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Toolkit to estimate the organizational structure of Arctic industrial complexes

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Toolkit to estimate the organizational structure of Arctic industrial complexes¹.

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Abstract

Severe climatic conditions, low population density, lack of infrastructure leave as the only possible nodular economic development of Arctic territories of the Russian Federation. In this case, a natural question arises: how to define points of growth, how to delineate those “patches of economic activity”? In today's economic conditions, growth points for Arctic territories will be large-scale resource projects. Therefore at the first stage of this study were carried out analysis and grouping of the mineral complex projects based on their geographical location, geological terms, mineral market conditions, as well as availability of alternative approaches of transportation and energy supply.

Unlike previously suggested approaches to contouring Arctic economic complexes, author suggests the usage of economic-mathematical tools to obtain quantitative estimates of the projects' effects and justify relationships between them. A simulation model of coordination of interests was created. On its basis, for the convenience of an outside expert was created a “situation room”, which is now in the stage of interface checkout.

It is emphasized that economic efficiency of the projects can determine interregional nature of economic complexes. The possibilities of interregional cooperation in this case are analyzed on the example of the Taimyr-Yakutsky ATPC.

Key words

Arctic aqua territorial production complexes, simulation model, situation room, project evaluation, possibilities of interaction

Necessity of active use of administrative and financial resources of the state, interdependence of projects and other characteristics of the new Arctic industrial complexes allow a methodological analogy with the classical TPC-approach. Territories of advanced development, clusters or territorial production complexes? Most likely the last. High role of infrastructure projects, the nature of the projects - resource, their national-economic significance of each of them individually, the need to create an individual development

¹ Paper was prepared with the support of the Russian President Grant for leading scientific schools, project LSS-775.2014.6 - “Space factor in the economic development of Russia: tools and analysis”

programs, balanced by resources and divided into stages, as well as geopolitical factor of intensification of economic activity in the Russian Arctic.

In today's economic conditions, growth points for Arctic territories will be resource projects. Assessment of each specific project and groups of them in relation to the transport options and energy supply were made to identify the most favorable configuration of economic complexes that is with the largest total effect (including the possibilities of its redistribution between the participants). However, it is in fact a set of interrelated, interdependent capital-intensive investment projects. Herewith business is interested in their evaluation separately while the state - in the complex. Therefore a special toolkit is required that can unite and weigh these levels of interest.

Focal character of development is quite obvious, and options of Arctic economic systems based on harnessing the region's potential of the mineral complex were offered, for example by Dodin², Bashmakova³ and were presented cartographically or verbalized in the form of a set of priority projects. Author's proposal, unlike these approaches is in the usage of economic-mathematical tools to obtain quantitative estimates of effects of the projects and justify relationships between them.

Proposed by the author earlier⁴ the system of arctic aqua territorial production complexes (ATPC) in this paper develops in the direction of the internal structure justification.

For this purpose we needed to implement research based on the following methods, see Table 1.

Table 1. Set of methods of investigation of organizational structure of the Arctic economic complexes

Objective	Methods and ways of solving	Pitfalls of methods
Compiling the list of prospective projects	Analysis and monitoring of geological data, infrastructure development	Classified information on certain types of minerals, low geological knowledge of the Eastern Arctic
Economic-mathematic modeling and evaluation	Analysis of dynamics of raw materials markets	Monopolization of markets complicates price prognosis

² Додин Д.А. Устойчивое развитие Арктики: проблемы и перспективы. – М.: Наука, 2005. - 283 с.

³ Экономическая безопасность и снижение неравномерности пространственного развития российского Севера и Арктики / под науч. ред. д.э.н. В.С.Селина, к.э.н. Е.П.Башмаковой. – Апатиты: Изд. Кольского науч. центра РАН, 2012. – 232 с.

⁴ Aleshina (Tarasova) O.V. Outlook for the economic development of Northern regions of Asian Russia [Electronic resource] // ERSA Congress Sustainable Regional Growth and Development in the Creative Knowledge Economy, 50th Anniversary European Congress of the Regional Science Association International : congress materials on USB-Storage, Jonkping, Sweden 2010. - Jonkoping, 2010. - Referred Session for young scientists "L. Regional economic growth and development", paper № 410.

of projects' effects	Study of pattern projects (mining, transport, energy)	The need to study a large number of technical, production, cost characteristics of objects of respective industries
	Scoping terms of project implementation	Ranking resource projects conditionally divides them into first and second stage, but this method does not consider related infrastructure projects for the future and does not correlate resource and new transportation projects in time
	Studying of the institutional environment of investment projects' implementation in the regions of the RF Arctic zone	Rapid institutional changes, instability in the international economic and geopolitical situation
	SMCI	Insufficiently represented regional interests
Determination of the national economic effects of projects	Optimization intersectoral interregional model (OIIM)	The complexity of justification of technological coefficients changes and restrictions in OIIM, neglecting of environmental constraints and interests of indigenous peoples
Justification of value chains	OIIM+SMCI	Large number of variants
Search for possibilities of interregional cooperation	SMCI	Complexity of bringing to practice
Visualization of results and effects	Situation room	The operation in the Situation Room require prior knowledge about the simulated situation

At the first stage were analyzed the geological scrutiny, the availability of existing transport routes and energy infrastructure for the development, the markets of certain types of minerals. The Table 2 ranks projects based on their significance for the economy and opportunities for industrial development. It groups projects by ATPC. Within these groups projects are listed in descending order of their importance and availability for commercial development (in accordance with the total scoring). Thus priority projects were highlighted and second stage projects listed. One can also see that the ATPCs themselves also have different priorities (for each in the corresponding row is counted a weighted by the number of projects score).

Table 2. Resource projects in the Russian Arctic and opportunities for their development

Project	Geological features*	Availability of infrastructure**	Market conditions***	Total scoring
Kolsky ATPC				8,2
Pechenga group	3	3	3	9
Lovozero	3	3	3	9
Covdor	3	3	2	8
Olenegorskoye	3	3	2	8
Khibiny group	3	3	2	8

Shtokman	2	2	3	7
Arhangelsky ATPC				8
Lomonosovskoye	3	3	3	9
Iksinskoye	3	3	2	8
Plesetskoye	3	3	2	8
Padma	2	3	3	8
Aganoozerskoye	2	2	3	7
Nenetsky ATPC				6,8
Timan-Pechepsk province	3	3	3	9
Yaregskoye	3	3	3	9
Pechora basin	3	3	2	8
Rogachevskoye	1	1	3	5
Pavlovskoye	1	1	1	3
Yamal ATPC				7,9
Bovanenkovskoye	3	3	3	9
Urengoy	3	3	3	9
Yamburgskoye	3	3	3	9
Tambej group	3	3	3	9
Novoportovskoye	3	3	3	9
Rai-Iz	2	3	3	8
Taikeusskoye	2	3	3	8
Ust-Marmara	2	3	3	8
Keishorskoye	2	3	3	8
Kharasaveiskoye	2	2	3	7
Leningradskoye	1	3	3	7
Rusanovskoye	1	3	3	7
Nunderminskoye	1	2	3	6
Antipayutinskoye	1	2	3	6
Norilsk-Turukhansky ATPC				9
Talnakh group	3	3	3	9
Vankor	3	3	3	9
Suzunskoye	3	3	3	9
Lodochnoye	3	3	3	9
Taimyr-Yakutsky ATPC				6
Ebelyakh	3	2	3	8
Tomtor	2	1	3	6
Popigai	2	1	3	6
Essey	1	1	3	5
Guli	1	1	3	5
North-Yakutsky АТПК				6,6
Kupol	3	3	3	9
Kular	3	2	3	8
Churpunna	3	2	2	7
Kuchus	2	2	3	7
Odinokoye	2	2	2	6
Tiretyah	3	1	2	6
Deputatskoye	2	1	2	5
Prospective for hydrocarbons areas in the region of the Lomonosov Ridge	1	1	3	5
Chukotsky ATPC				6,4

Mayskoye	3	3	3	9
Reveem	3	2	3	8
Peschanka	3	1	3	7
Chaplinskoye	1	2	3	6
Valkumei	1	3	2	6
West-Polyanskoye	2	3	1	6
Krutoye	1	3	2	6
Pervonachalnoye	1	3	2	6
Svetloye	1	3	2	6
Iultinskoye	1	2	2	5
Prospective for hydrocarbons areas in the region of the Mendeleev Rise	1	1	3	5

* - expert assessment by c.g.-m.s., L.A. Bondarenko, IEIE SB RAS.

** - based on ⁵

*** - according⁶

Contemporary market conditions

3 – high global market conjuncture;

2 – limited demand on the global market

1 – lowest global market conjuncture.

Availability of infrastructure

3 – year-round communication with an object is possible, available centralized or local energy sources;

2 – the object distanced from the existing transport communications and energy sources, it is required the construction of a small road sections "to the field";

1 – lack of infrastructure to a greater extent hindrance development opportunities.

Geological features and opportunities for industrial development

3 – Fields are being developed or explored;

2 – under exploration;

1 - first exploration stage or geological forecasts.

We therefore will consider only Asian Russia problems. See that in the Asian part of Russia ATPC have different priority. High priority have Yamal and Norilsk-Turukhansky. In this case, the main projects of the complexes do already have investors, "owners", and the

⁵ Алешина (Тарасова) О.В. Оценка влияния транспортного фактора на освоение ресурсов арктической зоны азиатской России // Известия Коми научного центра Уральского отделения РАН. - 2011. - № 1(5). - С. 83-88.

⁶ Информационно-аналитический центр «Минерал», Электронный ресурс, режим доступа: <http://www.mineral.ru/> (последнее обращение 23.04.2014); Похиленко Н.П., Толстов А.В. Перспективы освоения Томторского месторождения комплексных ниобий-редкоземельных руд // ЭКО. - 2012, - №11. с. 17-27; Похиленко Н.П., Афанасьев В.П., Толстов А.В., Ягольницер М.А. Импактные алмазы – новый вид высокотехнологичного сырья. ЭКО. -2012. №12. с. 5-11

task is to justify the need for integrated development of territories, to identify the conditions under which will be possible implementation of the second phase projects within complexes.

However, the most interesting is the evaluation of economic systems created "from scratch", especially in case of their inter-regional nature. Therefore, the author has taken as a case a Taimyr-Yakut ATPC. Here imbalance between the high potential of resource projects, their high value for the national economy and its realization is mostly pronounced. Imbalance is caused by low points for the availability of infrastructure and the level of geological knowledge about objects. Besides, the fact main deposits are located on the territories of different federal subjects could complicate the process of development.

Case-study: Taimyr-Yakutsk ATPC.

The priority projects of the Taimyr-Yakutsk ATPC are Tomtorskoe field of complex niobium and rare earth ores and Popigai field of industrial diamonds.

Niobium and rare earth ores as well as Popigai industrial diamonds have a wide range of applications in high-tech industries. Thus, using low-alloy steels containing niobium, it is possible to reduce by 30-40% the weight of structures in bridges construction, and also production of vehicles, oil and gas pipelines, exploration drilling equipment and increase its life by 2-3 times. This is strongly relevant in the construction of oil and gas pipelines in difficult natural and climatic conditions and in harsh environments, the construction of oil and gas platforms for offshore hydrocarbon production. The above would cause in the very near future cardinal growing demand for rare metals. Moreover rare earth metals are used for the construction of nuclear reactors, in steel alloys, in superconductors, are used in the production of powerful permanent magnets, ferrous and nonferrous metallurgy, electronic, chemical and other industries. Lanthanum is used for hydrogen accumulation alloys; batteries. Cerium - as an additive to cast iron, steel, aluminum, abrasives for polishing optical glasses. Promising areas of application of yttrium alloys are aerospace, nuclear engineering, automotive.

At the same time, the main consumers of industrial diamonds are manufacturers of computer chips, construction, engineering, drilling, cutting and polishing stones, transportation system. The use of diamonds also prolongs the life of tools and that not only leads to lower costs per unit of output, but also fewer tool changes and extension of non-stop production process.

Thus, realization of these projects could give rise to the Russia' innovative development. An important step is to estimate these possibilities, to search for the "return" from resource projects in the economy. Perhaps it might justify state support of northern capital intensive projects. As it goes beyond the project level analysis, estimates were made

using optimization intersectoral interregional model, IEIE SB RAS is famous for⁷. For this prospective we made qualitative changes in metallurgy, engineering, construction production methods. Then we calculated forecasted for 2030 year volumes of production by regions and industries to see structural changes expected. Finally we measured national economic effect after those changes in terms of sum final consumption in the year 2030 and compared them.

Two alternative scenarios for the country's economy development were formed and evaluated:

- "**Geopolitical**" - selected as a starting point and simulates the state of the economy with an active policy of promoting the north vector of development, based on the use of mineral potential of the Arctic territories. State finances intensive development of Northern Sea Route (NSR) to address the defense tasks in the Arctic zone of the Russian Federation, and also carries out a range of measures to promote the implementation of projects for the extraction of energy resources, non-ferrous metals and non-metallic materials. Formation of this scenario meant to include into the model of the new production method - "Production of nonferrous metals in the North". Its Aij are higher than the industry's average costs in the respective regions, due to the peculiarities of economic activity in the North. However, with a development of NSR primarily for defense purposes, there appears an opportunity for a private capital to use it as a way to reduce the share of transport costs in sum production costs.

- "**Innovative**" variant simulates the state of economy with the active use of rare earth elements and natural industrial diamonds in the domestic industry. Basic assumptions of modeling in this context are: an increase in the average service life of buildings and equipment, quality improvement of ferrous and nonferrous metallurgy, construction, reflected in reduced production cost of these sectors of the economy.

Other things being equal evaluation of this effect may be 598 billion rubles. of additional final consumption annually compared with the geopolitical scenario. Certainly, this benefit can be expected only when achieving the optimal structure of the economy, which requires a "guiding hand" of the state expressed in a timely support of certain projects (including northern and related to them). One can interpret the value of 598 billion rubles as the upper limit of the annual "aid" from the federal budget, which can get projects in engineering, metallurgy, construction, which aim to introduce Arctic resources into

⁷ Исследования многорегиональных экономических систем: опыт применения оптимизационных межрегиональных межотраслевых систем : [сб. ст.] / под ред. В.И. Сулова ; ИЭОПП СО РАН. - Новосибирск, 2007. - 249 с.

production: the effect of such projects will provide a qualitative improvement in these sectors when "switching" from "geopolitical" scenario to "innovative", other conditions being equal.

What is important, these unique deposits are located in different subject of federation and it thereby may result in increasing complexity of the development process. Competition between neighboring subjects of federation for the "banner" of these deposits can begin with choosing the most promising logistics center to supply them.

Since main mode of transportation is obviously sea, the competitors may be ports of NSR - Hatanga and Tiksi. Both ports have airfields capable of receiving all types of vessels, including those for military-strategic purposes. This role must be preserved in the future. Also important is the role of these ports as supply bases and shore support of the future international latitudinal transport corridor, which could become the NSR. Both one and the other port can become the logistic center, from which will be laid roads (path, winter roads, etc.) directly to the fields. Hatanga is more favorable (see Figure 1 ...): Popigaj is like "on the way" to Tomtor. The distance is about 300 km to Popigai and another 150 - to Tomtor. While Tiksi-Tomtor distance is about 500 km and therefore to Popigaya another 150. There is an intermediate option: seasonal use of the river port Uring Khaya (R. Saha) when relying on year-round support from Hatanga and Yenisei-NSR system. The advantage of this variant is its preparedness for handling (port is now operated by the subsidiary structure of "Alrosa" - LLC "Diamonds Anabara", which exploits Ebelyahskoye field).

One can see that to Hatanga tend other large fields – Guli and Essey of Maimecha Kotui-apatite-magnetite-rare-metal province, promising areas for hydrocarbons of the Taimyr Peninsula, etc. In addition, there are projects of bringing railroad from Norilsk to Hatanga as an element of the future Arctic corridor. This road will pass through the prospective for hydrocarbons area on Taimyr.

To Tiksi as to the main port on the NSR of the Sakha Republic clearly gravitate almost all deposits of gold and tin between Northeast Yakutia rivers Yana and Indigirka (their middle and lower reaches). Also Tiksi can become a strongpoint for the Arctic shelf of the Laptev Sea development. Thus, a policy to attract companies to participate in Arctic resource projects exploration being active in the medium term port Tiksi would have significant workload through realization of "purely Yakut" projects.

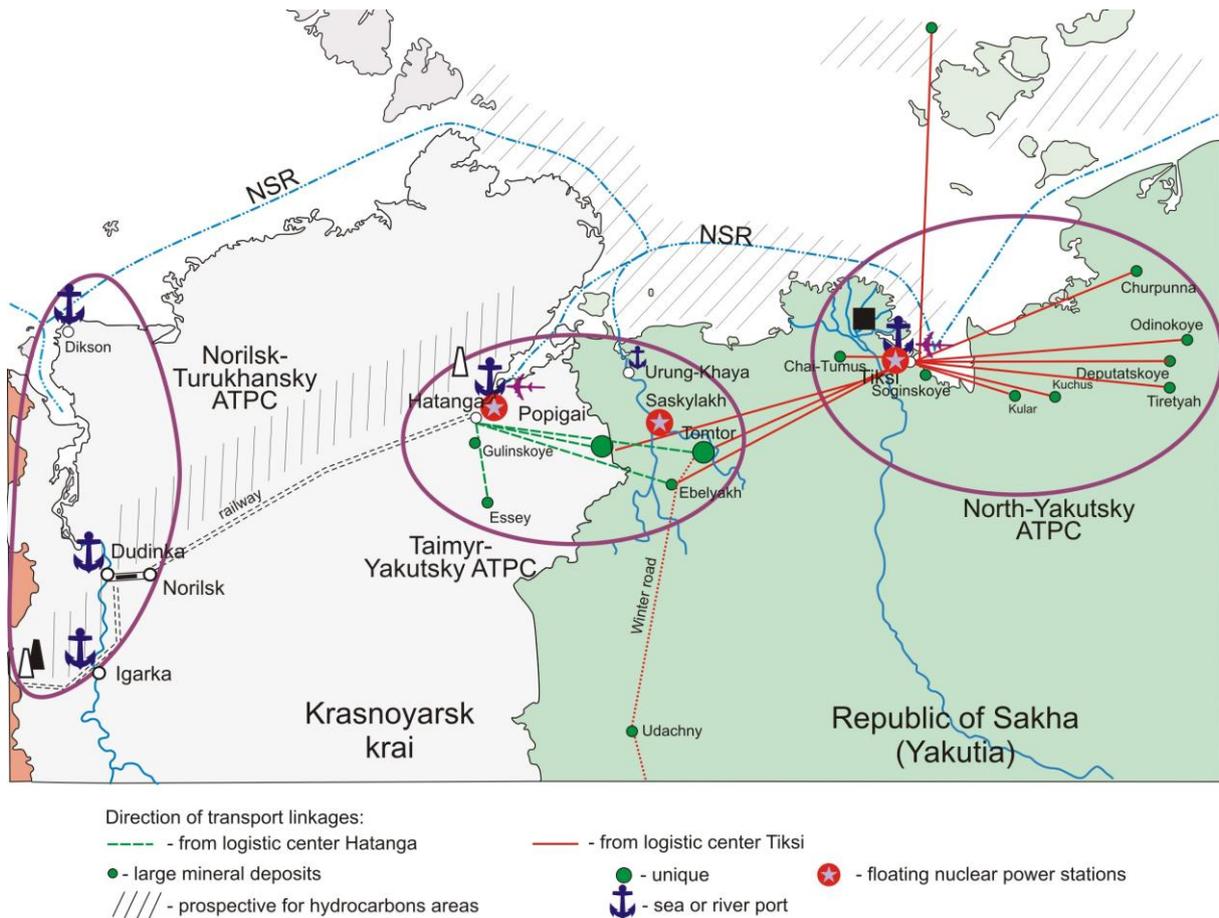


Figure 1. Prospective Siberian ATPC

The question of energy supply can also be considered as relevant due to the large distance from the centralized energy sources. At the same time, when justifying the rational scheme of power supply with a choice of new autonomous energy source, it is important to bear in mind that the construction and operation of any small power plants in northern conditions is obviously unprofitable. As an autonomous power can act not only modern diesel power plants and gas turbine power plants, but mini thermal power plants on local fuels, nuclear power low-power plants, renewable energy. When choosing between these options can be considered geopolitical, economic, and environmental factors. In the absence of local sources of fuel price of electricity may be prohibitively high, exacerbated by the seasonality of supply. As an advantage of nuclear power plant may also serve the following. Fully constructed and tested in the factory and brought to site in large blocks, assembled in a short construction season, they throughout service life do not require overloading the core, and then it can be evacuated leaving behind a "green lawn." However, the operation of power transmission lines from the power plant in the village Saskylakh to the objects will cost significant.

We should also consider personnel issue. In the Asian Arctic there is no speech of continuous settlement areas, except settlements near the projected mining complexes. There is likely to be implemented vahtovij variant of development, but the route of specialists to the objects remains open. Possible monthly air flight from Krasnoyarsk (or Yakutsk?) with a transfer to the local aviation in Hatanga (or Tiksi? Or Mirnii?). Alternative for local aviation can serve highways to fields, partly inland waterway transport. On a plot from Yakutsk to Tiksi is possible river route. Get from Krasnoyarsk to Hatangi possible following the Yenisei, and then the NSR. It should be noted that waterways, with the rate being advantage and disadvantage - their journey time, at the same time prone to seasonal restrictions. If we consider the actual condition of these routes, the choice in the medium term will be made in favor of aviation.

When justifying transport links is extremely important to determine who will be the consumers of products, where will be a continuation of "value chain". In this context, the diametral options are exports and domestic consumption. The latter could contribute to the development of new manufacturing industries in Russia (in Krasnoyarsk region, Tomsk Oblast, Novosibirsk Region, the Urals). Herewith may be applied vertically integration of mining and processing enterprises located in different regions of the federation, and through the mechanism of transfer prices effect can redistribute not in favor of resource region. At the same time, the economy of resource needle in the absence of state regulation export version is more likely to be implemented.

What is more, since the implementation of these major strategic projects can not proceed without the participation of the state (and DO not proceed), search for the optimal structure of the investment pool to finance investment is also of great practical interest. In particular, we should identify the benefits and threats of foreign capital participation. In fact foreign capital is least interested in balanced development of the territory, most in getting a quick commercial effect.

Thus, we see a wide field for variant economic assessments.

Economic-mathematical modeling of different variants of projects realization

Investment costs certainly will need to be distributed between actors of regional development, as conditions of economic activity require a widescreen public-private partnership in the Arctic. For justification of state participation into Arctic infrastructure serve geostrategic factors. Share of state participation required in terms of the commercial attractiveness of the certain projects could be defined in the simulation model framework. Effectiveness of various instruments of state support was estimated.

The assessment of the project' effects has been done with the author's simulation model of coordination of interests (SMCI), which includes specific institutional factors. SMCI actually comprises multiperiodic financial and economic models of individual enterprises. Drafting financial and economic model of the company is an important part of financial planning for a result-oriented commercial business and at the same time can serve as a starting point for assessing the socio-economic effects of the company within the region and the country. Such a model enables not only to make a plan of income and expenses, but also take into account the maximum number of institutional environment factors that may affect future cash flows.

The model has a block structure (see Figure 2). It allows a comparison of costs and effects for business, regions and Russian Federation as a whole.

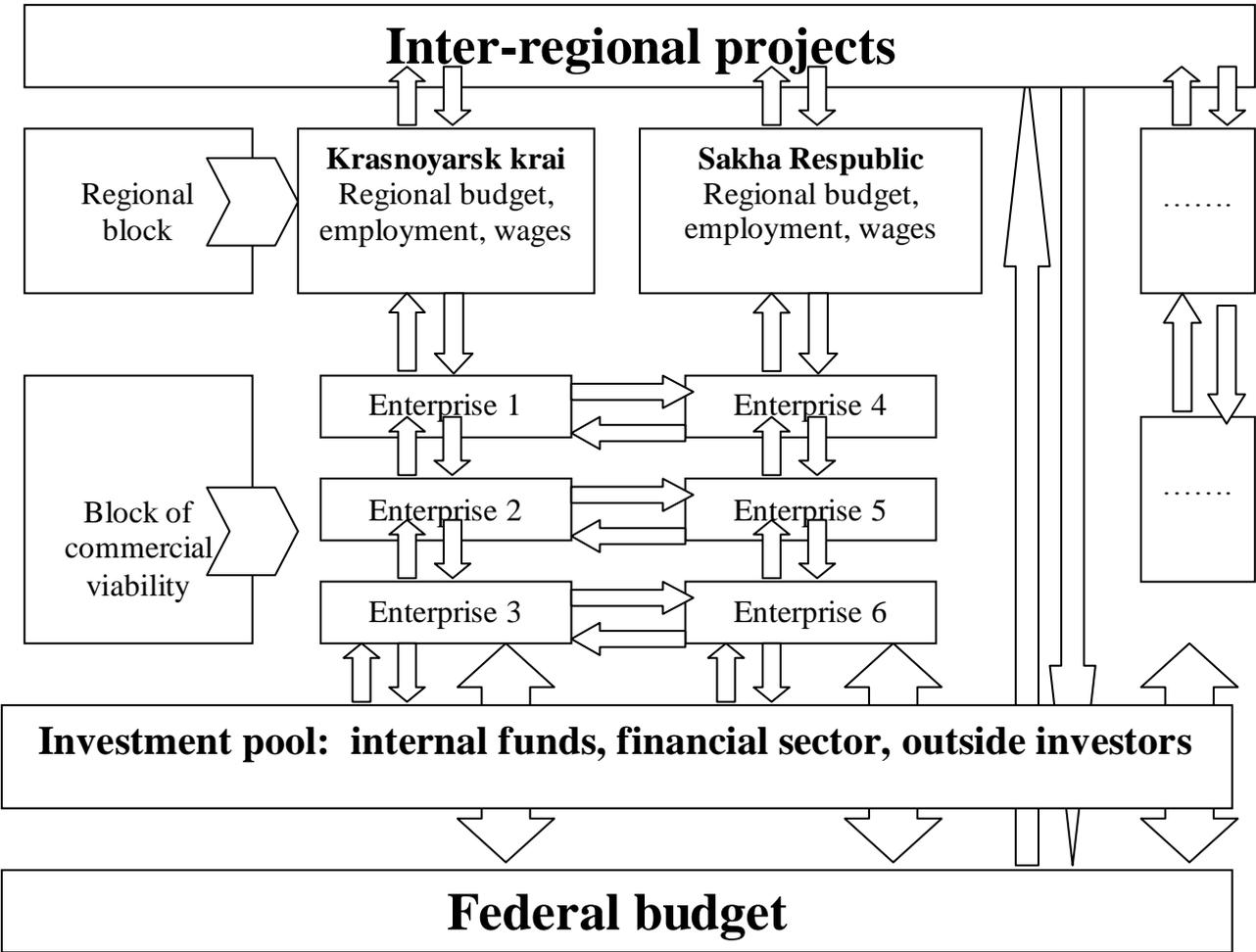


Figure 2. The simulation model structure

The block of commercial viability of the enterprises is carried on the principle of territorial binding. At the same time between the companies located within a single region or different, might be a technological or a financial relationship.

Regions blocks are presented separately including budget revenues, employment and wages level. The federal budget aggregates revenues from all objects in all regions.

For compiling financial and economic model it is needed reliable, comprehensive information, taking into account data about the essence of the company, its business processes. Also needed to know trends and tendencies of certain product' markets. In this regard, the construction of financial and economic model should be preceded detailed analysis of financial and economic activity of pattern enterprises, current and investment costs and benefits. Market analysis is carried out to identify opportunities of an enterprise for realization of its products, trends of rising prices, as well as examine existing standards and rules by which economic agents operate in this sector (institutional settings). Thus, the investor in the pre-project stage has the ability, changing one or more input parameters, to analyze the sensitivity of the basic output parameters and carry out management decisions.

The used model in contrast to a number of similar models explicitly contains the parameters of institutional conditions that reflect the financial, logistical and material strategies and investor' preferences, channels for inter-regional cooperation - the proportion of the profit withdrawal, the share of exports, parameter of redistribution of tax revenues between neighboring regions, indicator of vertical integration.

On the basis of the model described above for the convenience of an outside expert was created a situation room, which is actually a geoinformation system. Working with the room represents itself constant switching between projects' numerical data observation and the projects' and their effects' localization on the map of Russia observation. So, "entering the room" one has an ability to:

1. select ATPC for analysis;
2. within ATPC - select a problem for analysis (e.g., identification of directions of transportation links, choice of energy source, determination of investment pool structure, methods of government support, vertical integration of enterprises, interregional cooperation);
3. within problem - choose scenario of project realization projects according to its brief description and its basic premises. Scenario opens in the original form - the form of previously picked up set of parameters and the corresponding effects reflected map on the Russian Federation map;
4. explore the room possibilities within the scenario. In each scenario tips are spelled: what parameters in what range you can change, what results can be shown, what questions can be answered;

- Analyze results on the map - watch effects' overflowing from the "original" scenario, and then at each creative iteration.

Evaluation results of different options of organizational structure of the Taimyr-Yakutsk ATPC

Following the algorithm proposed above, on the first step is selected Taimyr-Yakutsk ATPC, priority projects of which are Tomtorskoe field of complex niobium and rare earth ores and Popigai field of industrial diamonds.

Transport. For most of the national economic benefits of their development requires technological chain to be continued in Russia (see above). Such continuation can be Zheleznogorsky MCC (Krasnoyasky region). Taking this into account the transport scheme using water transport route deposits-port Uriing Khaya-NSR-Yenisei-railway to Zheleznogorsk looks reasonable. In return raid is proposed to load fuel, materials and equipment⁸ - it allows reducing sum transport costs by 24,5%.

Energy source. The main competing conceptually different options when choosing the energy supply method for these objects are: building a small nuclear power plant with power lines to the fields and the use of traditional stand-alone power plants of small capacity. Table 3 shows the cumulative effects of business and the state in general, depending on the variant.

By the state gains in the study stands an aggregate effect of two projects generally equal to sum of private net present values of the two objects by the year 2030, regional and federal budgets receipts, minus outflow of profits and taxes overseas. Thus, we reflect interests of the entire national economy: government is equally concerned about business, regions, federal revenues, and profits of large companies staying in the country being settled as a real investments, or assets wrapping in the financial system. A gain of business is sum net present value in 2030.

Table 3. Economic effects of different variants of power supply within Taimyr-Yakutsk ATPC, bln. rubles.

	NPS+LEP	2 separate power stations
State	18,1	31,9
Business	18,5	17,9

Effect of business is higher if achieving "cheap" electricity from nuclear power plants built by the state and operated by a state-controlled company. However, the investment costs

⁸ Equipment, having an Ural origin, is brought up here by rail.

of the state on a nuclear power plant and partly on power lines greatly reduce the overall effect for the country. These losses can be justified by the defense and geopolitical factors, increasing frequency of NSR' passages and corresponding development of coastal infrastructure.

Investment pool structure and sales strategies.

Direction of sales has a strong influence on the commercial effect of business, as the internal and world markets prices at which consumers are willing to buy differ. Let us compare these sales strategies (see table 4).

Table 4. Evaluation of projects' effects of at various trading strategies (billion rubles).

	Raw materials export	Processed product export	Pro-russian	Mobilizational
Total effect of business	1,0	23,7	9,5	9,5
Total regional budget effect	5,2	10,3	6,1	6,1
Total federal budget effect	1,7	12,3	7,5	7,5
Net profit withdrawal	0	-19,7	-3,9	0
Overall effect	7,9	26,6	19,2	23,3

Raw materials export scenario implies that processing of ores in Russia is not carried out, besides income of producing objects is transferred abroad. Long-term return on investment in resource projects (15 years) and low NPV of investor in 2030 year (345 million rubles. hereinafter in 2012 prices) is to be left to the discretion of the investor. In this case it is not recommended to provide state support to the enterprises due to the high transnationalization of generated project flows. At the same time, free access for the investor's participation in the projects may be dictated by the need to obtain a growth point in the territory and at least minimal additional budget revenues. Note that the effect of transnationalization interests in financial part has not emerged here - net profit withdrawal is zero: at this level of profitability total outflow of financial results is less than attracted to the project funds.

Processed product export scenario – calculated for the orientation on domestic consumption of raw materials. Federal financial support in the construction phase for the marginally profitable mining projects is carried out under condition that the company sells in

the domestic market. At the same time owner of the Zheleznogorsky plant carries out 100% export policy. The calculation results showed that commercial attractiveness for the operator of rare metals mining with the refusal of exports, of course, decreased due to non-zero VAT on domestic sales. However, the Russian Federation is interested in launching Zheleznogorsky processing plant - the development of high-efficiency (37% rate of return on capital), high-tech manufacturing industry in the Asian part of Russia, a significant increase of revenues, and therefore provides state financial support. Necessary level of state support for the extraction of rare metals enterprise is estimated at 55% of the investments in the construction phase. The validity of the federal investment in mining company is reflected in the increase in NPV of the federal budget is 7.2 times. While negative moment is expressed in the output of 19.7 billion rubles. Thus total effect compared with the raw material export scenario is 18.7 billion rubles. and is maximum of all scenarios.

Pro-Russian scenario involves the active use of industrial diamonds, rare metals and their oxides in the economy of the Russian Federation (40% of production and Zheleznogorsk and Popigai is directed to the domestic market). As a result of changes in export policy the commercial effect of Popigai mining complex in 2030 is negative. However, the interest of the Russian Federation in innovative changes that are made possible through the use of materials produced here on the one hand, and on the other hand an interest of the Krasnoyarsk Region in obtaining best practices of production and a monopoly position on the nascent market of impact diamonds, give grounds equally distribute between them the amount of required funding for this project (15% of investments in the construction phase). We observe a significant reduction of commercial effect of the Zheleznogorsky plant, however the rate of return on capital of 14% is the normal rate for the industry, so additional project support is not provided. The price of the "innovation course" is 7.4 billion rubles.

Mobilization scenario is calculated in terms of pro-Russian, but intend to limit the transnationalization of investors of mining projects and also processing of strategic raw materials using administrative resources. This scenario can be extremely relevant because of the need to stimulate structural changes in the Russian economy caused by orientation use of impact diamonds and rare metals, which require significant amounts of investment. 19.7 billion rubles. of net profit accumulated by 2030 not being withdrawn abroad, may be partially or fully activated for the purpose of inducing innovations in metallurgy, engineering and construction. The overall effect losses in comparison with the best (processed product export) scenario are only 3.3 billion rubles.

It should be remembered, however, that domestic consumption, as shown above, can stimulate innovative development in the long term so that to increase national economic effect.

Vertical integration and interregional cooperation.

Vertical integration scenario is calculated based on the pro-Russian scenario (i.e. in circumstances when state support for resource objects, including Tomtorskoe GIC, is already granted). Transfer prices within this holding are taken at 70% of the world prices. Final financial results of the holding, achieved through the use of tools of transfer prices increased by 30.6%, but the shortfall in taxes to the budget of the Republic of Sakha (Yakutia) is estimated at 0.6 billion rubles (see Table 5) and is mainly a result reducing income tax collection. Wherein vertical integration in the whole receives a positive evaluation - 1.6 billion rubles, a way to compensate for the Republic of Sakha (Yakutia) its budget losses should be found.

Table 5. Evaluation of vertical integration and interregional cooperation (billion rubles).

	Pro-Russian	Vertical integration	Compensation of vertical integration through the budget	Compensation of vertical integration at the expense of business
Tomtor-NPV2030	1,9	-0,8	-0,8	-0,8
Zheleznogorsk-NPV 2030	6,9	12,3	12,3	11,7
NPV of Republic of Sakha (Yakutia) budget	2,7	2,1	2,7	2,7
NPV of Krasnoyarsk krai budget	3,4	4,6	4,0	4,6
Net profit withdrawal	3,9	5,4	5,4	5,4
Total effect	19,3	20,9	20,9	20,9

Compensation of vertical integration through the budget – since the interests of formed vertically integrated company (VIC) go against the interests of the Republic of Sakha (Yakutia) is proposed to find a compromise through the redistribution of effects. For one of the options for compensation is proposed reduction by the Krasnoyarsk region to the level of 14.2% income tax rate of VIC to be transferred to the regional budget (which is under the existing tax laws), so that the company donated the remaining 3.8% of the profits to the budget of the Republic of Sakha (Yakutia). This would leave unchanged overall business results.

Compensation of vertical integration at the expense of business – fundamentally different mechanism of compensation can perform the participation of the Government of the

Republic of Sakha (Yakutia) in the company's dividend distribution. A special control parameter was introduced: share of profit allocated to the budget of the Republic of Sakha (donation of shares being the case). Rejection of that compensation (valued at 2% of profits) can be accompanied by various prohibitions / restrictions of activity by the Republican administration up to Tomtorskoe enterprise stoppage. This method of payment allows keeping the same overall budgetary effect of the Krasnoyarsk region.

Thus, interregional nature of complexes was investigated and justified.

Conclusion

Through various methods, the analysis and options assessment of the organizational structure the Taimyr-Yakut ATPC were implemented. Of particular interest are the quantitative tools of economic assessments, including the original method of visualizing the results of calculations - situational room.

It was determined that the priority transport infrastructure projects should be: ports Uriing-Khaya, Hatanga, Yenisei-NSR system objects, on deposits should be organized decentralized energy supply - separate electric station with diesel fuel.

Best practice is to run a scenario **Compensation of vertical integration through the budget**. We recommend implementing all of its prerequisites - the state's financial participation in the construction phase, limiting investor transnationalization, promoting vertical integration of technology related projects, the redistribution of income tax revenues generated by VIC between regions where the upstream and downstream enterprises are located. The correction of development programs of these two Russian Arctic regions based on the above aspects is suggested.