Long-term forecasts of the oil and gas Arctic shelf development: the existing methodical approaches and assessment of a possibility of their application

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Abstract. The problem of the development of offshore oil and gas Arctic projects has risen recently due to the depletion of traditional overland oil and gas fields, as well as the discovery of significant hydrocarbon reserves in the Arctic seas and the strategic importance of the development of that zone for the Russian Federation. The decision-making process associated with the development of these projects takes place in high level of uncertainty of external environment. Consequently, existing tools and methods of forecasting the prospects of the projects are hardly applicable due to its specificity. This article presents a special approach for assessing the prospects of oil and gas offshore Arctic projects. It consists of a theoretical base, which is the newly developed TESCIMP-methodology, practical tools for implementing it, as well as a complex approach for the assessment. The research is segmented into four stages: the analysis of the factors influencing project’s prospects as well as the key pros and cons for developing it, a two-dimensional classification of specific indicators which allocates essential and stimulating ones and forecasting the prospects of the project, identification of projects’ levels which implies the selection of appropriate TESCIMP-factors. The indicators within those factors underlie practical tools of checklist and expert surveys that help evaluate the projects’ prospects. The last stage proposes a complex approach for a further assessment, which consists of three steps and based on the combination of expert surveys and statistical methods.

1. Introduction
The problems of the development of Arctic oil and gas resources are relevant nowadays due to the strategic importance of hydrocarbons, as well as the Arctic territories as a whole for Russian Federation [1, 2]. Prospects for the development of the Arctic shelf are associated firstly, with the advanced growth rate of the domestic mineral resource base, the socio-economic development of the region, the maintenance of innovative activity of Russian industries, and the strengthening positions in the international scene. At the same time, Russia's oil and gas industry faces serious challenges in terms of state regulation and technological development. The existing forecasts for the future development of the shelf are fragmented and do not offer the chance to unambiguously assess the future prospects for the development of hydrocarbon resources, in the conditions of increased uncertainty in the macroeconomic environment. This fact necessitates the formation of a special approach to long-term forecasting of development of the resources of the Arctic shelf. For the moment no specific theoretical or practical tools have been developed in this direction [3-7].
The aim of the research is to develop specific tools which form a theoretical base and complex approach to the assessment of the prospects of Arctic oil and gas offshore projects. The only fully launched oil and gas offshore project in Russia is the platform Prirazlomnaya with total reserves 72 million tons of oil [8]. A number of other oil and gas projects in the Arctic are at the various stages of realization. A lot of Russian offshore projects were planned to be implemented in cooperation with foreign companies and with usage of foreign technologies [9]. 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 problems of Arctic zone development, as well as development of oil and gas offshore projects are under discussion among scientists. Researchers discuss such issues, related to oil and gas projects, as infrastructure development; geopolitical, economic and political situation; complexity and high capital cost of the projects; environmental risks and others [10-15]. Some of them predict favorable prospects for offshore projects [16, 17]. But all the experts recognize strategic importance of offshore oil and gas projects for the national economy and the need of evaluating their prospects. 

In the world practice, forecasts of the Arctic energy shelf development continually are published by World Energy Council, Arctic Council, European Commission, International Energy Agency, Skolkovo Foundation, etc., but their forecasts are very general. As for the long-term forecasting of development of Arctic offshore projects by Russian scientists, the complex approach has been developed by M.O. Morgunova. She describes three scenarios of development of offshore projects in the long term period [18]. Despite complexity of this research, the scenarios are general and do not allow to evaluate the prospects of particular project.

On the basis of conducted analysis, we can conclude that this area is poorly studied. We suppose that the implementation of oil and gas offshore projects in the Arctic has different underlying issues that need to be investigated. This paper sets out to offer a complex approach to develop theoretical base and forecast the prospects of Arctic oil and gas projects.

2. TESCIMP-methodology for assessing the prospects of Arctic oil and gas offshore projects
The objective of this study, categorized as a project of Arctic oil and gas field development, could be characterized as specific. It dictates the application of a special approach to the research problem as well as practical tools for its implementation, as the commonly used analytical tools do not consider this specificity. As a result, such an approach is devised, accounting for all the complexity of the research area. In particular, we start our work with the formulation and development of a theoretical base, which is required for solving further particular tasks. Firstly, we set up with defining at the prospects of the Arctic oil and gas offshore project.

The prospects of the Arctic oil and gas offshore project is a characteristic of the hydrocarbon field development project located in the Arctic continental shelf of the country, which determines the possibility of its commercially effective implementation by a particular oil and gas company in the current conditions in the medium or long term [19].

A question then poses itself: how can the prospects of the particular Arctic oil and gas project be assessed? Answering this does not prove to be a simple endeavor. Trying to solve it, we develop an analytical framework that includes several practical tools that are suggested to be used in the process of assessing the prospects of the project.

The first stage of the study was devoted to the analysis of the key pros and cons for the development of an Arctic offshore project. The card of the arguments for offshore oil and gas project’s implementation was developed to satisfy that purpose, which can be found in [4].

Furthermore, conventionally used tools as SWOT-analysis were drawn in order to identify the strengths, weaknesses, opportunities and threats related with Arctic oil and gas offshore projects. We rely on it for assessing the internal and external environment of the project, and identify more factors influencing its prospects [4].

Secondly, we studied a set of indicators that most probably influence the prospects of offshore Arctic projects. We assume that all indicators affecting the implementation of projects belong to one
of the six key factors (TESCIMP-factors), which in turn are combined into two groups according to the possibilities of its direct management (Figure 1).

Figure 1. TESCIMP-factors classification.

The detailed explanation of TESCIMP-factors, their meanings and influence on the projects’ implementation prospects are exhibited in Ilinova et al (2018) [4]. We name the proposed analytical tool as TESCIMP-analysis and recommend it as a theoretical basis which underlies the special method of forecasting the prospects of Arctic offshore oil and gas projects.

As a result of the analysis conducted during the second stage, a two-dimensional classification of specific project indicators was introduced. We suggest using them as the practical basis for the later stages of the study related to forecasting of the project prospects. The classification systemizes all the selected indicators into twelve categories. They are associated with the criterion of “controllability” which has six factor groups, so-called TESCIMP-factors, and the criterion of “necessity”. The latter differentiates all indicators belonging to various TESCIMP-factors as essential and stimulating, which are qualitative and quantitative respectively.

Essential indicators are those which determine directly the prospects of the project – whether it is promising or not. Thus, an unsatisfactory value of any indicator indicates that the project is unpromising.

The authors define a promising Arctic oil and gas offshore project as a project to develop a hydrocarbon field located in the Arctic continental shelf of the country which has received such an assessment [4].

Stimulating indicators are resorted to for more detailed analysis of a particular project. They can help in estimating the relative degree of prospect, which is associated with the choice between 2 or more oil and gas projects. Moreover, they are proposed to be used in the last stage of this research, where the authors produce long-term forecasts of the project prospects. We propose to use them as the basis for a questionnaire to be completed by experts involved in the forecasting procedure.

In our opinion, the TESCIMP-methodology can be used as a generic approach to address the problem of evaluating the prospects of offshore Arctic projects. It considers different levels of projects, both national and international. It is not associated with a particular project, field or oil and gas company – instead, it presents a complex and versatile set of practical tools which can be applied to any offshore Arctic project. Table 1 shows the different levels of oil and gas projects that can be
developed in the Arctic offshore zone. It also highlights the key TESCIMP-factors which play the most important role for each projects’ level as well as the scope of indicators that should be selected in each case.

Table 1. The relation between the projects’ level and TESCIMP-factors.

| The projects’ level         | TESCIMP-factors                      | Scope of TESCIMP-indicators                                           |
|-----------------------------|-------------------------------------|-----------------------------------------------------------------------|
| Country and world           | Political factors                   | Indicators apply to all fields in the Arctic zone and projects of all levels |
|                             | Macroeconomic factors               |                                                                        |
| Region                      | Infrastructure                      | Indicators vary depending on the project extraction region             |
| Oil and gas company         | Technologies, Environmental Safety  | Indicators describe the level of technological support for a particular oil and gas company and its investments in developing the environmental safety of hydrocarbon production in the Arctic shelf |
| Field                       | Climatic and geological factors     | Indicators characterize the conditions for carrying out mining operations at a specific field developed by a concrete company |

The evaluation of the projects’ prospects involves the use of specific practical tools to assist decision-making. For that purpose, the authors suggest to use the checklists method. This consists of a questionnaire that should be filled in by the expert or a manager during the assessment process. The conformity of the answers to the desired values defines the results of the method, and may differ depending on the research area and the specific problem. The range of values the answers can take lies between 0% and 100%.

The checklist for determining the prospects of the project is closely related to the specific context. This may be the case of selecting one of the projects for the development of fields located in one region as the most promising for a particular oil and gas company. There may be a situation where independent experts are engaged in evaluating projects for the development of deposits located in different regions of the country planned for the implementation by different companies. Thus, the project has a certain level which is characterized by the corresponding TESCIMP-factors, as indicated in Table 1. In addition, the decision is made considering the current situation (Figure 2), which arises depending on the number of regions where the fields are located, and the oil and gas companies involved in developing projects.

The algorithm for assessing the prospects of the project involves the preparation of such a checklist, which will be relevant in a given situation for a project of a particular level. The formation of the checklist is based on the selection of TESCIMP-factors corresponding to the situation (Figure 2). However, we should admit that macroeconomic and political factors are relevant for each situation described, and should be taken into account in all cases. An example of the checklist which can be used in situation number four is presented in Ilinova et al (2018) [4].
3. Forecasting the prospects for implementation oil and gas offshore Arctic projects

3.1. Short-term methods

According to the TESCIMP-methodology, forecasting the prospects of particular offshore projects cannot be reliable without linking their characteristics with the real macroeconomic situation (macroeconomic factors). One of the most important quantitative indicators that definitely affect the effectiveness of offshore projects is the price of oil. Forecasting this indicator can become the basis for evaluating the prospects for the shelf development due to the possibility of taking into account such indicators as the planned revenue, the current profitability of the project, etc.

The study took into account the fact that the pricing of the Arctic oil brand (ARCO) is closely related to the prices of Urals oil, which in turn are highly correlated with the prices of Brent oil. Therefore, due to the lack of retrospective on the prices of the ARCO brand, the time series of the indicator "average annual price of Brent oil" from 2010 to 2018 was used [20]. The dynamics of this indicator is non-linear. In addition, its values on a relatively short time interval range varies from 46 to 112 dollars per barrel. We provide short-term forecasts of the oil prices with the help of extrapolation methods – Exponential Smoothing, Moving Average and the trend equation.

The forecast for 2019 using Exponential Smoothing was 69.09 dollars per barrel. The moving average of the third order gives a forecast value of 58.09 dollars per barrel. Both methods provide forecasts at the average level of the price values of recent years. According to the results of the forecast using the polynomial of the third degree by the end of 2019 the price of oil will reach 127.74 dollars per barrel.

Forecasts of oil price for 2019 obtained with the help of statistical methods differ significantly. It should also be noted that forecasting using trends have one important prerequisite – the studied time series should be stationary. That is, the values of the indicator throughout the time interval were formed under the same external conditions. The dataset of oil prices does not meet this requirement which makes the forecasts using trends unreliable in this case.

The same problem can arise when trying to deploy short-term statistical methods to predict the values of other quantitative indicators. In addition, not all stimulating indicators identified in the second stage of the study have the dataset which such methods require. Nevertheless, the values of such indicators can be forecasted with the help of expert methods, which can give estimates concerning the probability of getting in a certain interval. In addition, the available statistical information can serve as a basis for more complex expert surveys planned for implementation at the last stage of the study.
3.2. **Long-term methods**

As the result of the previous study, the following conclusion can be drawn: statistical methods have limited application when forecasting the prospects of oil and gas offshore Arctic projects. This is due to such key reasons as the lack of necessary information and dataset on the studied variables, as well as difficulties in understanding the process [21]. Instead, the application of judgemental methods can give adequate predictions, especially when both quantitative and qualitative information need to be taken into consideration, or it is impossible to forecast variable using formalized methods [22].

The practical implementation of long-terms methods regarding the problem of forecasting the prospects of oil and gas offshore projects can be realized with the help of experts. Expert methods also require background information, which serves as a starting point for the formation of expert assessments [23-25]. Such reference data are necessary to understand the dynamics of the predicted phenomenon, the nature of the relationship and the interdependence between the various indicators and events characterizing it.

During the third stage of the study, the authors analyze different long-term forecasting methods regarding the research problem. We list concrete methods that are applicable in solving the problem of forecasting the prospects of oil and gas Arctic offshore projects that can be found in Ilinova et al. (2018) [4]. Mainly, they can be drawn on for making predictions for the various elements influencing the project prospects.

Nevertheless, the existing long-term methods do not provide us the answer to the question of whether a project is promising or not, and its relative perspective in comparison with others. For that reason, a special approach needs to be developed. We assume that it should be based on expert surveys which are conducted in several steps. The survey forms should be developed with the help of forecasts of private indicators obtained using short-term and long-term forecasting methods. For the same purpose, retrospective data of some quantitative indicators is used, if the short-term predictions are difficult or impossible to obtain. It can form an information base which is significant for experts in the decision-making process.

3.3. **Analysis of the possibilities of using forecasting methods to assess the prospects of offshore oil and gas projects in the Russian Arctic**

The authors conduct the analysis of the possibilities of using different forecasting methods regarding the prospects of implementation of Arctic offshore projects in the long term. We base it on the availability and nature of information that can be used in the formation of such forecasts (Table 2). In addition, the table provides a brief description of the conditions under which the decision on the prospects of the project is made. It also includes initial information used to form the forecasts. For each group of methods, the researchers offer examples of TESCIMP-indicators included in the two-dimensional classification described above.

| Possibility of using Expert forecasting methods | Examples of TESCIMP-indicators |
|-----------------------------------------------|--------------------------------|
| **Wide application in this subject area due to the lack of background data for most of the indicators used to assess project prospects.** | • availability of potential foreign and domestic customers of hydrocarbons |
| **Internal and external indicators of the project are volatile. Projects are developed in the high level of uncertainty, because they are single in nature, which makes it difficult to compare with similar projects.** | • costs in connection with the tightening of industrial and environmental safety requirements |
|                                           | • oil and gas company’s costs in connection with the imposition of sanctions against the Russian oil and gas sector |
|                                           | • savings associated with tax credits for developing Arctic offshore fields |
|                                           | • degree of study of the water area and field geological structure sufficient to start production drilling |
Statistical forecasting methods

- Forecasting the project prospects as a whole has limited possibility due to the absence of statistical data series on the majority of indicators that have an impact on it. Can be used to predict the values of some quantitative indicators characterizing the prospects of the project in order to study their dynamics and form reference data for expert forecasting methods.
  - GDP growth rate of the country
  - Level of world prices for oil and gas
  - Duration of the cold season
  - Average percentage of water surface covered by ice on the industrial vessel’s way
  - Density of population in the region
  - Increase in proved reserves of the Arctic shelf around the project field due to geological exploration

3.4. Complex approach to forecasting

Taking into account the aforementioned analysis of the main approaches to short-term and long-term forecasting, as well as the specific features of the oil and gas offshore projects, we can conclude that forecasts of the prospects of those projects cannot be developed relying only on statistical methods. It is necessary to use the expert methods and develop the complex approach based on their combination. In this paper, we suggest the following approach which consists of three steps:

1. The general expert survey for collecting and analysis of experts’ opinion on development of Arctic oil and gas resources (step 1).
2. Collecting statistical data and implementing (when applicable) statistical methods on the particular indicators characterizing specific TESCIMP-factors, for instance, the price of oil (step 2).
3. The specific expert survey for collecting and analysis of experts’ opinion on forecasts of particular indicators and the influence of the specific indicators on prospects of offshore project (step 3).

To date, the questionnaire for the general expert survey is prepared by the authors (step 1). The questionnaire includes the following sections: general issues in the oil and gas industry development; prospects for the development of hydrocarbon resources of the Arctic shelf; international cooperation; priority tasks of business and government; financing and projects’ efficiency; technologies. Currently, we are collecting the experts’ opinion.

Within step 2, we try to apply statistical methods for oil price forecasting, as well as to collect the first group of specific indicators related to such companies as Gazprom and Rosneft, which are admitted to the Russian shelf. The first group of indicators characterizes the current and future capacity of that companies to implement oil and gas projects (the indicators of innovative capacity), such as the volume of R&D investments, the share of R&D expenses in revenue, the number of patents, economic efficiency of the implementation of innovative technologies, expenses on environmental safety (table 3).

| Table 3. Specific indicators of innovative capacity of Gazprom and Rosneft [26-29]. |
|---------------------------------------------------------------|
| **№** | **Indicator** | **Gazprom** | **Rosneft** |
|       | **Data** |        |        |        |        |        |        |        |        |        |        |        |
|       | 2016 | 2017 | 2018 | 2019 | 2020 | 2016 | 2017 | 2018 | 2019 | 2020 |
| 1     | R&D investments, billion rubles | 29 | 16,2 | 8,01 | 8,07 | 8,13 | 36 | 20,2 | 29,9 | 30-40 |
| 2     | Share of R&D expenses in revenue, % | 0,57 | 0,25 | 0,2 | 0,1-0,2 | 0,7 | 0,4 | 0,36 | 0,4-0,6 |
| 3     | Number of patents | 480 | 420 | 432 | 444 | 456 | 480 | 552 | 604 | 640 | 650 |
| 4     | Economic effect of the implementation of innovative technologies, | 3,3 | 3,3 | 3,3 | 3,3 | 3,3 | 4,2 | 4,2 | 8,3 | - | - |
Stage four is intended for the specific expert survey, which includes the collection of experts’ opinion about forecasting of the set of particular indicators and their influence on prospects of offshore project. It is supposed that the results received at the steps 1 and 2 will be presented to the experts to facilitate their decision-making process. As the result of planned research, we suppose to develop long-term forecasts of specific Arctic offshore projects development.

4. Conclusion
The authors identify specific features in evaluating the prospects for the implementation of Arctic offshore projects. We substantiate the need for an integrated approach in the preparation of long-term forecasts in this area. We highlight that such forecasting is carried out in highly uncertain environments, as a result of the almost complete lack of statistical information and data on Arctic projects. This stems from their unique nature, the complexity of climatic and geological conditions, the long terms of implementation, and the high capital intensity.

We propose to resort to the TESCIMP-methodology as a specific approach for assessing the prospects of Arctic projects, which includes the key factors influencing it, and a two-dimensional classification of indicators needed to evaluate it. We assume that there are several levels of projects, depending on the amount of fields, regions and oil and gas companies developing them. Therefore, several different situations can arise that influence the choice of TESCIMP-indicators.

The authors consider examples of the use of different existing forecasting methods in order to evaluate the prospects of the offshore oil and gas projects in the Arctic, carry out the analysis of possibilities of their application regarding the research task.

As practical tools for implementing the forecasts of the project prospects, we propose specially developed checklists and expert surveys, as well as commonly used statistical extrapolation methods, in order to forecast particular quantitative indicators. All of them use TESCIMP-methodology as the basis.

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