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# Implementation of A Multi-Criteria Approach in Addressing the Problems of Corporate Planning at Oil and Gas Producing Enterprises

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**ABSTRACT**

The possibility of the reduction of the problems of intrafirm planning to the category of multi-criteria ones is disclosed in this article. It is especially important in the conditions when large oil and gas producing structures implement the system of key indicators in their practical activity. The approach proposed by the author allows monitoring in dynamics the efficiency of the development of operating segments and the completeness of achievement of the planned indicators, timely identifying their deviations from the planned level and promptly making corrective managerial decisions. The system of intrafirm planning, based on a system of partial criteria in such segments as exploration and production, processing and marketing, petrochemistry and energy, is fragmentarily presented. The article also stresses the possible difficulties that can arise in the course of implementation of the proposed approach in the practice of large industrial enterprises and possible ways to overcome them.

***Keywords:*** Planning, oil and gas producing enterprise, key indicators, multi-criteria approach

## 1. INTRODUCTION

In the face of changing demand and difficultly controlled supply of hydrocarbons, the fluctuations in the exchange rates and inflation, the deterioration of the tax regime, the political instability in the countries of presence, the oil companies have to pay more and more attention to the improvement of the system of intrafirm planning. The establishment of its flexibility and adaptability will allow oil and gas producing structures in their modern business environment to adjust their operational activities to changing external environment. This, in turn, will provide a safety margin in all fields of activity of the company.

The system of intrafirm planning exists and operates in all oil and gas producing companies, so the point is not to build it from scratch, but to adjust it timely to the needs caused by the objective laws and regularities.

Oil companies are complex economic systems, operating in various business segments: exploration and production; processing and marketing; petrochemistry; energy and other areas. This predetermines a high complexity of the planning process and formation of the interrelated plans that take into account the development of all operating and providing subsystems. The approved plans at all levels of management should be implemented and aimed primarily at the achievement of the strategic goals and objectives of the company. The composition of the indicators included in a plan should be the basis for the monitoring system for their implementation during the planned period. Different targets, reflected in the plans, are evaluated by a certain set of indicators that characterize the specifics of the subsystem within which the plan is formed. All this allows talking about the possibility of application of the multi-criteria approach in addressing the problems of intrafirm planning of large oil and gas producing structures. Methodically, the implementation of this approach in the activities of oil companies remains incompletely developed, and the relevance and the practical importance of this issue make relevant the ongoing research in this field.

## 2. BACKGROUND PAPERS

This study of the possibility of the reduction of the problems to be addressed in the field of intrafirm planning to multi-criteria tasks is based on the results of scientific and applied research in the field of strategic and intrafirm planning, the introduction of a system of KPI, as well as the works concerned with the multi-criteria optimization in various fields of activity. At the same time, the ideas and the scientific approaches in the studied fields of knowledge of both domestic and foreign authors were studied and adapted to the activities of oil and gas producing enterprises.

The theoretical basis of the strategic planning process is comprehensively disclosed in the scientific papers of such scientists as I. Ansoff, A. Chandler and G. Mintzberg, D. Khan (Ansoff, 1980;Chandler, 1962; Mintzberg, 2004; Khan, 1997). The ideological basis of planning presented in the scientific papers of these authors can be traced in the activities of large oil companies and has a direct impact on the formation of a system of intrafirm planning.

In domestic practice, the problems of intrafirm planning are considered in the scientific papers of B.A. Raizberg, A.G. Lobko, M.M. Alekseeva, M.I. Bukhalkov, L.V. Strelkov, Yu.A. Makushev et al. (Raizberg, &Lobko, 2002; Alekseeva, 1999; Strelkov, & Makushev, 2011; Bukhalkov, 2009). The scientific papers of E.D. Kulagin, A.D. Brenz, A.F. Brugemann, L.G. Zolotnikova et al. (Kulagin, 2014; Brenz *et al.*, 1989) are concerned with the problems of planning at the enterprises of oil and gas producing industry.

Various instruments and practical aspects of implementation of the philosophy of use of the key performance indicators are widely represented in the scientific papers of D. Parmenter, Robert S. Kaplan, David P. Norton (Kaplan,& Norton, 1996; Parmenter, 2007).

The classification of the multi-criteria problems on the basis of methods for their solution was initially performed by Hwang and Yoon and was partially presented in the paper of Zak Yu.A. (Zak, 2014). Different aspects of the solution of the multi-criteria problems are considered in the scientific papers of Steuer R., Kini R.L., Raifa Ch., Lotov A.V., Pospelova I.I., Zinovieva E.G., Dubovskikh K.I. et al. (Steuer, 1992; Kini, &Raifa, 1981; Lotov, &Pospelova, 2008; Zinovieva, &Dubovskikh, 2012).

The systemic view of the use of the multi-criteria approach in addressing the problems of intrafirm planning at oil and gas production enterprises has not been widely discussed in the scientific papers. This predetermines the significance of this study and makes the issues considered by the author relevant.

## 3. MATERIALS AND METHODS

### 3.1. Operating segments as the basis of intrafirm planning in oil companies

Planning is the process of development and establishment of a system of quantitative and qualitative indicators of the development of the enterprise, in which the rates, the proportions and the trends of development are determined, both in the current period and for the future (Strelkova, & Makusheva, 2011).

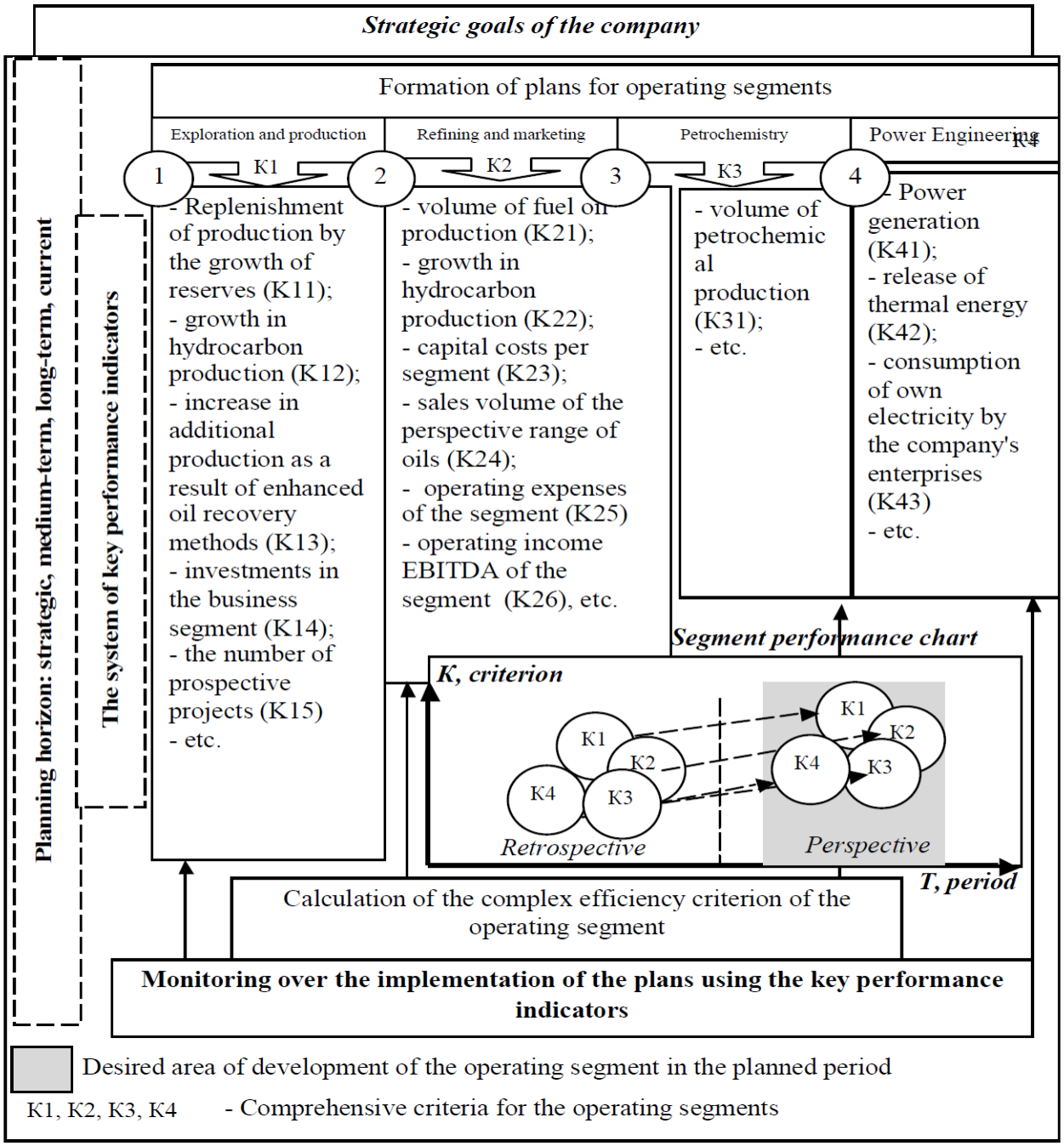


**Figure 1: The system of intrafirm planning of a large oil and gas producing structure (the formation principle, the fragment)**

Proceeding from the essence of the term "planning" as a process, it is expedient to consider it in the framework of the activity of large economic structures by the main business lines. In this case, it should be carried on in the framework of the activities of oil companies by operating segments, in each of which a system of estimated indicators for the implementation of the plan and achievement of the goals and objectives, set in the segment, is formed (Figure 1).

The system of planning is enlarged along the four main operating segments: exploration and production; processing and marketing; petrochemistry; power engineering. In each operating segment, a set of individual evaluation criteria for segment performance is being developed, which subsequently forms the basis for the formation of a monitoring system for the implementation of the plans during the planned period. In order to obtain an overall picture of the development of the company as a whole, it is advisable to calculate a comprehensive criterion for each operating segment and to create a performance chart for the segments of the company. This will allow tracking the situation at the end of the planned period, as well as at the intermediate stages of control over the achievement of the plan by the key indicators and timely identifying the deviations in case of delay in approaching the values of the criteria to the desired zone of development of the operating segment. In this case, the obtaining of a complex criterion is expedient to reduce to addressing the multi-criteria problem.

At present, a number of oil companies have formed their corporate performance evaluation system based on "Key Performance Indicators (KPI)". For example, "LUKOIL" PAO has been implementing this system since 2003, as indicated on the company's official website (http://www.lukoil.ru/)

The KPI are understood as a set of indicators characterizing the key success factors and determining the level of achievement of the strategic goals (Annual Report of "Lukoil" PAO, 2016).

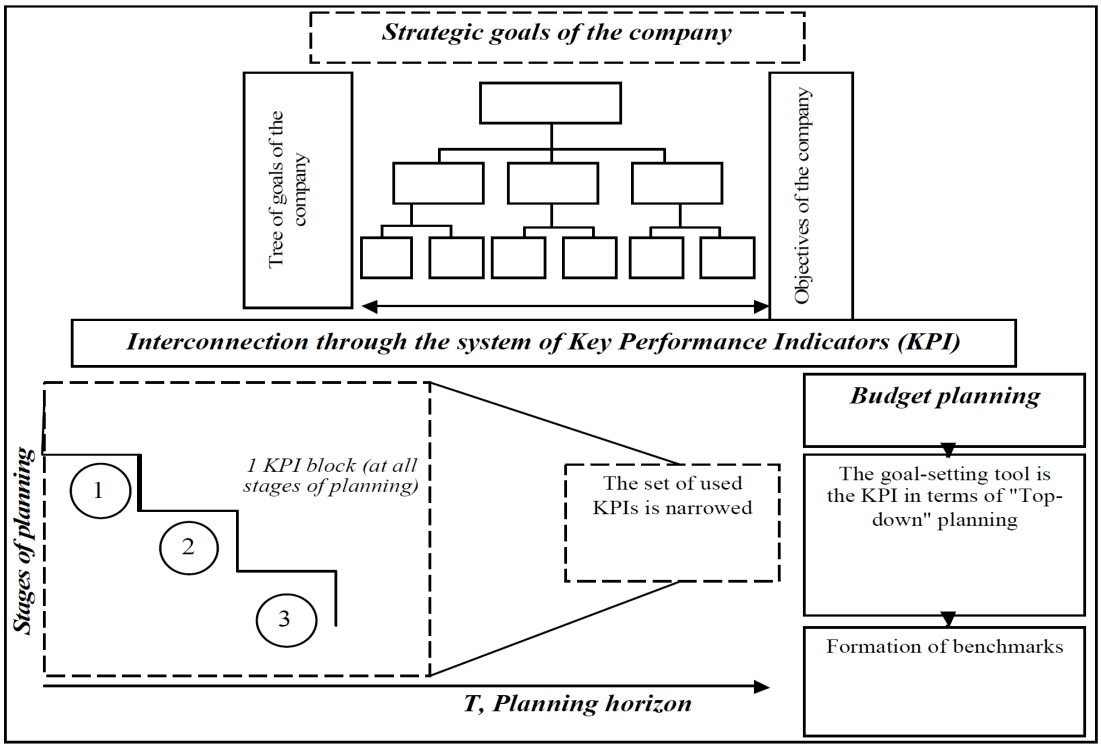


**Figure 2: KPI in the system of intrafirm planning**

The KPI in the system of intrafirm planning are presented in Figure 2. They are the link between the milestones and the objectives, assigned to the business segments. The milestones of the company are presented as a tree of objectives. Its degree of detail depends on the management of the company and the level of review and agreement. The KPIs are formed in a block and cover the activities of all operating and business segments of the company. In this case, the first KPI block is available at all planning stages. As a rule, with the growth of the planning horizon, the number of key indicators decreases. And the assessment of the achievement of the company's strategic goals by the key segments occurs according to a small set of indicators that are reflected in the annual activity reports and are publicly available on the official website of the company.

As part of the budget planning process, the KPI as a goal-setting tool is used both at the stage of development of the milestones (within the framework of the top-down planning concept) and at the stage of final formalization of goals and objectives in the form of performance benchmarks, regarding which further evaluation of the effectiveness of the activity is carried out.

The application of the KPI in the corporate management system of large oil and gas producing structures will make it possible:

1. To formalize goals and objectives in the form of a specific set of indicators at different planning horizons;
2. To evaluate the efficiency of the activities of the company as a whole, and of the individual business segments, business sectors and assets;
3. To motivate managers and employees to achieve the goals and objectives through the KPI in the framework of the system of material incentives.

The composition of the KPIs is updated and actualized as necessary, taking into account the revision of the strategic objectives and plans of the company, and the external conditions of activity. Currently, the Code of Conduct of LUKOIL Group contains about 60 unique indicators. The total amount of KPIs for the LUKOIL Group, for all business segments, business sectors and budget units is about 400 pcs. (The Annual Report of "Lukoil" PAO, 2016).

With such a sufficiently large number of evaluation criteria, the problem of obtaining of a comprehensive evaluation criterion via addressing the multi-criteria objective in each dedicated operating segment and making appropriate adjustments to the existing intrafirm planning system based on KPI, becomes relevant.

### 3.2. Methodical foundations of the multi-criteria approach and its application in the system of intrafirm planning

The calculation of the additive, multiplicative criterion or the distance method (Euclidean distance) can be considered as the methodological basis for addressing the multi-criteria problems in the system of intrafirm planning.

The formalized methods, through which a multi-criteria choice is made, can be represented by construction of a mathematical model. A characteristic feature of the mathematical decision-making model under many criteria is the simultaneous consideration of two spaces: the set of admissible alternative solutions Y and the criteria set X (Krivanova, 1997).

Since the decision-maker (DM) is guided by the goals to be achieved, each goal must meet a certain criterion by which the degree of its achievement can be evaluated, and the number of criteria depends on its complexity. Therefore, the more complex the target hierarchy, the more criteria must be used in the model (Stepanov, 1988).That fully corresponds to the specifics of the activities of large oil companies and predetermines the presence of a large number of KPI covering all operating segments.

When using the multi-criteria approach in the system of intrafirm planning, it becomes necessary to reduce the multi-criteria task to the one-criterion one. This most common approach has been implemented, including in the methods of convolution of criteria, by combining many criteria into one using the so-called weighting factors of importance. Thus, if the criteria are comparable and there is information about their relative importance, then the most rational is to present the evaluation structure in the form of a weighted sum of particular criteria (Lebedev *et al.*, 2009).

In conditions when the problem of multi-criteria optimization in the formation of the target plans is reduced to a single-purpose one, the methods presented in Table 1 can be used.

**Table 1**
**Methods for reducing the multi-criteria problem to one-criterion problem**

| *Method* | *Calculation formula* | *No. of the formula* |
|---|---|---|
| 1. Linear value function (additive criterion) | $V = \sum_{i=1}^{N} w_i k_i = w_1 k_1 + \ldots w_i k_i + \ldots w_n k_n,$<br>where $i$ is the index of optimality criterion,<br>$w_i$ is the weight (importance) of the $i$-th criterion.<br>the relative weights are commonly used, *i.e.* $\sum_{i=1}^{N} w_i = 1..$<br>$K_i$ is the value of the *i-th* criterion, if $k_i$ are the integers, then the method is a grade one | 1 |
| 2. The multiplicative criterion | $V = \prod_{i=1}^{N} w_i k_i$ | 2 |
| 3. The objective of the target programming in the Euclidean distance method | $d\,[k, b] \rightarrow \min,$<br>where $k$ is the vector function of the selected criteria $k_i (i = 1 \ldots N)$;<br>$b$ is the N-dimensional vector characterizing the ideal point;<br>including the desired values of individual criteria;<br>$d$ is the distance between kand $b$, that is, between the criteria characterizing the resulting and the ideal solution. | 3 |
| 4. The distance method (Euclidean distance) | $d\,(k, b) = \sqrt{\sum_{i=1}^{N} w_i\,(k_{in} - b_i)^2}$<br>$w_i$ is the weight (importance) of the *i-th* criterion;<br>$k_{in}$ is the normalized criterion value;<br>$b_i$ is some ideal point | 4 |

It should be borne in mind that when constructing the value function, it is necessary to take into account the criterion sign. For example, if a criterion takes into account the negative factors (properties), then it must be included in the additive criterion with a minus sign. In the multiplicative criteria for addressing the problems of maximization, the numerator reflects the criteria, the values of which it is desirable to increase, and the denominator reflects the criteria, the values of which it is desirable to reduce. The typical multiplicative criteria are: profitability, labor productivity, and capital productivity (Osinovskaya *et al.*, 2015).

The weight of each criterion can be determined on the basis of special studies (for example, economic-statistical), past experience, or determined by some other reasons.

A special kind of quantitative methods for addressing the multi-criteria problems includes those in which the value of alternatives is determined not on the basis of aggregating estimates by individual criteria (*i.e.*, by constructing a value function), but by determining the measure of proximity of the solution to some ideal (the so-called "ideal" point – the distance method). Due to this, the solution should provide the greatest approximation to the set of simultaneously unattainable goals. In this case, the objective of target programming, reflected in Table 1, expression 3, is achieved.

Expression 3 has a definite meaning: it shows the measure of the proximity of the chosen alternative (solution) to the ideal.

The parameters of the ideal point can be set in the form of normative values (for example, from the part of higher organization), and also can be determined by the decision-maker. The maximum (or minimum) values of the individual criteria are often used as the coordinates of the ideal point. In this case, the ideal point corresponds to the best achievement of all the goals simultaneously and is determined by the formula 4 (Table 1).

The theoretical foundations of the multi-criteria optimization methods have not been widely used in practice yet by the management of the enterprise, and especially in the area of implementation of such a management function as planning.

## 4. RESULTS

In the course of the study, the system of evaluation indicators, included in the model for assessment of the intensity and degree of timeliness of achievement of the planned indicators for the operating segments of a large oil and gas producing structure was obtained by the author. The objective function for construction of a complex criterion, based on the additive model was proposed.

The multi-criteria approach considered and described by the author, in terms of addressing the intrafirm planning problems, can help managers of various management levels as well as the functional managers with making timely and comprehensively weighted decisions in this field as well as will contribute to the improvement of the quality of ongoing monitoring over the implementation of the annual plans.

The systemic and constant calculation of the complex criteria for the selected operating segments will allow oil companies to track the level of competitiveness not only in the domestic but also in the world market. At the same time, a set of particular criteria included in the calculation of a comprehensive one can be reduced to such indicators as: sales volume, profit and profitability; the volume of reserves and oil production; the production and marketing of petroleum products; the level of investment activity; the renewal of funds, the technological development; the level of international business activity.

## 5. DISCUSSION

Oil companies are complex economic systems performing the works from geological exploration to processing and marketing. The complexity of the planning process in these structures is beyond doubt and is a field of interest for both representatives of science and practitioners. The discussion of the system of intrafirm planning, formed in the practice of large oil and gas producing structures, is insufficiently reflected in the scientific papers. Due to the confidentiality of the information on the specifics of the approaches to planning used, it is not possible to study in detail the practice of planning of these companies. Nevertheless, a fragmentary discussion of this issue can be seen in the scientific paper of Kulagina E.D., as well as on the official websites of the oil companies when publishing the annual reports on their activities.

Table 2 presents a comparative analysis of the planning systems of several oil companies, which shows the implementation of various principles for the formation of a system of intrafirm planning: from short-term orientation and rapid reorientation to new production facilities to the orientation toward the achievement of the long-term goals by ensuring the stability and sluggishness of the approved plans

**Table 2**
**Comparative analysis of the planning system of various oil companies***

| *Company* | *Features of the planning system* |
|---|---|
| CNPC – Chinese state oil company, engaged in oil production | Strategy – maximum oil production. Own resources are limited. Feature – the search for partners in different countries. The system of intrafirm planning is focused on a short-term period. Having finished the extraction in one place, the company reorients to other deposits in other countries. |
| Exxon Mobil –American company | The planning system is open to the company's employees. Particular attention is paid to the planning system for the implementation of major projects. The planning system is flexible enough and easily adapts to changing conditions. In their opinion, the competent planning and monitoring of its implementation can ensure the optimal and long-term return of reservoirs of each of the fields and increase the production of the oil extracted from each well |
| "Lukoil" PAO– Russian oil company. | The planning process is focused on the strict achievement of the goals set by the company in various operating segments. Only in the case of radical changes the plan may be revised. |

*Note :* * The table was compiled according to the scientific paper of Kulagina E.D. (Kulagina E.D., 2016).

Disclosing the possibility of application of the multi-criteria approach in the field of intrafirm planning, it is necessary to designate the complexity of development of a system of particular criteria on the basis of which a complex criterion is going to be calculated. Some companies work with the incorrect set of key indicators, many of which do not reflect the true KPIs of the enterprise. This is due to the poor knowledge of this issue on the part of the linear and functional managers, both in the field of problem theory and in the field of implementation practice. According to D. Parmenter there are three groups of performance indicators:

1. Key outcome indicators;
2. Performance indicators;
3. Performance growth indicators.

According to the analysis of the practical use of the key indicators, many of them represent an inappropriate combination of these three groups (Parmenter, 2007).

It is also necessary to note a point that can cause the complexity of using the approach proposed by the author to solve the intrafirm planning problems. The attribution of all weight indicators to all particular criteria is somewhat difficult with a large number of them. In this case, it is possible to recognize all the criteria as equivalent or to use the method of expert assessments to arrange the weight values throughout the system of particular evaluation criteria (Osinovskaya, & Lenkova, 2015).

## 6. CONCLUSION

The KPI are the main tool for managing the performance of many large oil and gas production structures. It is advisable to carry out a performance evaluation on a regular basis, and it should include:

1. The monitoring of current performance on a monthly (and in some cases weekly) basis;
2. The summing up of the results of activities on a quarterly and yearly basis.

For the individual indicators, first of all, the financial ones, it is necessary to perform the factor analysis with the allocation of the controlled and uncontrolled factors, which allows an objective assessment of the impact of the management on the results of the enterprise.

It should also be noted that the idea stated in this article cannot be implemented in practice with no automation of this process and a clear alignment of the information field for the calculation of all the key indicators for all the operating segments of the company.

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