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Social-economic processes of fuel and raw materials region: diversification, mathematical modeling and regularities

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Social-economic processes of fuel and raw materials region: diversification, mathematical modeling and regularities

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Abstract. The paper proposes the structure of production diversification in the fuel and raw material region. A distinctive feature of diversification is the provision of regional reproduction of natural resources – reserves of mineral deposits, as well as fuel and energy deposits – traditionally consumed energy products. The algorithm for determining the regularities of socio-economic processes in the region is developed and the results of its concretization are presented. The difference of the proposed algorithm is the joint accounting of quantitative and qualitative information, the emergence properties of social and economic systems under favorable and the following problem situations: crisis, resource scarcity, uncertainty of the prediction of changes in external conditions, changes in legislative bases. It is suggested to implement identification of possible negative processes at the initial stage and when eliminating them step by step: the formation of a hypothesis about the existence of regularity, cognitive modeling, formulation of statements. Based on the results of cognitive modeling of development scenarios for fuel and raw material regions, a set of statements that form the methodological basis for correcting hypotheses about regularities is justified. Four regularities of social and economic processes of the fuel and raw materials region are revealed.

1. Introduction

In modern conditions of economy management the most important strategic goal of development of fuel and raw material regions (FRMR) is the release of finished products of high technological conversion, which is confirmed by the “Program for the development of the Russian coal industry for the period until 2030” [1].

In this regard, the actual applied task of managing social and economic systems (SES) of FRMR is the development of effective options for technological conversion and diversification of enterprises of fuel and energy complex to ensure sustainable development. The mathematical statement of the problem of the SES FRMR following the trajectory of sustainable development is presented in [2]. When forming options for technological conversion and diversification of enterprises, it is proposed to consider the following directions of structural transformations that are regional clusters [3]: society, natural resources potential, ecology, economy and poles of growth.

2. Methods of research

To implement and improve the regional processes of reproduction of natural, human, financial, information and other resources, methods of identification of social and economic processes of FRMR were used. Identification of the significance of their influence on SES development indicators and integration of production processes, including technological conversions of various energy products, was carried out using methods of cognitive simulation.



3. Results and discussion

One of the promising areas for improving regional reproduction processes is the diversification of enterprises of fuel and energy complex and related industries [4 - 6].

figure 1 shows the structure of diversification of SES FRMR enterprises. A distinctive feature of diversification of FRMR production from other regions is the provision of regional reproduction of natural resources – reserves of mineral deposits, as well as fuel and energy deposits – traditionally consumed energy products. It should be noted that the current conditions of SES FRMR functioning result in higher planning requirements [7 - 11], which consists in the development of strategies, programs of operation and development, including the periodic formation of short-, medium- and long-term forecasts and the flexible modification of policies and programs, as well as their updating.

In this regard, in order to develop effective sets of technological conversions and diversification of enterprises in the fuel and energy complex, it is important to study the regularities of social and economic processes of FRMR.

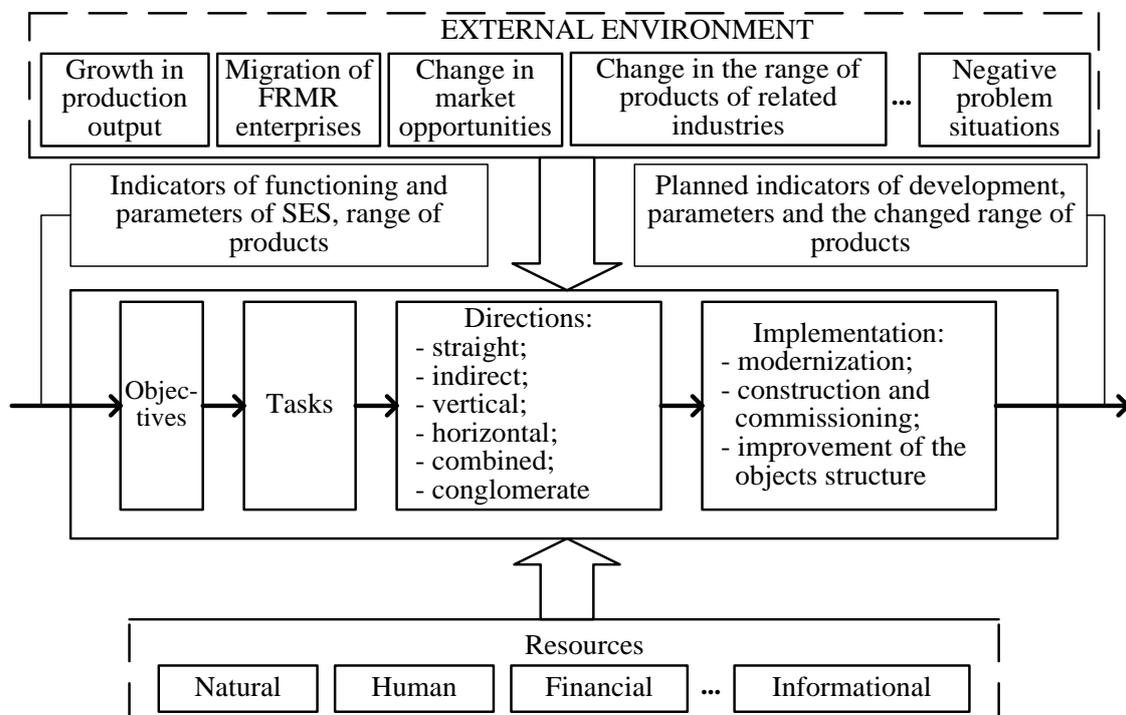


Figure 1. Structure of the production diversification in FRMR.

The algorithm for revealing the regularities of social and economic processes of FRMR (figure 2) is based on complexes of cognitive and imitation models [12 - 14] corresponding to regional clusters (society, natural resources potential, ecology, economy and poles of growth).

The difference between the proposed algorithm is the joint accounting of quantitative and qualitative information, emergence properties of SES in favorable and the following problem situations: crisis, resource scarcity, uncertainty of forecast of changes in external conditions, changes in the legislative basis of SES functioning.

Accounting of qualitative and quantitative information during the formation of decisions allows possible negative processes at the initial stage of their manifestation to be identified and problematic situations to be effectively eliminated. At stage 1 "Formation of hypothesis about regularity", a hypothesis is made about the existence of regularity that may or may not be present in the database. The hypothesis about regularity characterizes favorable or problem situations in FRMR. In the absence

of a hypothesis or difficulty in its formation (only at the first cycle of regularity identification), this stage is skipped and diagnostics of the directions of SES FRMR development are performed on the basis of stage 2 “Cognitive modeling”. In the absence of a hypothesis about the regularity, at stage 3 “Formulation of statements” its formation is performed. Correction of the hypothesis about the regularity is carried out when analyzing the results of modeling at a qualitative and quantitative level – stages 2 and 5. At stage 7, “Formulation of regularities” when confirming the hypothesis about regularity its formulation is carried out taking into account the results of cognitive and simulating modeling, describing the studied social and economic process of FRMR (figure 2).

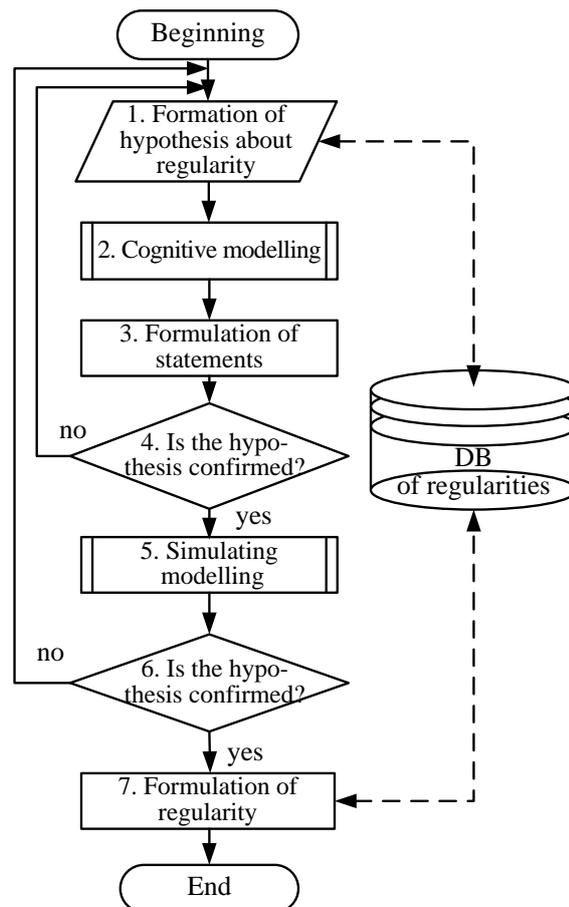


Figure 2. Algorithm for revealing the regularities of social and economic processes of FRMR.

Statements about the socio-economic processes of FRMR are obtained on the basis of analysis of the results of cognitive modeling of 275 different priority development scenarios at a qualitative level. The statements about socio-economic processes (stage 3) form the basis for correcting hypotheses about the regularities and consist of several provisions:

Statement 1:

1.1 The determining factor in ensuring a sustainable improvement in the life quality of FRMR population is the creation of new jobs.

1.2 The priority of improving the factor “state of labor market” provides a less socio-economic effect, compared with a combination of factors – improvement of the state of labor market, incomes and minimum of subsistence of population in FRMR.

Statement 2:

2.1 Strengthening or maintaining the natural resources potential of FRMR at a given normalized level is provided by a combination of three factors: the state of industrial reserves; investments in the reproduction of resources and legislative norms.

2.2 The state of natural resources potential depends on the effectiveness of problem solution connected with agreement of the interests of SES FRMR agents and the state.

Statement 3:

3.1 The ecological environment of FRMR depends on the type and production structure of SES agents and investment opportunities.

3.2 The load on the environment corresponding to one of the conditions of sustainable development depends on the balance of production volumes and emissions, except for non-waste production.

3.3 Diversification of FRMR production, focused on products of high technological conversions, in some cases also can ensure the stabilization or preservation of environmental conditions at a given normalized level.

Statement 4:

4.1 In crisis and post-crisis conditions, efficient operation of SES FRMR agents is provided through plans, programs and strategies coordinating their joint activities, developed and implemented by the center (regional and federal authorities).

4.2 The effectiveness of SES FRMR management in these conditions does not imply the suppression of the activity of SES agents, but is provided by joint integrated directed actions to overcome crisis problem situations and reduce potential joint losses.

Statement 5:

5.1 The level of production development of SES FRMR depends on investment opportunities, the state of main productive assets, structure and production volumes and causes the increase or maintenance of the gross regional product at the achieved level as one of the conditions for sustainable development.

5.2 Effective management of the level of production development, in accordance with the proposed approach, aimed at modifying the production structure of FRMR, can ensure the sustainable functioning of SES, even in crisis conditions.

Statement 6:

6.1 The level of development of the growth poles depends on the conditions of functioning created by the authorities on the basis of legislative norms (restrictions), on the state of the production structure and the level of diversification, which integrally determines its contribution to the economy.

6.2 The change in the production structure of growth poles is possible if favorable conditions for the functioning and action effectiveness of the authorities are created, and there is an effectiveness in interactions between them.

6.3 The location and “migration” of growth poles is substantially limited by territorial concentration and the markets of domestic resources.

The analysis of the results of simulation modeling of development scenarios (stage 5) is performed for the following types: pessimistic; moderate; rational; optimistic; dominant. 72 scenarios for technological conversions, consisting of 14 pessimistic, 15 moderate, 14 rational, 15 optimistic and 14 dominant variants, respectively, and 388 complex scenarios of five types (100, 64, 64, 80, 80, respectively) were modeled in the course of research.

At stage 7 of the algorithm for revealing the regularities of social and economic processes of FRMR (figure 2), the following confirmed regularities are formulated:

Regularity 1. A large amount of investments does not guarantee high quality of life for the FRMR population, due to the wavy character of its economy development – the presence of short waves with a period of 6-7 years and pronounced turbulence in raw materials markets. The hypothesis about this regularity is formulated on the basis of the results analysis of scenarios cognitive modeling – rational, optimistic and dominant types by the maps G_1 “Society” (Statement 1) and G_4 “Economy” (Statement 5) at stage 3. The hypothesis is confirmed by the simulation results of scenarios modeling for the SES FRMR development of optimistic and dominant type.

Regularity 2. Orientation to high technological conversions can provide a change in the production structure of FRMR and help to overcome its mono-specialized specialization alongside with the current negative trends in the economy: dependence on gross regional product, pronounced raw material orientation and high competition in transnational markets. The hypothesis about this regularity was formulated at stage 1 and confirmed by cognitive modeling of five types of scenarios on the basis of maps G₂ “Natural Resources Potential” (Statement 2), G₄ “Economy” (Statements 4 and 5), and G₅ “Poles of Growth” (Statement 6), as well as by the results of simulation.

Regularity 3. The distribution and migration of “growth poles” is substantially limited by the level of territorial concentration of enterprises in the regional economic space and environmental safety. Formation of the hypothesis about this regularity was carried out at stage 1 and confirmed by the results of cognitive modeling of scenarios of moderate, rational, optimistic and dominant types on the basis of maps G₂ “Natural Resources Potential” (Statement 2), G₃ “Environment” (Statement 3) and G₅ “Poles of Growth” (Statement 6). Confirmation is also the results of simulation modeling of scenarios –rational, optimistic and dominant types of SES FRMR development.

Regularity 4. The level of diversification of the FRMR subjects stimulates the emergence of new “poles of growth”, depends on the state of the market and is weakly dependent on existing legislative norms. The hypothesis about this regularity was formed at stage 1 and confirmed by cognitive modeling on the basis of map G₅ card “Poles of Growth” (Statement 6) and scenarios simulation modeling of all types of SES FRMR development.

4. Conclusion

Thus, the use of the revealed regularities of social and economic processes taking place in FRMR ensures a reduction in iterative formation of variants for technological conversion and diversification of enterprises operating within the fuel and energy complex, and the development of effective development strategies in favorable and problem situations of functioning. The created algorithm provides identification of regularities which is especially important in the unfavorable operating conditions and the need for new knowledge about current and prospective socio-economic processes.

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