usually, the relevant program groups, which remain faithful to the traditions of Excel (for example, "Estimate - Start", "Estimate - Pro" and other programs serving similar purposes), as well as accounting and calculation programs, express a more creative approach to issues such as the organization and implementation of optimal activities in the field of oil and gas production in terms of financial resources. It is worth noting that if the relevant work is carried out by internationally recognized and professional companies, then advanced versions of "PDMS-Account" (2019), "MS Project Calculation (2022)" and other related programs can be used (Bagirov et al., 2022, p. 54).

3. Control-technical and office engineering programs. Relevant programs that provide general and special digitalization services are distinguished by their complex purpose in international practice. On the one hand, they provide for the implementation of professional work related to engineering-design and engineering-calculation works that reflect projects and their financial aspects in order to more clearly express the goals set in the field of oil and gas production. Relevant programs that provide for the possibility of taking steps such as determining the goals of transformation, diversification, specific general and phased calculations, and the development of technical safety regulations for various categories of goods, take into account the assessment of aggregate intellectual capabilities (Bagirov et al., 2022, p. 59).

In addition, in the modern era, the direction called "artificial", the cornerstone of which is "professional and creative human imagination", is becoming more prominent in the social and economic life of society. Currently, this activity, which represents the highest opportunities and stages of digitalization in the oil and gas sector, industrial technologies presented as the V and VI generations in international practice, and a set of different configurations of fuzzy theory, offers broader opportunities for individuals and subjects of activity. The modern expression "artificial intelligence" is originally a hymn to the ability to create, transform and constantly update steps such as purposeful, realistic observation of many directions, collection of data, their grouping by features, variation, diversification, selection amplitudes, comparison, local and multifactor analysis, and ensuring access to new creative stages. It should also be added to this the purposeful unity of soft and hard skills, which are uniquely added to the oil and gas sphere. It refers to the set of artificial thinking and activity that takes the basis of the implementation of relevant experimental research from theoretical foundations and arises from the clarification of the character and properties of the object (industrial product or related service) (Christensen and Dillon, 2017, p. 134).

Which classification of artificial intelligence to apply depends on the specific research object and the goals set. Artificial intelligence, which acts as a visual manifestation of the general thinking style and imagination of people and expresses the hymn of technological development, reflects horizontal and vertical research and opportunities in the oil and gas production sphere, as in any field and direction (Zaretskyi and Ivanova, 2018, p. 69). Along with other directions, inclusive development is considered one of the foundations and main influencing factors of economic progress. The factor of using the realities that the natural environment gives us more efficiently and as loss-free as possible should always be in the center of attention. Meanwhile, addressing the requirements of the level of "industrial activity - minimizing losses" also speaks for itself in the current situation.

CONCLUSIONS

In this work we have tried to shed light on the current state of the oil and gas production industry in Azerbaijan, reinforcing the notion of how fragile its innovative and inclusive foundations remain. The conducted research led to a systematic study based on the tandem of "assessment of the real situation - application of prospective opportunities to practice," which necessitates numerous transformative and improvement steps. Among these, artificial intelligence applications grounded in the creative thinking and imagination of engineering professionals, alongside digitalization activities increasingly embedded in our daily lives, hold particular importance. Both components can be integrated into economic processes in different sequences.

Digitalization encompasses the production processes of the oil and gas sector. Given that this sector is considered strategic for the country, the compilation of daily and weekly reports represents a legitimate practice from accounting and statistical perspectives. Nevertheless, it is advisable to deepen numerical analysis, harmonize relevant work with international standards, and establish necessary connections and dependencies. Furthermore, progressive developments created by artificial intelligence can be supported by digital foundations, while new objects emerging from digitalization evolve through intellectual capabilities and skills. The organized establishment and systematic study of the "artificial intelligence - oil and gas production" tandem require structured and creative approaches across all its components, manifesting primarily at the technological and technical levels.

The formation of intelligent systems based on supply and demand principles and serving marketing objectives is guided by human creative thinking in both upstream and downstream oil and gas operations. These principles should encompass both domestic supply and international relations. In the modern era, broad consumption needs across the spectrum of domestic and foreign supply are primarily centered on natural gas resources. Thus, artificial intelligence mechanisms can address consumption patterns formed in individual, production, and service sectors through various aspects and configurations, based on the diversity of objects and activities, as well as on established rules, norms, standards, and general usage volume specifications. However, automating distribution volume determination through artificial intelligence mechanisms requires consideration of efficiency, optimality, harmony, and other relevant principles. Prioritizing these principles demands the application of creative thinking and skills. Consequently, the organized application of intelligent assessment enables extensive use of general and specific electronic capabilities, including multi-stage linear and branching programs, mathematical parabolas and hyperbolas. Beyond individual application of these components, the joint use of complex combinations, matrix and determinant calculations ensuring mutual relations and dependencies should clarify how artificial intelligence needs are met in the current period.

The gradual or comprehensive representation of operating conditions through artificial intelligence generates numerous product and activity configurations. These should reflect processes following the route "technological materials and means → semi-finished products → intermediate condensate and by-products → final (main, leading) finished products," while specifying their type-composition expressions at the "needs-proposals" level, considering process specifications and goods fractionation.

Additionally, in Azerbaijan artificial intelligence implementation is being promoted through the "Cascade" organizational model, widely adopted in Germany, France, Italy, Spain, and other leading European countries. This approach, organized as "finalize the activity at the previous stage → transfer to the next stage," expands the possibilities for applying creative intellectual human labor, ensuring systematicity and complexity in applying artificial intelligence at each stage. Its fundamental purpose is to align artificial intelligence steps with actual activity results.

Finally, productivity and efficiency of individual economic entities, achieved through various levels of positional coordination, enriched compliance methods with norms, regulations and standards of organic dependencies, and increased automation and digitalization of inter-enterprise coordination, not only illuminate the methods and directions for artificial intelligence application but also clarify its content elements. Therefore, the application within the "opportunities-realities" context maintains an individualized (situational) nature, involving optimization of average quantitative expressions while considering absolute and relative quantities in dynamic sequences, depending on the formed situation.

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