Arctic oil and gas offshore projects: how to forecast their future

A A Ilinova, A F Chanyshева and V M Solovyova
St. Petersburg Mining University, St. Petersburg, Russia

Abstract. Development of Arctic oil and gas resources is relevant due to the strategic importance of hydrocarbons, as well as Arctic territories as a whole for our country. The prospects for the Arctic shelf are related, first of all, to the development of domestic available mineral resources, the socio-economic development of the Arctic region, the maintenance of innovative activity of Russian industries, the strengthening of international positions of the country, the creation of industrial growth centers in the northern territories. Prospects for Arctic oil and gas resources development remain unclear today due to the high degree of uncertainty about external (especially macroeconomics and politics) and internal (project) environment factors. This fact makes it necessary to develop scientifically sound approaches to predicting the development of the Arctic shelf oil and gas resource. This paper considered the existing forecasts of oil production on the Arctic shelf, highlighted the specific features of forecasting the prospects for Arctic shelf projects implementation, considered the peculiarities of the application of statistical and expert forecasting methods. On the basis of the example of oil price forecasting, as a key indicator affecting the prospects of offshore projects, it was concluded that there are limited possibility of using statistical methods and the need to use expert approaches. It has been determined that in order to create a holistic approach to forecasting the future of Arctic offshore oil and gas projects, a comprehensive algorithm based on the use of existing forecasting methods and their reasonable combination, taking into account the peculiarities of predicted systems and indicators, is necessary.

1. Introduction

Due to impending depletion of the traditional world oil and gas reserves, the Arctic shelf despite its complexity becomes an increasingly promising source of hydrocarbons. The forecasted amount of unexplored Arctic continental shelf reserves is estimated as 90 billion barrels of oil and 47 trillion cubic meters of natural gas [1], [2].

The development of offshore oil and gas resources is a complex process involving a high level of risk, which is due to the high degree of influence of macroeconomic and geopolitical factors, market and technological components, etc. [3], [4], [5], [6], [7]. Many experts criticize the rapid development of the Arctic shelf, proving it by price noncompetitiveness of Arctic oil, low degree of technological security of the projects, etc. [8].

The only fully launched oil and gas offshore project in Russia is the platform Prirazlomnaya with total recoverable reserves more than 70 million tons of oil [9]. It is planned to reach full oil production of 5 million tons per year in 2021-2022. A number of other oil and gas projects in the Russian Arctic are at the various stages of realization. A lot of them were planned to be implemented in cooperation...
with foreign companies, but due to the ongoing sanctions from the U.S. and Europe and unstable macroeconomic and political conditions, the prospects of these projects remain unclear today. The moratorium on the new licenses on the Arctic shelf is imposed in Russia now and the access to the Arctic shelf is still available only for the state companies – Gazprom and Rosneft.

The high degree of uncertainty of Arctic oil and gas projects necessitates the development of science-based forecasts. To date, no specific methodological tools have been developed to predict the future of Arctic shelf development, and existing forecasts are fragmented and aimed mainly at theoretical justification of possible ways of future development [10], [11].

In the light of earlier conducted researches [12-13], in this paper we attempt to determine the peculiarities of forecasting the prospects of offshore oil and gas projects in the Arctic, as well as to estimate the possibility of application of existing forecasting methods (statistical and expert) to the development of such forecasts.

2. Literature review
Conducting the literature review, we can conclude that the majority of the papers devoted to the Arctic are written in the publicistic genre and present the analytical investigations. In the world practice, estimations of the Arctic shelf development are continually published by such organizations as International Energy Agency, U.S. Energy Information Administration, World Energy Council, World Bank, International Monetary Fund and many others, as well as by the large energy companies (for example, BP). But their forecasts mostly focus on oil prices and oil production in the Arctic, as well as on the identification of factors which influence prospects of oil production, mostly political, economic and market ones.

As for academic publications, different authors discuss geopolitical, economic, social and technological aspects related to the Arctic. Regarding oil and gas production in the Arctic such problems as infrastructure development, complexity and high capital cost of the projects, environmental risks and others are considered in the papers. There are a number of Russian scientists which pay attention to the investigation of prospects of the hydrocarbons production in the Arctic (Ampilov 2014; Amigaryan 2016; Morgunova 2017; Savinov and Ganzhinv a 2017; Nikitin and Dzublo 2017; Nikolaeva 2017; Mitrova, Grushevenko and Malov 2018, etc.) [14], [15], [16], [17], [18], [19], [20], [21].

Some of scientists predict favorable future for Arctic oil and gas projects in the terms of its general prospects assessments (Fadeev 2016; Barsukov 2014) [22], [23], some of them – the opposite (Criticism of oil and gas projects 2015) [24]. But all the experts recognize strategic importance of offshore oil and gas production for the national economy in the long-term period and the need of evaluating its prospects.

3. Main part
The key task of forecasting the development of Arctic offshore oil and gas projects is to transform the existing uncertainty into probability, on the basis of which long-term and medium-term forecasts can be made.

It is obvious that the problem of determining the prospects for Arctic hydrocarbons development is complex and requires an integrated approach. The complexity of the studied economic system, the variety of the factors at different levels and particular indicators make it necessary to systematize them in terms of influence on the prospects of shelf projects implementation [11], [25]. The development of such forecasts requires a combination of existing approaches and tools, the use of different groups of forecasting methods and their adjustment. It is also necessary to take into account the features related to the industry and market conditions.

The specific features of forecasting the prospects of Arctic oil and gas offshore projects implementation are the following:
- High degree of uncertainty in forecasting long-term trends in the oil and gas industry (including geopolitical and macroeconomic factors);
- Uniqueness of each project which implies availability of individual (unique) approaches to technologies selection, logistics schemes, management system, and impossibility of application of analogy methods;
- Need of taking into account and linking a large number of factors;
- Lack of organized statistical data for mathematical model development;
- Need of taking into account and linking forecasts at different levels (state, region, industry, company, project);
- Need of combining business interests with strategic priorities of the domestic oil and gas industry, the economy of the country as a whole, and society [12], [13], [17], [18].

One of the main indicators in forecasting shelf development prospects is the volume of oil production. Existing forecasts of oil production on the Arctic shelf are significantly different. Thus, according to the Ministry of Energy of the Russian Federation, by 2025 the annual volume of oil production will not exceed 5 million tons per year, and by 2035 - 11 million tons. At the same time, some experts provide more optimistic forecasts. According to the data prepared within the Special Project in partnership with Gazprom Neft Shelf LLC, oil production could reach 22 million tons by 2030, and 33 million tons by 2035.

The variability of oil production indicates the existing ambiguity in the medium-term and long-term forecast of the shelf development.

Even more important (initial) quantitative indicator significantly affecting the prospects of oil and gas offshore projects is the price of crude oil. Increase in oil prices could positively affect the economic efficiency of such projects influencing such indicators as NPV, PI, IRR and DPBP.

Figure 1 shows the dynamics of Brent oil prices over the past ten years.

Volatility of oil prices is caused by the list of complex factors, mainly by the fluctuations of the dollar, U.S. oil production, shifts in oil demand, agreements of the Organization of the Petroleum Exporting Countries (OPEC), as well as many others. We summarized the examples of oil prices’ forecasts developed by the U.S. Energy Information Administration (EIA), World Bank, International Monetary Fund (IMF), Organization for Economic Cooperation and Development (OECD).

According to the EIA, oil prices forecasts average 70 U.S. dollars in 2019 (actual price in 2019 was about 64 dollars per barrel according to the Ministry of Energy of the Russian Federation [28]), and 67 in 2020 (Short-Term Energy Outlook [29]). The World Bank forecasts that the oil prices will be falling up to 2020 and then will be increasing after 2020 to reach 70 U.S. dollars per barrel on average up to 2030. The IMF predicts that the oil prices will hold around 55 dollars in 2022, while the OECD forecasts 80 U.S. dollars by the same year. As for the long-term, EIA forecasts the average price around 81 U.S. dollars by 2025 and its increase up to 105 by 2040 and 107 by 2050. Thus, the
forecasts presented by authoritative international organizations differ significantly. Such forecasts are developed on the basis of expert methods, analytical studies, and management methods (for example, event analysis).

As for the forecasting methods, there are quite a large number of their classifications [30], [31] – by the prediction period, degree of formalization, information base, etc. [32]. Practically all groups of forecasting methods can be divided into mathematical-statistical and expert methods.

The first group of methods uses factographic information (quantitative parameters of the research object) and relies on probability theory, laws of large numbers and mathematical statistics. The basis of these methods is quantitative analysis of the data. Extrapolation forecasts are of importance in this group of methods.

The second group of methods is based on an intuitive (expert) approach. In general, all expert forecasting methods can be divided into individual and group (collective) methods. Usually experts participate in forecasting if the object of the study is extremely simple or, on the contrary, extremely complex. In the second case, it is impossible to gather information sufficient to make a decision, except by presenting a special professional opinion on the subject and the object [32].

The forecast of future oil prices is a good example of how statistical methods can be used. The pricing of Arctic oil ARCO is closely related to the prices of Urals oil which in turn have a high correlation with the prices of Brent oil. Therefore, due to the absence of retrospective of ARCO prices, the indicator "average annual price of BREAT oil" from 2010 to 2018 was analyzed (Figure 1). The dynamics of the indicator is non-linear. Its values range from 46 to 112 dollars per barrel, so such extrapolation methods as exponential smoothing, moving average and regression model were used to develop the forecast.

Using the exponential smoothing method, the forecast for 2019 was $69.09 dollars per barrel. The moving average method gives a forecast for 2019 of $58.09 dollars per barrel. Generally, both methods provide forecasts comparable to the average values of recent years. According to the third degree polynomial, the price of oil was 127.74 dollars per barrel in 2019 (Figure 2) and about 222 dollars per barrel in 2020, which is not possible.

The obtained results with the use of statistical methods differ significantly. The actual average price of Brent oil for 2019 (according to the Ministry of Energy of the Russian Federation [28]) was about 63 dollars per barrel. Statistical methods are useful if the time series is stationary. It means that the indicator was influenced by the same range of factors throughout the study period, and its values
were formed under the same conditions. Considering the above, oil prices indicator is not like this. This explains the results obtained by trying to predict oil prices using statistical methods.

4. Discussion

On one hand, it is obvious that forecasting of oil prices can become the basis for assessing the prospects of offshore projects. On the other hand, oil prices can barely be predicted by both statistical and expert forecasting methods.

It is obvious that the oil price is an indicator that depends on both the economic and political situations in the world. World economic crises, military conflicts, discovery of new large oil fields, economic sanctions, political decisions of the leaders of oil and gas industry – all these are not a complete list of factors determining the dynamics of oil prices. The formation of world oil prices is not a stable and easily predictable process.

Thus, in methodological terms, there is a problem with the tools for forecasting both individual indicators and the prospects of offshore projects in general. Extrapolation forecasts, which are based on the past trends, are not applicable to this task, as stable patterns of development of such projects in the Arctic have not been formed. The use of other statistical methods is severely limited due to the lack of retrospective data and the difficulty of assigning quantitative scores to each indicator. Expert assessments can be applied partially, since any estimates of the future development of offshore projects in the long term will be probabilistic.

An expert approach to the problem will give us more appropriate results in comparison with statistical methods. Thus, the application of expert methods in this case is possible and necessary.

In general, there is a need for a complex approach and algorithm for developing such forecasts. The authors laid the foundations for such research, where the application of expert forecasting methods is planned at all three stages of the study. At the first stage we plan to organize general expert surveys to determine the overall prospects of Arctic shelf development; at the second stage – to reveal specific indicators influencing each particular project; at the third stage – to predict the impact of specific indicators on the prospects of oil and gas offshore projects and to identify possible ranges of the values of project indicators with the help of specific expert surveys.

The background for the use of expert forecasting methods in determining the prospects for offshore projects in the Arctic are presented in Figure 3.

**Figure 3.** Prerequisites for the use of expert forecasting methods to assess the prospects for Arctic offshore projects.

- Possibility of replacing lack of data for extrapolation
- Possibility to work with data (indicators) that are non-linear (e.g., exchange rates, oil price)
- Data suitability for expert processing only
- Availability of unique expert qualities (knowledge, experience, feeling) of specialists
- Possibility to involve specialists of different profiles for highly specialized forecasts (for example, forecast of development of specific technologies for offshore projects)
5. Conclusion
Effective development of offshore oil and gas projects is one of the priority tasks in oil and gas industry development. However, the presence of significant oil and gas reserves on the Russian Arctic shelf cannot clearly indicate the success of such projects as their initiation and implementation are subject to a whole group of contradictory factors.

This paper identifies specific features of forecasting the prospects of Arctic offshore projects. It is determined that such forecasting is carried out in conditions of high uncertainty which is due to the almost complete absence of statistical (retrospective) information and data on Arctic projects. In turn, this is due to their uniqueness, complexity of climatic and mining-geological conditions, long terms of implementation, high capital intensity, etc.

In view of the difficulty of forecasting the prospects for Arctic offshore projects, it is important to use expert methods. Such studies should be conducted according to a certain algorithm, and expert assessments should be applied step by step starting from the general expert opinion on the prospects of Arctic shelf development to specific surveys with the help of particular indicators.

Acknowledgements
The research was carried out with the financial support of the Russian Foundation for Basic Research (RFBR), the project "Evolution of methodology of technological forecasting of development of the interconnected industrial and social and economic systems at hydrocarbon resources development in the Arctic" No. 18-010-00734.

References
[1] Gautier D L et al 2009 Assessment of Undiscovered Oil and Gas in the Arctic Science 324 (5931):1175-9
[2] Bird K J et al 2008 Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle USGS Fact Sheet 2008-3049
[3] Ilinova A A and Solovyova V M 2017 Technological problems of the development of hydrocarbon shelf resources of the Russian Arctic St. Petersburg: Oil and gas of Western Siberia. Materials of the international scientific and technical conference 104-106 (in Russian)
[4] Cherepovitsyn A E, Fadeev A M and Larichkin F D 2017 The features of oil & gas complex’s strategic management and hydrocarbon products transportation at developing marine oil & gas fields in Arctic Bulletin of Murmansk State Technical University 4 742-754 (in Russian)
[5] Chanysheva A F et al 2019 Long-term forecasts of the oil and gas Arctic shelf development: the existing methodical approaches and assessment of a possibility of their application IOP Conference Series Earth and Environmental Science 302:012068
[6] Molchanov K and Romasheva N 2019 Conceptual approaches for building a balanced portfolio of projects in oil and gas companies in exploration and production sector E3S Web of Conferences 140 03004
[7] Cherepovitsyn A E, Romasheva N V and Chvileva T A 2018 Prospects for the exploration of hydrocarbon deposits in the Arctic based on socio-economic evaluation International Journal of Civil Engineering and Technology 9(13) 938-948
[8] Ilinova A A and Solovyova V M 2018 Study of implementation prospects of oil and gas shelf projects in the Arctic The North and the Arctic in the new global development paradigm Lusin readings-2018 82-83 (in Russian)
[9] Savina A 2016 Gazprom Neft Shelf: Prilazlomnoye Field Development ROGTEC 14-23
[10] Borisov V N et al 2015 Theory and practice of integrated development of the Arctic zone of the Russian Federation Saint Petersburg The Publishing House of Polytechnic University p 192 (in Russian)
[11] Ilinova et al 2018 Producing long-term forecasts for the Arctic shelf. Innovation-Based Development of the Mineral Resources Sector: Challenges and Prospects XI Russian-german
raw materials conference committee 539-553

[12] Chanysheva A F and Ilinova A A 2018 Methodical approaches to the forecasting of prospects of the Arctic hydrocarbon resources development. North and market: formation of an economic order 6(62) 53-63 (in Russian)

[13] Ilinova A A and Solovyova V M 2018 Technological aspects of development of Russian Arctic shelf resources. North and market: formation of an economic order 4(60) 32-42 (in Russian)

[14] Ampilov Y P 2014 The development of the Arctic shelf and the Far East. Problems and prospects. Offshore 4(6) 8-15 (in Russian)

[15] Amiragyan A 2016 Oil and gas in the Russian Arctic. Fuel and energy complex of Russia 9 35-39 (in Russian)

[16] Ampilov Y P 2017 The Russian shelf «window of opportunity» Drilling and oil 2 Available from: https://burneft.ru/archive/issues/2017-02/3 [Accessed 2 January 2020] (in Russian)

[17] Morgunova M O 2017 Prospects for development of hydrocarbon resources of the Arctic shelf of Russia in conditions of transformation of the world energy sector. Thesis for the degree of candidate of economic sciences. National Research University named after I.M. Gubkin. Available from: https://www.gubkin.ru/diss2/files/Dissertation_Morgunova_MO.pdf [Accessed 15 December 2019] (in Russian)

[18] Savinov Y A and Ganzhinova S A 2017 Perspectives of Russian offshore projects in the Arctic World economy. The Russian Foreign Economic Bulletin 4 25-32 (in Russian)

[19] Nikitin B A and Dzublo A D 2017 Prospects for the development of gas resources in the shelf of the Arctic seas of Russia. News of the gas science 4(32) 15-24 (in Russian)

[20] Nikolaeva A B 2017 Sustainable development of the Arctic shelf: Problems and prospects. Proceedings of the Fersman scientific session of the Kola science Center of the Russian Academy of sciences 14 531-534 (in Russian)

[21] Mitrova A, Grushevenko E and Malov A 2018 Prospects of Russian oil production: Life under sanctions. Report of the Skolkovo Foundation. Available from: https://energy.skolkovo.ru/downloads/documents/SEneC/research04-ru.pdf [Accessed 15 January 2020] (in Russian)

[22] Fadeev A M 2016 The shelf has a bright future. Information resource ProArctic. Available from: http://proarctic.ru/10/03/2016/expert/20514 [Accessed 15 December 2019] (in Russian)

[23] Barsukov Y 2014 Offshore projects are more profitable than projects on land. Kommersant. Available from: https://www.kommersant.ru/doc/2613726 [Accessed 18 December 2019] (in Russian)

[24] Criticism of oil and gas projects 2015 Opinions of managers, politicians, specialists and industrialists on the raw dependence of the Russian economy and the development of hydrocarbon fields in the Arctic. Available from: http://www.greenpeace.org/russia/Global/russia/report/Arctic-oil/2015-03-17_oil_gas_projects_critics.pdf [Accessed 19 December 2019] (in Russian)

[25] Carayannis E, Ilinova A and Chanysheva A 2019 Russian Arctic Offshore Oil and Gas Projects: Methodological Framework for Evaluating Their Prospects. Journal of the Knowledge Economy. doi:10.1007/s13132-019-00602-7

[26] Crude oil prices: Brent Crude 2014-2021. Available from: https://www.statista.com/statistics/409404/forecast-for-uk-brent-crude-oil-prices/ [Accessed 20 January 2020]

[27] The price of Brent crude oil. Available from: https://worldtable.info/yekonomika [Accessed 19 December 2019] (in Russian)

[28] Ministry of Energy of the Russian Federation. Available from: https://minenergo.gov.ru/en [Accessed 16 December 2019]

[29] Short-Term Energy Outlook. The U.S. Energy Information Administration (EIA). Available from: https://www.eia.gov/outlooks/steo/ [Accessed 16 January 2020]

[30] Ord K, Fildes R A and Kourentzes N 2017 Principles of Business Forecasting. Wessex Press
[31] Svetunkov I S and Svetunkov S G 2015 Methods and models of socio-economic forecasting. Theory and methodology of forecasting Yurayt p 352 (in Russian)

[32] Sultanov I A Types of innovative forecasting methods Projectimo Available from: http://projectimo.ru/innovatika/metody-prognozirovaniya.html [Accessed 16 January 2020] (in Russian)