

# Methodological bases for evaluating the effectiveness of Arctic field development

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**Abstract.** The article reveals the methodological foundations for a comprehensive assessment of the effectiveness of the development of deposits in the Arctic shelf. On the one hand, the assessment assumes, based on the use of a multicriteria approach, ranking the priority of field development, on the other hand, the formation on its basis of a strategic model for managing the oil and gas complex, taking into account the development of Arctic fields. The authors emphasize the advisability of conducting a comprehensive assessment in relation to the development of the respective region. The list of indicators considered by the authors, which forms the basis of the multicriteria model, is open and can be adapted to the purposes of the assessment, as well as the scope of the results obtained. The methodological approach proposed by the authors can serve as an express assessment of the effectiveness of the development of fields in the Arctic. The classic matrix of the Boston Consulting Group, which takes into account the level of efficiency from the development of the Arctic shelf fields, has been chosen as a tool for forming a strategic management model.

## 1. Introduction

A common method for evaluating the effectiveness of projects related to the development of Arctic shelf deposits is the analysis of financial and material flows. The results obtained are used as the basis for forming evaluation criteria that are later adopted for all related projects. We can safely say that this approach is more focused on the financial component. However, the development and development of Arctic shelf deposits also has other aspects that are associated with such important parameters as the technical and economic potential of deposits, and the impact on the level of socio-economic development of regions and countries.

The narrow focus on evaluating the effectiveness of projects and design solutions for the development of Arctic shelf deposits justifies the relevance and necessity of creating a model of strategic management of the oil and gas complex. This model will include: previously conducted research on the most preferred order of development of Arctic deposits, obtained on the basis of an assessment of the technical and economic potential of the research objects and taking into account numerous criteria. Also, the model should take into account the assessment of the level of socio-economic development of regions, which will also be based on the analysis of various indicators.

## 2. Methods

As all mentioned above, the strategic management of the oil and gas complex, in particular, the management of projects for the development of hydrocarbon deposits in the Arctic, is associated with the level of socio-economic development of such regions as: Yamalo-Nenets Autonomous region,



Republic of Sakha (Yakutia), Murmansk region, Nenets Autonomous region, Taimyr and Chukotka Autonomous regions.

First of all, it is necessary to create a group of indicators that will allow assessing the level of socio-economic development of the regions presented above. Indicators should cover as much as possible the specifics and level of influence of Arctic shelf deposits on regional and national development. Taking into account this factor, the following indicators were identified:

- $X_1$  — number of employees, thousand people;
- $X_2$  — government revenues from investment in projects, USD million;
- $X_3$  — budget revenues from tax payments, USD million;
- $X_4$  — share in GDP, %;
- $X_5$  — share of total emissions of air pollutants into the atmosphere, %
- $X_6$  — share in the total volume of discharge of polluted waste waters, %

The impact of the oil and gas complex on the level of socio-economic development of regions in accordance with these indicators is presented in table 1.

The impact of the oil and gas complex, in particular the development of Arctic shelf deposits, on the socio-economic development of the region can be assessed using multi-criteria optimization methods, such as the method of integral analysis or additive criteria.

**Table 1.** Parameters of influence of the oil and gas complex on the level of socio-economic development of regions

Indicator symbolic designation	Parameters
$X_1$	Number of employees to employ to develop each field
$X_2$	Influence on the size of state revenue indicators
$X_3$	Influence on the size of state revenue indicators
$X_4$	Influence on the size of state revenue indicators
$X_5$	Impact on the Arctic ecology (environmental parameter)
$X_6$	Impact on the Arctic ecology (environmental parameter)

The multi-criteria optimization method allows you to identify the most generalizing (aggregate) factors, as well as the dominant trends from the set of versatile characteristics that describe the objects of research. A significant advantage of this method is the ability to compare heterogeneous indicators by combining them into values that satisfy and combine all characteristics [2].

In this research, it was decided to use an additive criterion. The additive method is based on the construction of an objective function, the folding of criteria with the determination of the weight coefficients of each criterion, and their ranking, necessary for the analysis. The formula for calculating the total value is shown below:

$$A_i = \sum_{i=1}^n d_i \times n_i \quad (1)$$

$d_i$  – weight and significance of the indicator;  $n_i$  – indicator value

The values of  $d_i$  are weight coefficients that determine in quantitative form the degree of preference of the  $i$ -th indicator in comparison with others [9].

Data published on official Internet resources were used as input parameters for the assessment [3,4,5,6].

### 3. Results

As a result of calculations performed using the additive criterion (1), the following results were obtained, presented in table 2.

**Table 2.** The results of the calculation

The name of the field	Symbolic designation	Values
1	2	3
Water areas of the Pechora sea		
Field 1 (GC)	A1	0,51
Field 2 (OGC)	A2	0,52
Field 3 (O)	A3	0,63
Field 4 (O)	A4	0,60
Field 5 (O)	A5	0,56
Field 6 (O)	A6	0,76
Water areas of the Kara sea		
Field 7 (GC)	A7	0,71
Field 8 (GC)	A8	0,70
Field 9 (G)	A9	0,55
Field 10 (G)	A10	0,57

It is necessary to note that there may be more socio-economic indicators, and the selected indicators are not the only option.

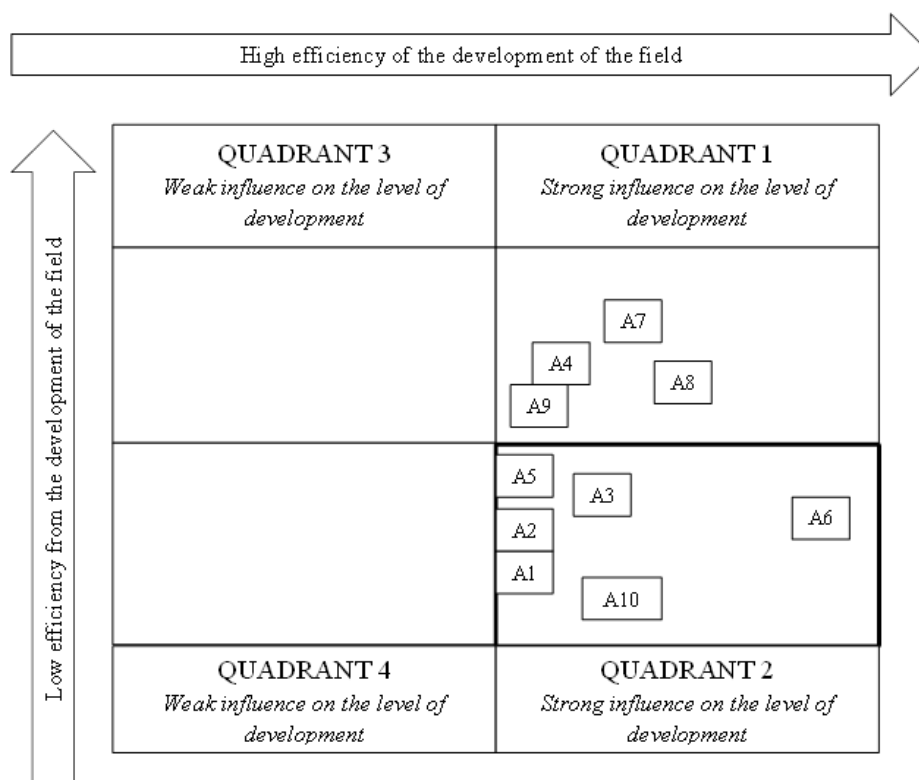
For further evaluation of the results, it was decided to use the BCG matrix. By placing data in the position for each object of research in the quadrants of the matrix, you can formulate conclusions or management decisions aimed at the development of objects [1]. The selected parameter will allow you to make a conclusion about your position: the degree of influence on the socio-economic development of the regions.

The matrix for evaluating the efficiency of developing oil and gas fields in the Arctic based on socio-economic parameters is shown in picture 1.

*Note:* quadrant 2 is highlighted in the boldest font, as it indicates the best scenario (development benchmark).

Thus, quadrant 1 identifies a clear leader – Field 7, which indicates that the development of this field has the greatest positive impact on the level of socio-economic development of the regions. In quadrant 2, there are deposits that also have a strong influence on the level of development. This implies the need to assess the feasibility of developing oil and gas fields, taking into account not only the impact on the level of development, but also taking into account the technical and economic potential. In other words, in the future, it is possible to evaluate projects for the development of oil and gas fields in the Arctic, based on two parameters – the degree of influence on the level of socio-economic development of the regions and the degree of efficiency of development.

The development of oil and gas fields in the Arctic opens up huge opportunities and development prospects not only for the regions, but also for the entire country. However, we should not forget that any activity in the Arctic is associated with numerous risks and threats that must be taken into account when conducting any assessment.



**Figure 1.** The matrix of effectiveness of the development of hydrocarbon fields in the Arctic.

#### 4. Conclusion

In this research, the Boston Consulting group (BCG) matrix was used as an evaluation tool. You can use the upgraded matrix to develop effective management and strategic decisions. The study also evaluated and placed only one parameter in the matrix, which may cast doubt on the effectiveness of the developed management decisions. In the future, you can combine the results of two studies and select two parameters for evaluating oil and gas fields in the Arctic, to obtain the most accurate and reasonable result. This is also necessary in order to evaluate deposits that, for example, go beyond the quadrants of the matrix.

#### 5. References

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