LONDON JOURNAL
OF
INTERDISCIPLINARY SCIENCES

eISSN 3049-7809

Scaling of the infrastructure of service organizations of geophysical services

Vnukova Nataliya *
Oksana Makovoz **
Roman Shevchenko ***

Abstract

The purpose of the study is to analyse the features and scalability of the infrastructure of geophysical service organisations. The implementation of optimal strategic management through a model for any large petroleum geophysics enterprise aimed at economic growth and national interests is proposed. An approach to semantic coordination and modernisation of geographic services is proposed, where service providers share explicit knowledge of the interactions in which their services participate, and these interaction patterns are used operationally to discover and integrate geoweb services. During the research, cluster analysis was used to conduct a comparative analysis of the selected companies, the quality of possible methods of distribution of the selected population and using criteria. The volume of service geophysical services depends on the rate of increase in hydrocarbon production, which is directly related to the state's strategy. Analysis of the competitive environment for the State-owned Enterprise Ukrgaspromgeofizika requires an assessment of the factors affecting the organisation's activities in the field of geophysical services for the gas industry. The volume of service geophysical services depends on the rate of increase in hydrocarbon production, which is directly related to the strategy of the state.

Keywords: Scaling, infrastructure, risks, service organisations, geophysical services

https://doi.org/10.31039/ljis.2024.3.286

* Simon Kuznets Kharkiv National University of Economics, Kharkiv, Ukraine, vnn@hneu.net

** National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Ukraine; IHI Zittau, Dresden Technical University, Dresden, Germany, oksana.makovoz@tu-dresden.de

*** Ukrainian Scientific Research Institute of Natural Gases Joint stock company, «Ukrgasvydobuvannya», Kharkiv, Ukraine, shevchenko.roman@ugv.com.ua

1. Introduction

The focus is on the geophysical services sector within the market segment exclusively in the context of the oil and gas sector. Geophysical surveys and operations are conducted directly in oil and gas wells, aimed at obtaining reliable data on the presence of hydrocarbon deposits (oil and gas) and performing extraction work from the subsurface (e.g., perforation and explosive operations). The All-Ukrainian Industry Association «Federation of Employers of the Oil and Gas Industry» is the largest association of oil and gas enterprises in Ukraine.

Key companies in the market:

Clients: Oil and gas extraction enterprises of state ownership (Naftogaz of Ukraine NJSC) and private ownership (DTEK, Ukrnaftoburinnya, Geo-Alliance, Smart Energy, Poltava Petroleum Company).

Contractors: Geophysical enterprises of state ownership (State Enterprise Ukrgazpromgeofizika) and private ownership (Weatherford Ukraine LLC, Ivano-Frankivsk Geological Expedition, Poltava Geophysical Operations Directorate SE, Carpathian Geophysical Operations Directorate PJSC, Poltava Geophysical Operations Private Enterprise, Ukrspetsgeologiya LLC, GEO-DELTA-KB LLC, Nadra Services LLC).

State Enterprise Ukrgazpromgeofizika is a subsidiary of Ukrgazvydobuvannya JSC, part of Naftogaz of Ukraine NJSC. It provides geophysical services for other gas extraction branches of Ukrgazvydobuvannya JSC – Shebelinkagazvydobuvannya Gas Production Directorate (GPD), Poltavagazvydobuvannya GPD, Lvivgazvydobuvannya GPD.

Thus, if the state pursues a course towards achieving energy independence through its own resources, it directly leads to the growth of the geophysical services market in both the state and private sectors (taking into account the cost of energy resources). At the same time, the significant regulatory environment surrounding Naftogaz of Ukraine NJSC may limit the funding of the declared strategy and projects, which undoubtedly casts doubt on their successful implementation.

Ukrgazvydobuvannya JSC covers 81% of its need for geophysical services through Ukrgazpromgeofizika, while the remaining 19% are outsourced to the aforementioned private companies. Residents of regions where Ukrgazpromgeofizika operates are directly interested in the company's impact on the environment.

These risks are borne by gas extraction enterprises that closely cooperate with the communities in the regions where the company operates. As a result of such activities, royalties from extraction are directed to community budgets, which stimulates close cooperation. Additionally, the company actively engages in social activities with the communities and funds social projects.

The applied relevance of the research is driven by priority measures to ensure the effective functioning of aircraft management, communication, and navigation systems in Ukraine under the influence of disruptive heliogeophysical disturbances. This includes the establishment of a specialized national geophysical service to conduct diagnostics, forecasting, and situational analysis of the heliogeophysical situation and provide timely updates on its changes,

particularly in the interests of Ukraine's civil aviation (Kalashnyk, G. A., Kalashnyk-Rybalko, M. A., 2018).

To support decision-making during geophysical emergencies, the implementation of an information-technical realization of the mathematical model developed by scientists is proposed, aimed at improving the process of crisis decision-making through the comprehensive execution of the «Geophysical Emergency» mode within a unified system of time (Agazade, T., Tyutyunyk, V., Chornohor, L., & Tyutyunyk, O., 2022).

Another important area of activity for geophysical services is their involvement in the global fuel-energy, petrochemical, and oilfield services complex, ensuring that their development aligns with trends in the fuel-energy resource market (Stepanov O. P., 2015).

The driving force behind innovation in our research object is the team of experienced specialists at Ukrgazpromgeofizika, led by the CEO. We observe well-established communication between subordinates and management, which helps identify «bottlenecks» in operations and develop solutions to address them. This approach allows for the implementation of new equipment and technologies to solve specific and urgent tasks, securing support and appropriate funding from the parent company.

Scientists conceptualize the geopolitical and geoeconomic nature of the risks of financing the development of global energy, in particular, with the participation of geophysical services. The question has been updateddetermination of an effective strategic model of enterprise managementpetroleum geophysicsin the context of economic security (Trotsenko, A. A., Belevsky, T. V., Kyivska, O. G., Aleksandrova, E. Yu., & Gurevska, L. A. (2018). In the conditions of economic instability, the tools of strategic matrices are offered in the conditions of the changing situation on the market of geophysical services. Meanwhile, the geophysical services market is heterogeneous. The problem of semantic heterogeneity in modern spatial data infrastructures, which scientists consider throughspecific scenario of geoservice integration (Lorenzino Vaccari, Pavel Shvaiko, & Maurizio Marchese, 2009).

2. Literature Review

The grouping of the main companies as elements of the infrastructure of the geophysical services market was carried out. The methods of drilling well research are characterized. During the research, cluster analysis was used to conduct a comparative analysis of the selected companies, the quality of possible methods of distribution of the selected population and using criteria.

During the modernization and scaling of infrastructural objects of the geophysical services sector in the market segment of the oil and gas sector, it is important to investigate the methods of drilling wells, because they are the ones that will primarily help the intensification of production processes. Geophysical methods of well research are one of the sections of applied geophysics. They are used to solve geological and technical problems related to the search, exploration and development of mineral deposits. The first geophysical studies in wells were geothermal measurements, which were carried out in 1906-1913 by D. V. Golubyatnikov in the oil fields of Baku. In the future, some scientists, in particular Yu.M.

Zavorotko, developed other methods of geophysical research (Yu.M. Zavorotko, 2010). Geophysical methods of well research are methods of determining rock properties and coreless geological documentation of sections, based on the study of various physical fields in wells. The widespread use of these methods contributes to the application of highly efficient methods of drilling without core selection, which sharply reduces the cost of work and increases the speed of drilling wells. At the same time, data on various physical properties of the rocks surrounding the wellbore sometimes provide even more information about geological sections than core selection.

Geophysical methods of well research are used to study the geological section and structure of deposits, dismemberment of rocks by lithological features, detection of minerals in sections, assessment of properties of reservoirs of surrounding rocks and their possible oil and gas-bearing productivity. In addition, they provide parameters for the interpretation of materials from terrestrial geophysical surveys. Control of the technical condition of wells (determination of their diameters, curvature, presence of cement in the annular space, etc.), shot blasting works in wells (sampling of walls, perforation of casing columns) is also carried out with special equipment. Logging uses almost all physical fields and methods used in terrestrial geophysics. However, there are differences between the borehole and surface geophysics methods, which are determined by the specific conditions of performing work in wells. This led to the creation of an independent field of exploration geophysics - logging.

Measurement of certain parameters in the well is usually carried out automatically when lifting the logging cable with a field indicator at a speed of 200 to 5000 m/hour (Yu.M. Zavorotko, 2010). Logging uses electrical, radioactive, thermal, seismoacoustic, magnetic and other physical methods. The effectiveness of geophysical research in wells is very high, especially in petroleum and structural geology, where the drilling of all wells is accompanied by logging. In engineering and hydrogeological studies, geophysical methods of wells allow solving such problems as studying porosity, waterlogging, rock filtration properties and, together with core selection, serve for geological documentation of sections.

The modern development of the oil and gas industry of Ukraine necessitates the widespread introduction of new technologies for the development and intensification of oil and gas production. Previously, Naftogaz's IT infrastructure was placed on its physical servers, which were «morally» outdated and did not meet the needs of modern automated systems. As a result, technicians could no longer simultaneously modernize them and transform the infrastructure. In 2021, the physical and virtual servers of the central office of Naftogaz were transferred to the private PRO Cloud.

When solving the problems of control over the development of oil and gas deposits, geophysical methods of well research are of primary importance, which allow studying the features of reservoir flooding, determining the initial position of the distribution of oil and water in productive deposits, filtration capacity properties of rocks, residual oil saturation in flooded reservoirs, displacement coefficients oil, coverage of formations by flooding, oil recovery within the watered deposit.

The volume of service geophysical services depends on the rate of increase in hydrocarbon production, which is directly related to the state's strategy. That is, if the state is on course to

achieve energy independence at the expense of its own resources, then this is a direct growth of the geophysical services market in both the state and private (certainly taking into account the cost of energy resources) market segment. At the same time, the significant regulatory nature of Naftogaz may limit the financing of the declared strategy and projects, which certainly calls into question their successful implementation.

3. Conclusions

Information from open sources of information (Andrey Starostin, 2024) shows the relevance of the implementation of new trends in geophysical services and the increase in the volume of completed works (Despite the war, Naftogaz increased the number of geophysical well surveys 2 times, 2024), in particular in difficult mining and geological conditions associated with the increase in drilling depths for oil and gas wells (Preparing for winter: the deepest well in the history of Naftogaz was drilled in Ukraine, 2024).

In order to analyze the competitive environment of the oil and gas service market and identify patterns of influence on it, 10 companies that provide geophysical services on the Ukrainian market were selected for research. These companies are the main players in the market and provide services for both public and private sector companies. In order to carry out a comparative analysis of the selected companies, the following criteria have been determined, which have a significant impact on the performance of the companies selected for research, namely:

- the amount of work carried out for the current year;
- form of ownership (public/private);
- presence on foreign and domestic markets;
- customer (state/private gas production companies);
- period of work on the market;
- base of measuring equipment (Soviet/modernized/world standards);
- offering unique research.

Calculation of average indicators and comparison of the selected criteria made it possible to determine clear patterns.

The first indicator – «volume of work» varies widely and indicates the heterogeneity of the market associated with the desire of the Customer of the works to choose acceptable and profitable offers in the price range from potential Contractors. The peak value of the volume of work performed for company «1» is connected, first of all, to the fact that this company is in the organizational structure of the Customer (criteria «form of ownership» / «customer») and performs work at cost price.

At the same time, the ability of company «1» to perform a significant amount of work is justified by the availability of modern equipment and the possibility of conducting unique

research. The specified regularity is also clearly observed for the company «8», which indicates the reliability of the conclusions drawn.

The analyzed criterion «presence on the foreign and domestic market» indicates the fact that most of the players are domestic companies. At the same time, the market is open to the entry of international companies and the emergence of some competitive threats to other participants associated with unique offers from such companies. It should be noted that some companies.

The criterion «period of work on the market» proves that the players have been working on the market for a considerable period of time and, regardless of the technological level («base of measuring equipment» criterion), are able to provide the Customer with relevant and popular offers. The company data and the numerical values of the criteria were analyzed using the cluster analysis method, which made it possible to group them accordingly and classify the companies according to the following categories:

- leaders;
- growing;
- stable players;
- outsiders.

The conducted studies indicate an active stage of development of the oil and gas service market, which is due, first of all, to the urgent need and tendency to increase the extraction of hydrocarbons and provide the country with its own energy resources and a significant number of companies capable of providing such services. In Ukraine, the complex complex of interrelated production, technical, organizational, financial and economic problems of the transition to a green economy needs to be solved by radical changes in the institutional structure of the national economy and the ideology of the state government (Timoshenkov, I., V. Babenko, O. Nashchekina, & O. Makovoz, 2020).

Over the last period of time, State Enterprise «Ukrgazpromgeofizyka» has come a long way in the context of modernizing existing equipment and purchasing new world-class equipment. The modern development of the oil and gas industry of Ukraine necessitates the widespread introduction of new technologies for the development and intensification of oil and gas production. Effective management of cooperation and communication with all these stakeholders is an important aspect of the successful operation of the organization.

Development of mechanisms for the formation of a strategy for development and economic security based on the analysis of the competitive environment, main stakeholders, target setting and positioning in solving the problems of geophysical service organizations. At the same time, the representative of the international company «Wetherford Ukraine» LLC is not only the owner of similar equipment, but also a developer of technical and technological solutions in the field of geophysical services and a monopoly on their use. Other companies presented in this list have a much smaller base of devices and equipment for conducting geophysical work.

Analysis of modern trends in the scaling of infrastructural facilities in the geophysical services sector in the oil and gas sector market segment shows that the company's experience is measured by decades of successful work of the division within the structure of the parent company. And although there are probably companies on the market with a much longer history of activity, this indicator can be leveled by significant periods of downtime and much lower intensity of their work. Success, in this case, can be considered through the prism of the implementation of the set plans and tasks.

References

Kalashnyk, G. A., Kalashnyk-Rybalko, M. A. (2018) Basic measures to ensure the effective functioning of control, communication and navigation systems under the influence of destructive heliogeophysical disturbances. *Science and technology of the Air Force of the Armed Forces of Ukraine,* 1, 92-98.

Agazade, T., Tyutyunyk, V., Chornohor, L., Tyutyunyk, O. (2022) Peculiarities of supporting anti-crisis decision-making in the conditions of geophysical emergencies. *Scientific Bulletin: Civil Defense and Fire Safety* ,2(14), 65-79. https://doi.org/10.33269/nvcz.2022.2(14).65-79

Stepanov O. P. (2015) Conjuncture, infrastructure and geofinance of the global fuel, energy and petrochemical complexes Strategy of socio-economic development of Ukraine. *Collection of scientific works*. K.: KNUKiM, 90-102

Trotsenko, A. A., Belevsky, T. V., Kyivska, O. G., Aleksandrova, E. Yu., Gurevska, L. A. (2018) Defining an effective strategic model of enterprise management in the context of economic security. *Revista Espacios* 39 (36) 18. http://w.revistaespacios.com/a18v39n36/a18v39n36p18.pdf

Lorenzino Vaccari, Pavel Shvaiko, Maurizio Marchese (2009) A geo-service semantic integration in spatial data infrastructures. *International Journal of Spatial Data Infrastructures Research,* 4.4, 24-51.

Yu.M. Zavorotko (2010) Physical foundations of geophysical methods of well research. *UrkDGRI*, Kyiv 339

Andrey Starostin (2024) Change in view of geophysical studies in wells. *Newfolk Oil and Gas Consulting Center.* Available from: https://oil-gas.com.ua/statti/

Despite the war, Naftogaz increased the number of geophysical well surveys 2 times (2024) [Internet]. Available from:https://eb.com.ua/nezvazayuci-na-viinu-naftogaz-u-2-razi-zbilsiv-kilkist-geofizicnix-doslidzen-sverdlovin-5798

Preparing for winter: the deepest well in the history of Naftogaz was drilled in Ukraine (2024) [Internet]. Available from: https://www.unian.ua/economics/energetics/vidobutok-gazu-pid-chas-viyni-naftogaz-proburiv-nayglibshu-u-svojiy-istoriji-sverdlovinu-12328383.html

Timoshenkov, I., V. Babenko, O. Nashchekina, O. Makovoz (2020) Institutional foundations of Ukraine's transition to the green economy. Research in World Economy, Vol 11 4 16-22.