To the Question of Strategic Management Subsoil Use

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Abstract. The paper presents the results of a comprehensive study of mining industry management in Russia. The author offers new methods and innovative techniques of managing the industry and of reproduction of mineral resources.

There are no regulatory documents allowing to evaluate the efficiency of mining industry management, no concept of developing relations in the sphere of subsoil use, including strategic mineral resources; and no regulations, providing the procedure for the application of legislation in the sphere of subsoil use.

A modern management paradigm is based on creating conditions for the integration of information flows, inventories, data bases and technologies necessary for the situation analysis and making management decisions.

Strategic management allows to identify the potential of the mineral complex. However, the efficiency of the used method can be achieved if the response to environmental changes and trends is timely.

The author of the article makes an attempt to rank problems in the mining industry, offers the ways of solving them and analyzes legislation in the sphere of subsoil use.

The results of research, presented in the paper, serve as a basis for further consideration of the problems and for working out a model aimed at increasing the management system adaptability to rapidly changing environmental conditions.

1. Introduction

1.1. Relevance of research

The solution of strategic problems of economic growth requires the increase in the use of mineral resources by 1.5 – 2 times. But if the existing rates and the system of mineral deposits exploration are kept at the same level, the availability of mineral reserves base will inevitably decrease. Then, there will be no economic growth. It will take at least 15 years of intensive geological exploration works to avoid mineral and raw materials depletion, objective cycle inertia “geological exploration – reserves preparation –use of mineral resources base”, being taken into consideration. The industry management system should contain mechanisms of formulating goals for achieving the results in future and their implementation during a period of at least 15 years.

Meanwhile, all the problems connected with subsoil use in Russia are caused by bad management of the industry. Destructive changes in the management began when fundamental principles of dialectics were forgotten and the principle of «Struggling Opposites», a vivid example of which is the
second law of thermodynamics, was ignored. The most important advantage of the dialectal approach is revealing the negative factors of the analyzed systems.

A complimentary chain, connecting the institutions of management in the sphere of subsoil use turns out to be broken. Weak interconnections and interdependence between different bodies of management lead to imbalance of mineral resources base, the development level of which does not meet the requirements of the Russian economy.

Practice shows that resource based economies can be innovative [1]. The development of new resource branches of industry depends on the ability of economy and society to use techniques and resources for natural environment transformations and using them in the economic production. That is why one of the main management tasks facing the country is realization of these techniques. Justification of these tasks, their formulation, development and determination of the ways to achieve the goals may be possible only with the implementation of strategic management. This study is considered to be relevant because it raises a very acute problem of finding new directions of development in the system of subsoil use management in order to solve the problems facing the industry.

1.2. The degree of the problem investigation
Strategic management of subsoil use is a problem for scientific research. It is considered to be quite new for economics. The concept of “strategic management” is applied to the strategic management of a commercial organization. It is necessary to improve strategic management of high–level economic systems in Russia – regional economies, industrial sector and industrial complexes.

The term “strategic management” was introduced in the works of such foreign researchers as I. Ansoff, Ch. Vissema, G. Mintsberg, D. Hassy, A. Topson, A. Tompson, A. Stricklend. Russian scientists also contributed into the development of strategic management science – O. Vikansky, V. Sizov, R. Futkhutdinov and others. Since the end of 1960s of the 20th century the term “strategic management” has been used to separate managerial activity in setting and implementing long-term economic development tasks from managing current activities of the economy. The problem of the effective use of resources potential is still acute and models of making management decisions in the sphere of mineral resources us have not been investigated yet.

1.3. Novelty of research and practical significance
The study has revealed the fact that the planning needs of the Russian economy in the main types of minerals are registered in strategic planning documents of the industry. However, these documents do not contain qualitative indicators, reflecting demand in mineral resources; sometimes the indicators are given only for some types of minerals.

The author of the paper considers the lack of scientific strategy for the mining industry development in Russia to be the main cause of problems in the field of subsoil use. It is possible to work out a necessary scientific strategy only after the analysis and evaluation of the subsoil is carried out.

The practical significance of the research lies in the fact that the elements of the proposed organizational and economic management mechanism can allow to balance economic interests of mining enterprises, consumers of mineral raw materials and the owner of the mineral resources’ deposits – the state. This mechanism will also allow to distribute the income between the state and mineral resources users on mutually beneficial basis.

2. Goals
The main goal of the study is justification of the strategic management of subsoil use and development of major directions of improving the mining industry management, based on the modern information technologies by accelerating informatization (digitalization) of the Russian economy.
3. Research methodology
Comparative, strategy and institutional methods have been used in the research process. These methods have shown that informatization and digitalization of economic space set new scientific – theoretical and practical tasks to improve the system of management in the industry.

Application of information flows is complementary. At the present stage of managerial thought development, a more sophisticated model of management is being sought. The model is aimed at enhancing the adaptive capabilities of management system to rapidly changing environmental conditions. Using the theory of «Multilateral Platforms» [2, 3] we proved that the modern paradigm of strategic management is based on the creation of conditions for the integration of information flows, inventories, data bases, technologies into the economy, necessary for analyzing the situation and making management decisions.

4. Problem analysis
The results of the analysis of the mineral resource base have shown that in the nearest future Russia will face the problem of a profitable mineral reserves deficit, which can be prevented by carrying out a strategic study of subsoil and creating effective economic mechanisms in management.

Despite the fact that the demand in mining products is stable, the industry is strongly affected by constraints. It is the result of the depletion of rich mineral deposits, usage of more complicated technological schemes for extraction and processing of ores and the deposits development in the territories with a completely missing or poorly developed infrastructure. The development of mining industry should be closely connected with digital technologies use in the industry management.

However, the national project “Digital Economy in the Russian Federation” sets the tasks of achieving certain indicators, but not creating high-tech base in the mining industry [6]. It means that the state is not planning technological modernization and long-term development of the mining industry.

Subsoil use is characterized by the following features, indicating the necessity of strategic management in the industry: the works are carried out in accordance with the stages, some works are performed by specialized organizations; the objects for subsoil use are distributed on the competitive principle; a state body participates in projects as a customer, but the works are performed by both the state and private enterprises. Strategic character of management provides timely preparation of an object for operation at a certain stage.

The list of all participants in all kinds of works must be made in advance; relationships between the participants, mechanism for coordinated actions, legal aspects should be also determined. The objects must be managed by government bodies on the basis of information and digital technologies, capable to work with large information flows. There may be failures of work at certain stages because of bad regulatory background, fragmentation of information flows, and as a result of it, the object turns out to be unprepared for operation. Formally, geological exploration done by some organization does not mean that this organization will use the deposit [7]. It is the state that owns it and has got the authority to provide the deposit for use and development to some organizations. There were cases when some deposits were offered to organizations without any previous geological exploration.

The types of subsoil use [8]:
1) regional geological study including regional geological and geophysical works, geological survey, geological engineering survey, scientific research;
2) geological study, including search and evaluation of mineral deposits;
3) deposits exploration;
4) mining;
5) construction and operation of underground facilities not related to mining;
6) specially protected geological objects;
7) collecting mineral, paleontological and other geological collection materials.

Besides the above-mentioned activities, different kinds of specialized works are carried out: geological earthquake prediction; volcanic activities research; subsoil monitoring; ground water
control; study and assessment of subsoil sites’ suitability for the construction and operation of subsurface facilities; creation of specially protected geological objects; collecting mineralogical and paleontological collection materials.

Federal subsoil use agency worked out a document «Strategic Development of Geological Industry up to 2030», which was approved by the RF Government on June 21, 2010 № 1039-p (Strategy) [9]. But this Strategy does not contain provisions allowing to respond quickly and adequately to changes in the economy.

The Strategy determines general directions of mining industry development and fixes indicators which are necessary to be achieved.

5. The Results of the Study

While analyzing the Strategy [9] of the mining industry development, we used Isikawa diagram [10], and came to the conclusion that the transformation of the institutions in the sphere of the mining industry management is necessary. Isikawa diagram presents the causes that make realization of the Strategy impossible (see Fig.1). The Ishikawa diagram allowed to identify the consequences in the studied issues, to establish the most significant cause-and-effect relationships, to rank them and to formulate strategic objectives.

![Figure 1. The Ishikawa Diagram.](image_url)

Weak interconnection between different management institutions in the field of subsoil use was revealed in the process of research. The conceptual apparatus and the system of legal regulation have not been fully formed yet. This is the cause of risks in the field of state national security.

The analysis of the regulatory documents and their systematization revealed challenges in the legal regulation of the mining industry and in the fiscal interests of the state in subsoil use.

It was found out that such areas of legal regulations as: management of subsoil use; subsoil protection; legal status of some mineral resources; mining industry integration into economy; development of resource-saving mining production; a deposit as an object of management and others are not regulated legally.

The principle of subsoil state ownership is maintained in most countries and such management system of the industry provides the opportunity to adapt the industry to changing circumstances. Due to economic situation many countries adopted legislative acts on the policies in the field of mineral resource complex or on the strategy in the sphere of fuel and energy resources development.
Table 1 presents ranking of countries according to the level of institutional foundations of subsoil use, including legal ones.

**Table 1.** Ranking of countries according to the level of institutional foundations of subsoil use, legal ones being included [11, 12].

| Countries   | I₀, % | Explanations                                                                 |
|-------------|-------|-----------------------------------------------------------------------------|
| Norway      | 85,71 | I₀ –level of institutional foundations of subsoil use development, determined by method of double convolution of the institutional maps of each state and built on a binary number system in accordance with formulas. |
| USA         | 84,29 |                                                                 |
| Canada      | 82,86 |                                                                 |
| Finland     | 81,43 |                                                                 |
| Russia      | 54,29 |                                                                 |

The system of management may be divided into three parts: state management of relations in the sphere of solid mineral resources use; state administration in the oil and gas spheres; state management of subsoil use on the continental shelf. There is no uniform system of legal acts, regulating extraction, processing, production and transportation of mined and processed raw materials. That is why one of the most important tasks is bringing mining legislation into a system by codifying it [13, 14]. Attempt to create such an act were back in 1997.

*The development of new resource based industries depends on the ability of economy* and society to use technologies and resources for the natural environment transformation and involving it into economic production. It is one of the most important tasks of the state.

Table 2 presents new branches of industry development on the basis of mining production in the countries which are now known to be major suppliers of mineral raw materials, but some of them have not been involved in suppling raw materials before.

**Table 2.** New branches of industries on the mineral – raw complex base in the resource based economies [16, 17].

| Country  | Resource specialization | New branches of industry (new specialization of the economy) |
|----------|-------------------------|------------------------------------------------------------|
| Norway   | Ferrous metals mining   | Marine biotechnology                                       |
|          | Oil production          | Marine electronics (navigation and underwater technologies) |
In the process of resource based economies development through the introduction of innovative technologies, major resource based countries go from just mining minerals to metallurgy, metalworking; then to sea transport and electronic equipment.

For example, that was the way of creating electronic equipment in Norway and Sweden for shelf and underwater drilling. It was Norway that worked out the 1st in the world automatic navigation system for oil field development. Canada, Sweden and Finland succeeded in the sphere of telecommunication and electronics.

Such economic development served to create a new economic theory of «Development Blocks», which became the basis for the theory of «Innovative Development» [18].

There are no technological mechanisms of developing mineral deposits in Russia. The national project “Science”, being realized now, does not include the costs of basic, applied and exploratory research in the sphere of subsoil use [19]. Tables 3, 4 present allocations from the Federal budget on scientific research work in the sphere of subsoil use and geological exploration in Russia and state allocations from the budgets on the same items of some other resource based countries.

**Table 3.** Gross domestic product, expenditures on science and scientific publications of scientists from the world’s largest economies (according to January 1, 2015) [20].

| Countries      | GDP          | Costs on research support work | Number of publications on natural and technical sciences |
|----------------|--------------|--------------------------------|--------------------------------------------------------|
|                | Total sum in billions $ USA (purchasing power parity of national currencies) | In % to the world’s amount (considering IMF data) | Total sum in billions $ USA (purchasing power parity of national currencies) | In % to the world’s amount (considering IMF data) | Total number of publications | In % to the world’s number of publications |
| USA            | 17348,1      | 15,87                          | 485,4                                                 | 26,92                                                 | 643925                                      | 28,46                                      |
| Japan          | 4650,1       | 4,25                           | 166,9                                                 | 9,25                                                  | 111875                                      | 4,94                                      |
| Rep. of Korea  | 1683,9       | 1,54                           | 72,3                                                  | 4,01                                                  | 69196                                       | 3,06                                      |
| Canada         | 1600,4       | 1,46                           | 25,8                                                  | 1,43                                                  | 97394                                       | 4,30                                      |
| EU             | 18747,6      | 17,15                          | 365,8                                                 | 20,29                                                 | 784756                                      | 34,68                                      |
countries

| Country     | 2014  | 2015  | 2014  | 2015  | 2014  | 2015  | 2014  | 2015  |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Germany    | 3757.1| 3,44  | 108.8 | 6,03  | 152207| 6,73  |
| France     | 2604.2| 2,38  | 58.8  | 3,26  | 69316 | 4,55  |
| Great Britain | 2598.6| 2,38  | 44.2  | 2,45  | 182286| 8,06  |
| BRICS      | 33090,3| 30,26 | 514,2 | 28,52 | 543375| 22,80 |
| China      | 18083,0| 16,54 | 368,7 | 20,45 | 333411| 14,73 |
| India      | 7347,0| 6,72  | 61,9  | 3,43  | 81956 | 3,62  |
| Russia     | 3666,3| 3,35  | 39,9  | 2,21  | 41399 | 1,83  |
| Brazil     | 3287,0| 3,01  | 37,2  | 2,06  | 53205 | 2,35  |

Data in 2019 are the same as in 2014.

However, these data (table 3) on the Russian budget expenditure on science are not complete. 60% of money that Russia spends on the research support works go to the military-oriented researches.

Table 4. Major indicators of innovative activity in the sphere of industrial production in Russia [20].

| Russia                        | Level of organizational innovative activities on all types of research support works in % | Volume of innovation products in billions of rubles | Proportion of innovative products in the volume of production in % | Proportion of expenses on research support work in total production |
|-------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------|
|                               | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| Total amount                  | 9,9  | 9,3  | 3579,0 | 3843,4 | 8,7  | 8,4  | 3,0  | 2,7  |
| Industrial production         | 10,9 | 10,6 | 3037,4 | 3258,3 | 8,2  | 7,9  | 2,1  | 1,8  |
| including:                   |      |      |       |       |      |      |      |      |
| - hydrocarbon production      | 8,5  | 7,6  | 635,7  | 342,4  | 8,0  | 4,0  | 1,4  | 1,4  |
| and coal mining industries   | 5,9  | 5,6  | 12,8   | 26,0   | 1,2  | 1,9  | 1,0  | 0,5  |
| - manufacturing industries   | 13,6 | 13,3 | 2362,4 | 2856,3 | 9,9  | 10,6 | 2,4  | 2,1  |
| Activities connected with    | 8,8  | 8,0  | 32,4   | 46,6   | 9,6  | 11,0 | 2,6  | 6,1  |
| information technologies     |      |      |       |       |      |      |      |      |
| and computer engineering     |      |      |       |       |      |      |      |      |
Dependence on imported software and equipment for geological exploration is getting critical. Software packages of foreign companies make up 98% in modelling oil field development [20].

It is necessary to consider the complementarity of external factors and elements of an organizational and economic mechanism for mining industry management. Aggregate of information flows is one of such elements. Information flows characterize management systems; they create the basis for making management decisions. Geological information may be a part of such a flow.

Determining features of strategic system of subsoil use management for a long-term period are as follows: information flows coordination; possession of information and the nature of information resource.

Figure 2 shows the system schematically through interdependences.

![Figure 2. Complementarity of external factors, totality of elements of management organism and the type of integrated management system.](image)

Significance of the mining industry in the economy of Russian Federation is increasing, but the analyses and evaluations of subsoil development level are different and depend on the sources. Increased consumption of the results in the sphere of subsoil use in the long-term plans of the economic development is not considered. In such conditions mineral resources potential cannot be realized.

Tables 5, 6 present the results of the research. Table 5 presents data for 2002. After 2002 all the indicators of the mineral resource complex are scattered. All the necessary data are contained in different sources; information on the same minerals differs greatly (for example, in the materials of State reports on the Russian mineral complexes in the Ministry of Natural Resources).

Tables 5, 6 determine the position of Russia in the structure of the world mineral complexes.

| Table 5. Position of Russia in the structure of the world mineral complex (1.01.2002) [21]. |
|---------------------------------------------------------------|
| **Main kinds of minerals** | **In % to global community** | **Resources** | **Reserves** | **Mining** | **Consumption** |
| Oil | 13 | 4,7 | 8,8 | 3,6 |
| Gas | 45 | 32 | 25,1 | 16,8 |
| Coal | 17,4 | 10,3 | 5,4 | 4,8 |
| Uranium | 8 | 5 | 7 | 5 |
| Diamonds | 45 | 30 | 24 | 9,5 |
| Gold | 8 | 8 | 5 | 1 |
| Platinum | 7,8 | 12,5 | 15,9 | 4 |
| Palladium | 22,7 | 31,4 | 44,3 | 2 |
| Beryllium | 30 | 2 | 7 | 2 |
Table 6. Position of Russia in the structure of the world mineral complex (1.01.2018) [22].

| Main kinds of minerals       | Resources | Reserves | Mining | Consumption |
|------------------------------|-----------|----------|--------|-------------|
| Oil                          | no data   | 5        | 14     | 2,87        |
| Gas                          | 32        | 17       | no data|             |
| Coal                         | 10        | 5,2      | no data|             |
| Uranium                      | 5         | 4,8      | no data|             |
| Diamonds                     | 25        | 40       | 30*    | no data     |
| Gold                         | 15        | 9        | 8      | 1           |
| Platinum                     | 16,5      | 10       | 11     | no data     |
| Palladium                    | 33        | 39       | no data|             |
| Silver                       | 7         | 7        | 6      | no data     |
| Бокситы (aluminum raw materials) | 3        | 7        | 3      | 0,7         |
| Nickel                       | 8         | 12       | 15     | 0,3         |
| Copper                       | 5         | 9        | 4      | 0,35        |
| Rare earth elements          | 8         | 21       | 2      | no data     |

Compiled by the author of the article.

* Excess is due to minerals import.

It is necessary to mention that the significance of mineral raw materials for Russia will not decrease in future. This significance will grow with the increase of living standards in the country because of specific consumption of energy, metals and other minerals.

6. Conclusions

6.1. The main reason of the problems facing the Russian government is the lack of a scientifically based strategy in the mining industry development. Such strategy may be worked out only after analyzing and evaluating the subsoil, and carrying out geological exploration.

6.2. Table 7 presents regulatory and legal structure received in the process of analyzing regulations in the sphere of subsoil use. Applicable regulatory federal laws have been taken into consideration.
Table 7. Approximate structure of subsoil legislation (Mining code)

| Subsoil and subsoil use code | Title of recommended law (Code section) | Notes |
|-----------------------------|----------------------------------------|-------|
| Mining code                 | On studying the subsoil                | Recommended |
|                             | On subsoil use                         | Recommended |
|                             | On oil production and oil refining     | Recommended |
|                             | On production sharing agreements       |       |
| or                          | On precious metals and stones           |       |
| The Russian federal subsoil code | On a continental shelf                  |       |
|                             | On state regulation of coal mining and using. |       |
| or                          | On trunk pipeline transport             |       |
| Subsoil legislation of RF   | On gas and oil [25]                     | Recommended |
|                             | On coal industry                        | Recommended |
|                             | On mining property and property relations |       |
|                             | On special tax regimes in subsoil use   | Recommended |
|                             | On unified system of control and supervision in subsoil use | Recommended |
|                             | On waste                                |       |
|                             | On mining expertise and audit           |       |
|                             | On rational and complex subsoil use     |       |
|                             | On entrepreneurship in subsoil use       |       |
|                             | On ecological safety of subsoil and subsoil use |       |
|                             | On concession agreements in subsoil use  |       |
|                             | On cross-border deposits                |       |
|                             | Antitrust law in subsoil use            |       |
|                             | On restoration in subsoil use            |       |

6.3. A state program should be developed to create domestic equipment, technologies, software, necessary equipment for the production of works in the field of subsoil use. Access to geological information obtained by the mining companies, in full remains unavailable, with the information generated by the different mining companies, scattered, not structured, not informative, not stored in proper conditions, and in the future is lost.

6.4. It is necessary to develop a state program on creating modern domestic techniques, technologies, software and equipment for subsoil use operations.

Regulatory concept of geological information, with legal and economic aspects, should be worked out. That is why one of the main tasks in the mining sphere is the creation of geoinformation market and inventory of information resources because the quality and the amount of available ones do not satisfy the demands of the State and subsoil users. The system of subsoil use management must be strategic by nature.

6.5 Weak interconnections and interdependences between different sectors of management system in the mineral sector of the Russian economy cause a mineral base imbalance. It is necessary, and the analysis proves it, to reevaluate the mineral base and to formulate new tasks for the mineral complex in the changing conditions, to search for new methods of their fulfilment and to find new management techniques of subsoil use.
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