

Article

The Future of Russian Arctic Oil and Gas Projects: Problems of Assessing the Prospects

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Abstract: The development of Arctic marine resources is currently the focus of the world's largest oil and gas companies, which is due to the presence of significant hydrocarbon reserves. However, the decision-making process for implementing offshore oil and gas projects in the Arctic is highly uncertain and requires consideration of many factors. This study presents a comprehensive approach to evaluating the prospects of oil production on the Russian Arctic shelf. It is based on a specific methodology which involves expert forecasting methods. We analyze the current conditions and key factors and indicators, focusing on oil prices and quality of technologies that could influence the decision-making in the oil and gas company concerning Arctic offshore fields' development. We use general scientific methods—analysis, synthesis, classification and systematization—and propose a method for assessing the prospects of Arctic projects which is based on a three-step algorithm. Together with practical tools presented in the article, it will support decision-making on the project initiation and the development of a particular field.

Keywords: Russian Arctic; marine resources; forecasting; expert methods; oil and gas; offshore projects; shelf; prospects



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1. Introduction

At present, the global oil and gas industry is undergoing post-crisis processes and transformation of the energy sector. In March 2020, the price of Brent crude oil reached a record minimum value, below \$20 per barrel [1]—the average price of Brent crude oil was about \$42 per barrel in 2020 (Figure 1).

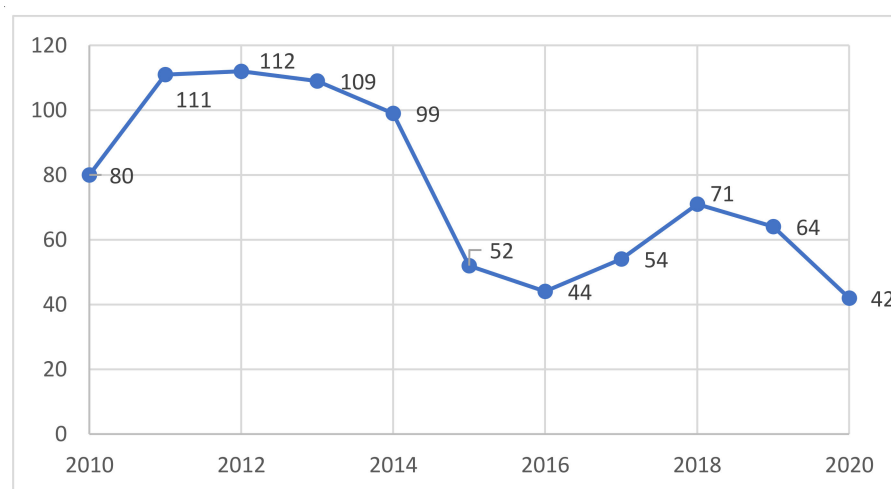


Figure 1. Dynamics of Brent crude oil prices during 2010–2020, USD/bbl. Source: developed by the authors based on [2,3].

Currently, reorganization of the industry is taking place due to the fact that oil could start losing its leading position in the structure of world energy consumption [4–8] as alternative energy sources are developing rapidly [9–13], and the industry is experiencing a number of significant changes, in particular in connection with the COVID-19 pandemic [14–17]. Yet, oil accounted for 33% of the global energy balance in 2019 [3]. However, according to analysts, the share of oil will steadily decline—BP estimates a decrease to 24% by 2030 and 17% by 2040 [18].

Such trends are unprecedented in the global economy and significantly increase the uncertainty throughout the industry, which itself is highly volatile [16]. It makes oil and gas projects with high production costs unprofitable [19]. This is especially true for Arctic marine projects, which are innovative and capital-intensive in nature.

It is well-known that the Arctic has rich hydrocarbon fields in the shelf zone, which is of particular interest to Russian and foreign companies [20–25]. In this regard, it is still debated whether the development of Arctic marine resources is reasonable.

For Russia, oil and gas production in the Arctic has been an important issue for a long time, since it is a powerful driver for the development of the Northern territories and the country's economy as a whole [26,27]. The presence of Russian oil and gas companies in the Arctic is of geopolitical significance [28–31]. In this situation, the problems of developing Arctic mineral resources (including oil and gas) are widely discussed both at the state level and in the academic literature [32–35].

Thus, since 2008, the foundations of strategic management of the Arctic region have been developing in Russia. They are aimed firstly at socio-economic spatial development of territories and ensuring national security. In recent years, a set of basic strategic documents has been adopted which reflect general issues of strategic management and planning, protecting Russia's national interests in the Arctic [36–38], as well as specific problems, such as the development of logistics routes and infrastructure (for example, the Complex plan for modernization and expansion of the main infrastructure of the Russian Federation until 2024, the Development Plan for the Northern Route for the period until 2035, etc.) [39,40], the development of mineral resources, etc.

Some legislative documents (for instance, the strategy for the development of the Arctic zone of the Russian Federation and ensuring national security for the period up to 2020) were valid until 2020. In March 2020, the Fundamentals of the State Policy of the Russian Federation in the Arctic for the period up to 2035 were adopted [36]. One of the purposes of this document is to propel the economic development of the Russian Arctic zone and increase their contribution to the country's economic growth. In November 2020, the strategy for the development of the Russian Arctic zone and ensuring national security for the period up to 2035 was adopted [37]. It presents the main objectives, as well as the tools for the development of the Russian Arctic.

An approach aimed at forming “reference zones” (points of growth) in the Arctic seems interesting. It is established as the main tool for implementing state policy in the Arctic and assumes the development of the Arctic territories as an integrated project. Many of the designated “reference zones” (Kola, Nenets, Taimyro-Turukhansk and others) are focused on raw materials, which confirms the critical importance of implementing oil and gas and other mineral resource projects in the Arctic.

As for academic literature, many researchers devote their works to certain aspects of Arctic territorial development: issues of economic development [26,41], attracting labor resources to the Arctic [42,43], national and environmental safety [30,44], development of hydrocarbon fields in the Arctic seas [45], territorial peculiarities in the Arctic [46], assessment of associated risks [32,47] and many others.

In this regard, due to the complexity and uncertainty about the future of Arctic projects, works in the field of strategic planning and forecasting are of interest. Some of them represent practical tools, such as scenario-based roadmap method and scenario planning [48,49], the choice of a policy implementation strategy based on the forecast of its effectiveness [50], retrospective forecasting and strategic planning maps [51].

For example, Kondratenko makes an attempt to form an effective program for the development of the Arctic shelf based on economic and mathematical modeling [52]. This approach considers the various aspects of the objects analyzed and justifies investments in Arctic offshore oil and gas projects using its own methodology of multi-criteria analysis.

The opinions of researchers and experts regarding the prospects for the development of oil and gas marine resources in the Arctic are radically different. Many experts oppose the development of such deposits due to the commercial inefficiency of projects and the need to import foreign mining technologies. Others, on the contrary, are in favor of implementing projects in the Northern seas due to their positive effects on the Arctic regions, such as improvement of the demographic situation and standard of living. Experts also argue that this opinion is based on the need to strengthen Russia's geopolitical position in the Arctic and improve the image of the Russian oil and gas industry, to prepare for the development of the Russian Arctic shelf [28–30,44,53].

The complexity of Arctic hydrocarbon production projects is due to the influence of a wide range of factors that should be considered when making decisions concerning their future. At the same time, many indicators are qualitative, and the process of evaluating the prospects is difficult to formalize. All this significantly increases the uncertainty surrounding the project and affecting the decisions on its implementation.

It is obvious that oil prices determine the efficiency of hydrocarbons production in the Arctic seas [27,54]. The quality of technologies for offshore production also plays a significant role. In fact, these are the key factors which determine the expediency of developing Arctic offshore hydrocarbon resources, and from this viewpoint, it is inappropriate to talk about high commercial effectiveness of such projects at the moment. However, oil prices' growth, the emergence of new technologies for offshore production and other factors will raise this issue again.

As a result of a thorough analysis of the literature, we have come to the conclusion that there are few studies in the field of evaluating the prospects for the implementation of Arctic offshore projects. In particular, Morgunova presents methods of scenario planning for the development of Arctic shelf deposits in the long term [33]. However, the described scenarios provide only general guidelines concerning the future development of Arctic marine resources and do not consider the prospects for specific oil and gas projects. This confirms the relevance of our research, which is a systematic approach to the problem.

In this work, we use the phrase “forecasting the prospects of an oil and gas Arctic offshore project,” meaning that evaluating the long-term prospects of such projects should be based on expert forecasting methods. The prospects of an Arctic oil and gas offshore project appear as its qualitative characteristic, which determines the possibility of their commercially effective implementation. The obtained forecasts will demonstrate the economic performance of the specific offshore project in the long-term.

Our earlier analysis of the possibilities of applying traditional forecasting methods (expert and statistical) to assess the prospects for developing Arctic marine hydrocarbon fields showed that expert methods (expert surveys) are indispensable for such an assessment. Statistical forecasting methods are not applicable for long-term forecasting purposes due to high uncertainty and variability of the external environment and lack of necessary statistical information on the studied indicators [55–57]. In this regard, we hypothesize that the use of expert surveys is the only possible way to form adequate long-term forecasts in this research field.

Thus, the research problem is that the decision-making process for the development of the Arctic offshore field is complex and requires an appropriate scientific base. For that, we propose a systems approach to the problem that will help managers of oil and gas companies make qualified decisions.

Taking into account the above, the purpose of this work is to develop a universal conceptual and methodological approach to forecasting the prospects for offshore hydrocarbon production projects in the Arctic. The practical value of the study lies in the developed system of specific indicators, toolkits and method for forecasting the prospects of an oil

and gas Arctic project. From the analysis, we conclude that (i) long-term forecasts of the prospects of Arctic marine oil and gas projects should be based on up-to-date expert opinions, and (ii) decisions on the project implementation should be supported by scientific research and involve specifically designed practical tools. For that, we recommend using the methodology described below.

2. Materials and Methods

During the research, we used several scientific methods, such as scientific analysis and synthesis, classification, systematization and decomposition. We applied commonly used short-term and long-term forecasting methods—extrapolation and expert methods mainly, as well as consensus forecasts.

In the beginning, we paid special attention to such critical aspects as post-pandemic oil prices' forecasts, the development of offshore oil production technologies and the break-even point of Arctic oil and gas projects in the Arctic. Yet, we hypothesize that decision-making on Arctic offshore projects' implementation should consider a wider range of factors and specific indicators.

Then, we systemized all factors and indicators that may hold back or, on the contrary, facilitate the implementation of the project. It allowed us to highlight six key factors which influence the project's prospects. We call them TESCIMP factors, which stand for Technologies (T), Environmental Safety (ES), Climatic and geological factors (C), Infrastructure (I), Macroeconomic factors (M) and Political factors (P). A more detailed description of each factor and its influence on project prospects was provided in our previous research [58]. Indicators inherent to each specific project were classified in four groups in accordance with two criteria—"controllability" and "necessity"—forming a matrix of TESCIMP indicators. The controllability criterion allocates indicators into two groups—"manageable" and "conditionally manageable" ones. It reflects the ability of managers to control and influence the values of TESCIMP indicators. The necessity criterion divides indicators into two groups—"essential" and "stimulating"—depending on the significance of each indicator and the contribution it makes to the assessment of the project's prospects. The essential indicators are qualitative and are used to assess the project's prospects in current conditions based on the conformity of their real values to the desired ones, with the help of a special checklist. Stimulating indicators are quantitative and help evaluate the project's prospects according to the method described below. The full list of indicators can be found in our previous research [58].

Finally, we assume that forecasting the prospects of the Arctic offshore projects should be carried out in the framework of our previously developed TESCIMP methodology. In addition to the classification described above, it involves special practical tools which facilitate solving the problem. They are included in the research algorithm presented below. All these form a complex system and present a comprehensive approach to forecasting the prospects of an Arctic offshore project.

3. Results

3.1. Oil Prices and Technology Development as Crucial Points of Arctic Oil and Gas Projects' Prospects

As noted above, the main factors determining the future of oil and gas projects on the Arctic shelf are oil prices and technology. Oil prices, especially in the face of energy transition, are difficult to predict, and even general trends (positive or negative) for oil prices are hard to forecast. Regarding the new technologies for oil production in the Arctic, the level of their development varies in different countries. As for Russia, predicting the level of technology development is an extremely difficult task. The important thing is that they can have a significant impact on reducing the level of operating costs (OPEX).

Figure 2 provides the analysis of post-pandemic oil price forecasts by the U.S. Energy Information Administration (EIA) and energy companies such as Shell, Eni and BP. In addition, it shows the consensus forecast of oil prices until 2030.

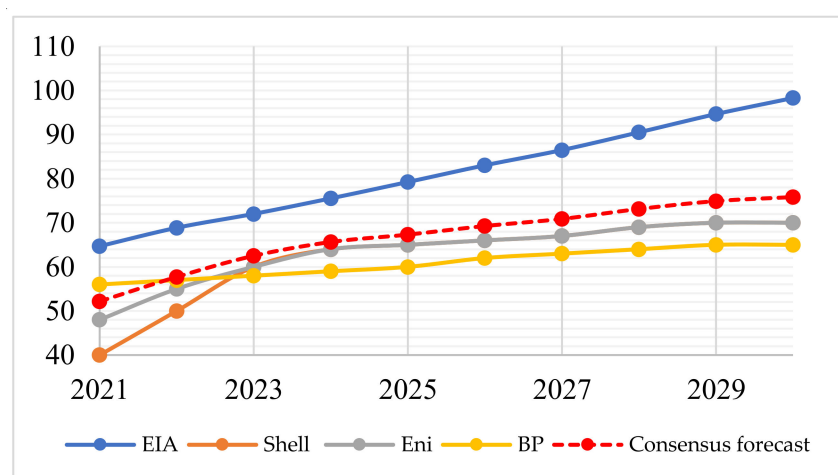


Figure 2. Long-term Brent crude oil price forecast until 2030, USD/bbl. Source: developed by the authors based on [1,59].

According to the forecasts presented in Figure 2, oil prices will grow. We can conclude that under the optimistic scenario (close to the EIA estimates), oil prices will gradually increase to \$100 per barrel by 2030. In the pessimistic scenario (close to BP's estimates), oil prices will vary in the range of \$60–\$65 per barrel.

As for the level of operating costs in oil production on the Russian Arctic shelf, experts' estimates differ significantly. According to the latest estimates of the Ministry of Energy of the Russian Federation, the break-even point of oil marine projects in the Arctic is about \$50–\$70 per barrel [60]. Some experts assess the costs at the level of \$42–\$43 per barrel [61]. However, this is an average estimate for all fields in the Arctic, and it will differ for each specific project. Thus, according to Gazpromneft company, the cost of oil production at the Prirazlomnoye field (the only fully launched oil project on the Arctic shelf) will be less than \$10 per barrel after all investments are made and the project reaches its full capacity [62].

The Norwegian company Equinor states that the break-even point of Johan Castberg oil field is less than \$35 per barrel, and Equinor's portfolio reached a break-even point of \$27 [63,64]. Norway has made great strides in the development of Arctic hydrocarbons, demonstrating record low OPEX for offshore oil production. In general, the breakthrough technologies' development can open up new opportunities for oil production in marine fields, including Russian oil and gas companies.

It should be noted that in addition to OPEX, the amount of capital expenditures (CAPEX) is also critically important. According to experts, the cost of drilling on the shelf is 10 times higher than on land, and on the Arctic shelf it is about 27 times higher [65]. The development of drilling technologies may also be a powerful driver to enhance the development of Arctic oil and gas projects.

At the same time, each Arctic project is unique (which is also confirmed by different estimates of the cost of oil production on the Arctic shelf), has a different geographical location and, accordingly, different infrastructure and geological conditions, and determining the prospects for such projects cannot be based only on oil prices and technology development. It confirms the need for a thorough analysis of each particular case and project with the involvement of experienced experts.

3.2. Method for Assessing the Prospects of an Oil and Gas Project on the Arctic Shelf

After the analysis, we came to a conclusion that expert forecasting methods are a significant tool that could help managers prepare justified long-term forecasts for the prospects of an oil and gas project on the Arctic shelf.

As the result of this study, we present a method for assessing the prospects of projects on the Arctic shelf. It can be used by managers of oil and gas companies having specific plans for extraction of hydrocarbons from the Arctic shelf zone as an additional instrument

for assessing the prospects of such projects. It is a formalized method for considering expert opinions in the decision-making process.

This toolkit is based on an algorithm that helps to apply a complex approach to forecasting the project's prospects and consists of three main stages (Figure 3). The “inputs” of each stage are presented in ellipses on the left side. These are the specific practical tools used within the stage, as well as incoming information. The central part of the algorithm reflects the processes being implemented, and the right part—the results obtained.

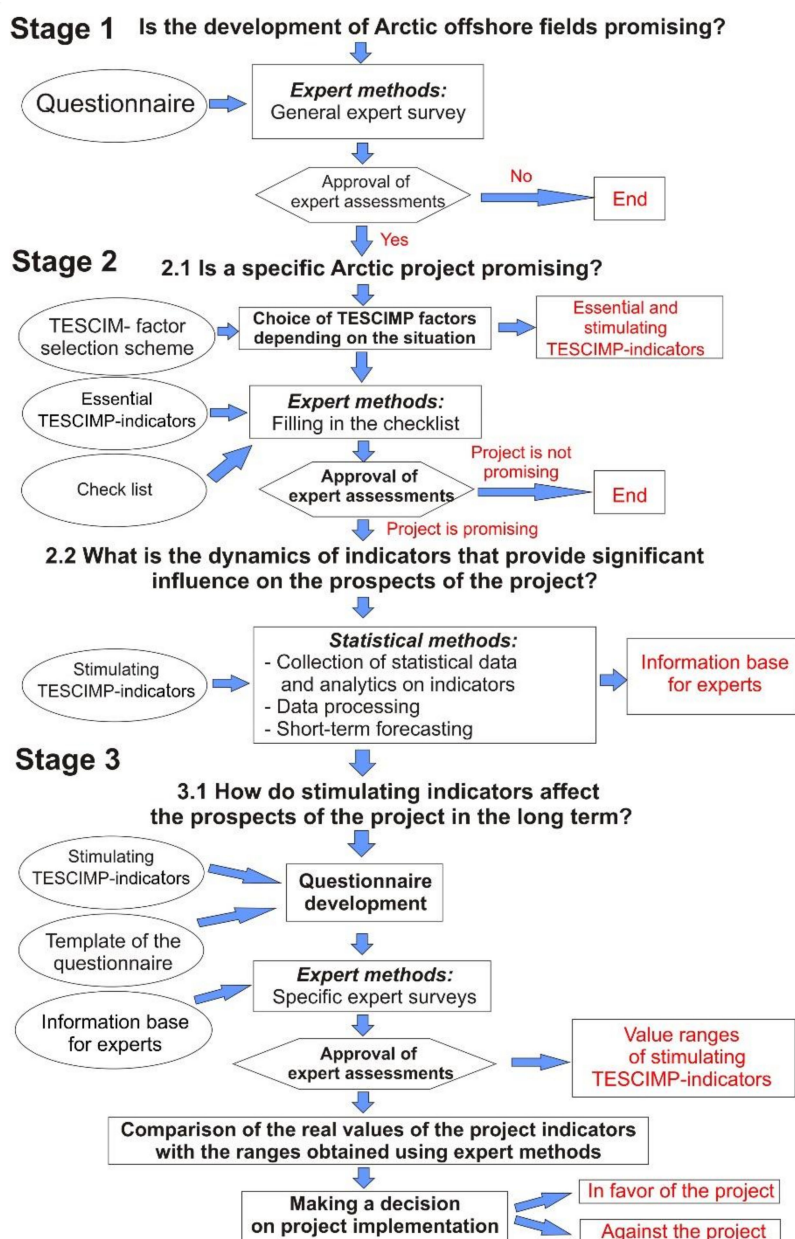


Figure 3. Algorithm of a complex approach to forecasting the prospects of an oil and gas project on the Arctic shelf. Source: developed by the authors.

The first stage of this research is focused on expert forecasting methods in terms of overall prospects for hydrocarbons' production in the Arctic seas. The goal of this stage is to give an answer to the question whether the development of the Arctic shelf is expedient or not. At this stage, specialists of various profiles, scientists and managers of oil and gas companies are involved to ensure the objectivity of the study. The questionnaire of the general expert survey includes the following issues: (i) development of the oil and gas

industry as a whole, (ii) prospects and investment attractiveness of offshore oil and gas projects in the Arctic, (iii) state regulation in the field of Arctic marine resources' production, (iv) international cooperation and (v) technological problems of hydrocarbon production on the Arctic shelf. A fragment of a general expert survey questionnaire is presented in Appendix A (Table A1). After the survey, the expert opinions are analyzed and adjusted. The results of this survey provide a comprehensive expert opinion on the prospects for the development of the Arctic oil and gas shelf. It will give a company's manager a profound outlook of key tendencies and problems that will accompany the project to be developed, which will help him make a reasonable decision on initiating a project in the current conditions.

The second stage consists of selecting TESCIMP factors and their corresponding indicators that affect the implementation of a specific project, depending on the situation. Moreover, the output of this stage is an information base for experts which will help to support the decision-making process at the third stage—during the specific expert surveys. This step is based on the TESCIMP methodology and includes the collection and processing of statistical and analytical data for key indicators, and the use of statistical and expert forecasting methods.

In order to determine TESCIMP indicators for assessing the prospects of an oil and gas project on the Arctic shelf, we developed a scheme for selecting TESCIMP factors, which is used every time a decision is made to develop a particular field in the corresponding circumstances (Figure 4). The prospects of the project are estimated by oil and gas companies planning to develop the field.

No. of regions No. of companies	1	Factors	2	No. of regions No. of companies
1	Situation 1 (M, P, C, T)	Macroeconomic (M) Political (P) Climatic and Geological (C) Technology (T)	Situation 3 (M, P, C, I)	1
2	Situation 2 (M, P, T, C, ES)	Infrastructure (I) Environmental Safety (ES)	Situation 4 (M, P, C, T, I, ES)	2

Figure 4. Scheme for selecting TESCIMP factors for evaluating the prospects of an oil and gas project on the Arctic shelf. Source: developed by the authors.

The selected TESCIMP factors and indicators can take different values depending on the field, the operator company and the production region. If the deposits are located in different countries and it is necessary to choose one of the projects, political and macroeconomic factors will play an important role in assessing their prospects. In addition, even for Russian projects, the influence of these factors is crucial, as they create, or do not create, the opportunities for their successful implementation.

Therefore, these factors should be considered when evaluating the prospects of any project. If the fields for the development are located in the same region, technologies and climatic and geological factors will be paramount when choosing one of the alternative projects by one company. This case corresponds to Situation 1 in the scheme. The environmental safety appears to be a crucial factor when there are two or more oil and gas companies applying for the fields' development, since it is directly related to their environmental policy. If there are deposits located in different regions, the values of infrastructure indicators become important for the project precedence.

To assess the prospects of a specific project on the Arctic shelf, we propose to use a checklist which can be formed after selecting TESCIMP factors and the corresponding qual-

itative indicators (the so-called “essential” indicators). If the real values of each required indicator in the checklist coincide with the desired ones, the project under consideration can be assessed as promising [58].

The information base for experts includes short-term forecasts about the values of particular quantitative TESCIMP indicators (we call them “stimulating” indicators as their values can motivate or demotivate the company for the field development [58]). For this, extrapolation methods using retrospective data are mainly used. In addition, we propose to systematize up-to-date analytical information about the dynamics and current values of the indicators under consideration. An example of an information base for conducting a specific expert survey is presented in our previous research [66].

The third stage is dedicated to specific expert surveys on the prospects of an oil and gas project and uses the outputs of the first and second stages. Its goal is to evaluate how stimulating indicators affect the project prospects in the long term. For specific expert surveys, a template is used as a basis for the special questionnaire, which is updated each time before the research. This is necessary because the questionnaire itself is not static, since it includes stimulating indicators that change depending on the situation of choice of a specific project. As a result of the survey, each stimulating indicator should obtain a range of its values (A, B or C), which is preceded by the expert approval procedure. The ranges of the values of each indicator obtained by the expert method can be written as follows:

$$a_{ij \min} \leq a_{ij \text{ low}} \leq a_{ij \text{ high}} \leq a_{ij \max}, \quad (1)$$

where $a_{ij \min}$ is the minimum value of the indicator, and $a_{ij \text{ low}}$ and $a_{ij \text{ high}}$ are the values of stimulating indicator a_{ij} limiting the mid-range (B).

If the minimum and maximum value of any indicator is difficult to establish, one can take $a_{ij \min} = 0$; $a_{ij \max} \rightarrow \infty$.

Figure 5 illustrates how stimulating TESCIMP indicators can be used for constructing a profile of a particular field from the managerial point of view.

An example profile shown in Figure 5 reflects the results of the specific expert survey and serves as an output of Stage 3 of the algorithm. TESCIMP factors used to construct the table are selected according to the scheme (Figure 4). In this case, we present an example of Situation 4 when all six factors are considered. The boundaries of each value interval (i.e., $a_{ij \min}$, $a_{ij \text{ low}}$, $a_{ij \text{ high}}$, $a_{ij \max}$) are assessed using expert methods and are the outputs of the specific expert survey. The black curved line is drawn based on the values of a range of indicators (left column) that fall in the corresponding intervals—the so-called “profile” of a project. In this example, the curved line shows a profile of a promising Arctic oil and gas offshore project, assuming that the optimistic oil price scenario will take place. Promising Arctic oil and gas offshore project is defined by the authors in our previous research [58].

Thus, this toolkit is designed to visualize how the real project’s quantitative indicators behave relating to the possible value ranges for each indicator. It helps the company’s managers compare the real values of the project indicators with ranges A, B and C and prepare an informed decision on the project’s implementation.

Moreover, we propose to quantify the prospects of an Arctic offshore oil and gas project.

Suppose m is the number of factors selected according to the above scheme, k_i is the number of indicators for each factor, $i = \overline{1, m}$, and a_{ij} is the real values of the project indicators for each factor, $i = \overline{1, m}$ and $j = \overline{1, k_i}$.

To get the final project assessment, we propose to use a matrix of coincidences of the real values of project indicators with ranges A, B and C. The elements c_{ij} of this matrix are obtained as follows: $c_{ij} = 1$, if the real value of the indicator falls within the range A, i.e., $a_{ij} \in [a_{ij \min}, a_{ij \text{ low}})$, $c_{ij} = 2$, if $a_{ij} \in [a_{ij \text{ low}}, a_{ij \text{ high}})$, and $c_{ij} = 3$, if $a_{ij} \in [a_{ij \text{ high}}, a_{ij \max})$.

	Stimulating TESCIMP-indicators	Values of indicators		
		[a _{ij} min ... a _{ij} low]	(a _{ij} low ... a _{ij} high)	(a _{ij} high ... a _{ij} max)
Direct dependency of indicators' values on the project prospects (↑)				
Macroeconomic factors	level of world prices for oil and gas, USD / bbl	0 ... 40	40 ... 70	70 and more
	increase in proved reserves of the Arctic shelf around the project field due to geological exploration, million tons of fuel	Filled by experts	Filled by experts	Filled by experts
	GDP growth rate of the country, %	Filled by experts	Filled by experts	Filled by experts
	savings associated with tax credits for developing Arctic shelf fields, million rubles	Filled by experts	Filled by experts	Filled by experts
Technologies	company's R&D expenses aimed at developing production technologies on the Arctic shelf per unit of output, million rubles / unit of products	Filled by experts	Filled by experts	Filled by experts
	number of innovations implemented in the total number of innovations developed in the oil and gas company, %	Filled by experts	Filled by experts	Filled by experts
	share of intangible assets (rights on IPOs) in the oil and gas company's assets, %	Filled by experts	Filled by experts	Filled by experts
	the share of company's R&D expenses in income (profit), %	Filled by experts	Filled by experts	Filled by experts
Infrastructure	number of patents received, pcs per year	Filled by experts	Filled by experts	Filled by experts
	number of shipyards, machinery plants, factories of building materials and other industrial organizations in the region, pcs.	Filled by experts	Filled by experts	Filled by experts
	density of population in the region, thousand people	Filled by experts	Filled by experts	Filled by experts
	level of deterioration of existing objects of transport and engineering infrastructure in the region, million rubles	Filled by experts	Filled by experts	Filled by experts
ES	company's expenditures associated with environmental protection, million rubles	Filled by experts	Filled by experts	Filled by experts
	PROSPECTS	LOW	MEDIUM	HIGH
Inverse dependency of indicators' values on the project prospects (↓)				
Political factors	oil and gas company's costs in connection with the imposition of sanctions against the Russian oil and gas sector, million rubles	Filled by experts	Filled by experts	Filled by experts
	share of foreign technologies in the total number of applied technological solutions, %	Filled by experts	Filled by experts	Filled by experts
	the share of services rendered by foreign oilfield service companies in the total volume of services rendered, %	Filled by experts	Filled by experts	Filled by experts
Climatic and geological factors	distance from the field to the coastline, km	Filled by experts	Filled by experts	Filled by experts
	depth of the sea on the extraction site, m	Filled by experts	Filled by experts	Filled by experts
	depth of oil / gas occurrence, m	Filled by experts	Filled by experts	Filled by experts
	average percentage of water surface covered by ice on the industrial vessel's way, %	Filled by experts	Filled by experts	Filled by experts
	average wind speed at the mining site, m / s	Filled by experts	Filled by experts	Filled by experts
	average score of sea disturbances on the Beaufort scale, point	Filled by experts	Filled by experts	Filled by experts
	average duration of the period of poor visibility (up to 1 km), days per year	Filled by experts	Filled by experts	Filled by experts
	number of days in a year with ice cover at the place of extraction, days	Filled by experts	Filled by experts	Filled by experts
Infrastructure	duration of the cold season, days per year	Filled by experts	Filled by experts	Filled by experts
	distance from the field to the main infrastructure objects (pipelines, tank farms, settlements, roads, railway, sea ports, shipyards, machinery plants, factories of building materials), km	Filled by experts	Filled by experts	Filled by experts
ES	payments for negative impact on the environment, million rubles	Filled by experts	Filled by experts	Filled by experts
	costs in connection with the tightening of industrial and environmental safety requirements, million rubles	Filled by experts	Filled by experts	Filled by experts
	PROSPECTS	HIGH	MEDIUM	LOW

Figure 5. Example profile of a promising Arctic oil and gas offshore project. Source: developed by the authors.

Then, the assessment of the prospects of an Arctic offshore project (PAOP) can be calculated using the arithmetic mean of the elements c_{ij} of the matrix of coincidences:

$$PAOP = \frac{\sum_{i=1}^m \sum_{j=1}^{k_i} c_{ij}}{\sum_{i=1}^m k_i}. \quad (2)$$

We propose to interpret the values of the PAOP indicator as follows:

- If $PAOP \geq 2.5$, the actual project indicators are in favor of the project implementation, indicating its long-term prospects and resistance to external changes.
- If $PAOP < 1.5$, the project can possibly become unpromising in the long term, projects with such values of PAOP are not recommended for development from the viewpoint of their commercial implementation.
- If $PAOP \in [1.5, 2.5)$, the project is promising under current conditions and has a medium level of stability to changes in the external environment in the long term.

4. Discussion and Conclusions

The purpose of this work was to develop the method for evaluating the prospects of hydrocarbon projects on the shelf of the Russian Arctic. It provided a comprehensive study of the problematic field, analyzed the current situation and developed methodological frameworks and tools for forecasting the prospects of Arctic projects. Consistent application of the proposed methods in accordance with the proposed algorithm will provide answers to key questions:

- Is the development of hydrocarbon deposits on the shelf of the Russian Arctic promising in the current situation and in the medium and long term?
- What factors have a key impact on the prospects of a specific Russian Arctic project and what is the dynamics of the main indicators?

As mentioned above, the problem of forecasting the prospects for the implementation of oil and gas offshore projects in the Arctic is difficult to formalize, which focused this study on expert forecasting methods. The reliability of the results obtained when conducting general and specific surveys was achieved by attracting a large number of experts and the approval procedure, which is reflected in the research algorithm.

This work offers an approach to forecasting the prospects for offshore projects based on a comprehensive study of its pros and cons, consideration of a large number of factors and indicators that influence them. We assume this will allow an unbiased approach to the problem of choosing the most promising project for implementation and will serve as the basis for an effective decision-making process.

The proposed method provides recommendations to managers of oil and gas companies regarding the implementation of offshore Arctic projects. Due to the high uncertainty surrounding the decision-making on the development of deposits, as well as the multidirectional influence of numerous factors, especially qualitative ones, a more precise assessment seems difficult, and its need is debatable.

In general, the results of the study are focused on the long-term perspective, since they lie in the field of strategic planning and forecasting of such long-term and expensive projects as the development of marine oil and gas fields in the Arctic. They can be used by government agencies and oil and gas companies engaged in the development of the Russian Arctic shelf when initiating and planning such projects.

Further research will be devoted to validation of the proposed method with other cases and forecasting the prospects of particular oil and gas projects on the Russian Arctic shelf. The study will be conducted for the management situation, which involves choosing one of several potential projects and is characterized by its own set of key factors. The proposed approach is designed to support decision-making for managers of oil and gas companies and helps them in dealing with a complex structure and difficult to forecast practical and scientific problem.

The research led to the following conclusions:

1. Despite the fact that the key determinants of interest in the Arctic shelf are oil prices and available Arctic drilling and oil production technologies, the development of marine resources of the Russian Arctic is dependent on a large number of various indicators, each of them having a different impact on the project's prospects. The role of innovations is increasing significantly [34], as well as the parameters of sustainability of oil and gas projects in the Arctic [67]. At the time of the research, the expediency of such projects could be characterized as doubtful.

2. The ongoing crisis associated with the COVID-19 pandemic hit the industry hard, and, particularly, the offshore Arctic projects. Being doubtful before the pandemic, in the current global conditions, they lose any potential profitability.
3. Despite the current commercial inefficiency of the Arctic projects, Russia continues supporting Arctic offshore projects. This is due to the fact that the implementation of hydrocarbon projects in the Arctic is strategically significant for the Russian Federation. It can also be confirmed by recently adopted strategic plans of the government on the development of Russian Arctic and marine resources [36,37]. Obviously, such projects in the current macroeconomic situation will require more government support.
4. The state support of Arctic projects becomes a crucial essential indicator for its initiation in the current conditions. This should be kept in mind as an important assumption when forecasting the projects' prospects until the macroeconomic situation changes significantly.

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Appendix A

Table A1. Fragment of a general expert survey questionnaire—Objectives of the state and business in the implementation of offshore projects.

Question	Possible Answers	Your Answer
What, in your opinion, should be the state regulation of the development of the shelf and the implementation of offshore projects? (check one box only)	Direct participation of the state—direct contribution and participation of the state in the economic, financial, scientific and industrial spheres	
	Indirect participation of the state—formulation at the state level of rules, norms, strategies that determine the development vector and targets	
	Combination of direct and indirect state participation	
	Other: _____	
Do you consider the current state regulation in the field of shelf development to be effective? (check one box only)	Yes, current government regulation can be considered effective	
	Yes, the current state regulation can be considered effective, but requires improvements	
	In general, the current state regulation can be considered quite effective, but there are problems with the declarative nature of the main policy documents and initiatives	
	In general, current government regulation can be considered quite effective, but there are problems in the area of interconnection of the main policy documents and initiatives	
	No, the current government regulation cannot be considered effective, significant adjustments are required	
	Other: _____	

Table A1. Cont.

Question	Possible Answers	Your Answer
What aspects of state regulation of shelf development require improvement? (check one or more boxes)	Legal regulation in general, the legal framework for the development of the shelf	
	Tax policy	
	Licensing issues, procedure for granting the right to use subsurface areas	
	Financial mechanisms, development of financial instruments	
	Information security	
	Development of environmental standards	
	Implementation of state control	
What can be considered the main goal of the government in the implementation of Arctic shelf projects? (check one or more boxes)	Other: _____	
	Ensuring effective international cooperation	
	Increasing geological knowledge	
	Stimulating R&D in this area	
	Building strategies for the commercialization of R&D results in this area, taking into account the interests of all stakeholders	
	Ensuring sustainable development of industries producing up-to-date machinery in this area (oil and gas engineering and related industries)	
	Development of small and medium-sized businesses (oilfield services)	
Is it necessary to liberalize the admission of private companies to work on the Russian shelf? (in order to attract additional funding, innovations, etc.) (check one box only)	Ensuring sustainable social and economic development of the Arctic region	
	Other: _____	
	Yes, it is necessary	
What can be considered the key problems for business (oil producing companies) in the implementation of offshore projects? (check one or more boxes)	Yes, it is necessary to perform individual tasks	
	No, there is no need	
	High bureaucracy at all stages	
	Imperfect tax regime	
	High capital intensity of projects	
	Funding problems	
	High prices for raw materials, resources, services (high production costs)	
	Inadequate provision with domestic equipment and technologies	
	The need for implementation of related infrastructure projects	
	The tightening of environmental legislation	
What can be considered the main goal of business in the development of the Arctic shelf?	Lack of qualified personnel	
	Other: _____	
	The preservation/development of cooperation with foreign partners	
	Proactive participation in solving issues related to technological security of projects	
	Proactive participation in solving issues related to ecological safety of projects	
What can be considered the key business objectives in improving the technological security of offshore projects?	Interaction with scientific and educational organizations	
	Other: _____	
	Creation and development of private R&D centers	
	Development of cooperation with domestic enterprises of oil and gas engineering	
	Development of cooperation with small and medium-sized businesses (oilfield services)	
	Collaboration with Asian R&D partners	
	Use of government mechanisms: development institutions, clusters, technology platforms, etc.	
	Other: _____	

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