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The method of scenario-situational modeling in forecasting the innovative potential of territorial production complexes in the Far East

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Abstract. The study is devoted to the examination of indicators of the economic state and innovative potential of the Far East, as well as individual entities. The theoretical basis of scenario-situational modeling and its importance in developing development strategies and forecasting the results of implementation are also presented. Purpose of the study is to develop scenarios for forecasting the innovative development of territorial production complexes in the Far East using scenario-situational modeling. The materials included analytical reports on economic activity in the Far East for 2020–2024 and ratings of Russian regions for 2020–2024. The methods used were analysis of statistical reports and scenario-situational modeling. The Far Eastern Federal District's territorial production complexes are based on mining, fishing, logging, fuel and energy, the defense industry, and mechanical engineering. Khabarovsk Krai holds a leading position in terms of innovation potential. Overall, the region's economic development is at a growth stage, despite existing problems (distance from the economic center, difficult terrain and climate, labor shortages, underdeveloped logistics, sanctions). Significant heterogeneity and unevenness in the development of innovation and technological processes throughout the district was noted. In addition, there are limitations on the innovative activities of industrial enterprises and an insufficient degree of implementation of technologically new projects in key sectors of the economic entity. Using the method of scenario-situational modeling, three options for the innovative development of territorial production complexes of the Far Eastern Federal District until 2030 are proposed. Each scenario takes into account a number of influencing factors, existing and potential resources, potential risks and threats, and productivity changes. The optimistic scenario predicts economic growth of more than five times that of the previous scenario. The optimal scenario, which can be achieved within the first two years, will reflect stagnation; however, there will be growth in economic indicators and expansion of the area of presence. The pessimistic model predicts a long-term economic downturn. The authors concluded that scenario-based modeling is effective in forecasting a region's innovative development.

Keywords: strategic analysis, technological resources, economic modernization, industrial cluster, macro-region, regional development, assessment of prospects

Contribution. All the authors participated in the development of the concept of this review, data collection, processing and analysis, drafted the manuscript, and formulated the conclusions.

Conflicts of interest. The authors declare no conflicts of interest.

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Метод сценарно-ситуационного моделирования в прогнозах инновационного потенциала территориально-производственных комплексов Дальнего Востока

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Аннотация. Рассмотрены показатели экономического состояния и инновационного потенциала Дальнего Востока, а также отдельных субъектов региона. Представлена теоретическая основа сценарно-ситуативного моделирования и его значение в разработке стратегий развития и прогнозирования результатов внедрения. Цель исследования — разработать сценарии прогнозирования инновационного развития территориально-производственных комплексов Дальнего Востока методом сценарно-ситуационного моделирования. Материалы исследования: аналитические отчеты экономической деятельности Дальневосточного федерального округа (ДФО) за 2020–2024 гг. и рейтинги инновационных регионов России за 2020–2024 гг. Основу территориально-производственных комплексов ДФО составляют горнодобывающая, рыбная промышленность, лесозаготовка, топливно-энергетический, оборонно-промышленный комплекс и машиностроение. Лидирующую позицию в отношении инновационного потенциала имеет Хабаровский край. В целом экономическое развитие региона находится на стадии роста, несмотря на существующие проблемы (удаленность от экономического центра, сложность рельефа и климата, кадровый дефицит, неразвитая логистика, санкции). Отмечена существенная неоднородность и неравномерность развития инновационно-технологических процессов в целом по округу. Кроме того, имеют место ограничения инновационной деятельности промышленных предприятий, недостаточная степень реализации технологически новых проектов в ключевых отраслях хозяйствующего субъекта. С помощью метода сценарно-ситуационного моделирования предложено 3 варианта инновационного развития территориально-производственных комплексов ДФО до 2030 г. Каждый сценарий учитывает ряд факторов влияния, имеющиеся и потенциальные ресурсы, возможные риски и угрозы, а также изменения производительности. В соответствии с оптимистичным сценарием будет достигнут экономический рост, выражающийся увеличением показателей более чем в 5 раз. Оптимальный вариант, который может быть достигнут уже в первые два года, отразит стагнацию, тем не менее будет наблюдаться рост экономических показателей и расширение зоны присутствия. Пессимистическая модель указывает на экономический спад в долгосрочной перспективе. Доказана эффективность применения сценарно-ситуационного моделирования в прогнозировании инновационного развития региона.

Ключевые слова: стратегический анализ, технологический ресурс, модернизация экономики, промышленный кластер, макрорегион, региональное развитие, оценка перспектив

Вклад авторов. Все авторы участвовали в разработке концепции исследования, сборе, обработке и анализе данных, написании текста рукописи, формулировке выводов.

Заявление о конфликте интересов. Авторы заявляют об отсутствии конфликта интересов.

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Introduction

The socio-economic development of regions is a highly relevant task due to its impact on the quality of life of the population, sustainable economic growth, and increasing the competitiveness of the economy in the global market. The speed and quality of development depend on many factors: geographical location, natural resources, industrial infrastructure, human resources, local government management, and innovative potential.

In this context, forecasting the possibilities for the formation and integration of innovations can be considered one of the main stages of strategic development. The method of scenario-situational modeling is becoming increasingly popular, as it allows for the rapid development of various regional development options and the real-time implementation and evaluation of implementation results.

The Russian Far East is one of the largest territories in the country with a low population density, possesses rich natural resources, a favorable geographical position, and proximity to a number of developing countries. At the same time, there are difficulties in the form of natural disasters, underdeveloped logistics networks, personnel shortages, and continuous population outflow.

Territorial production complexes (TPCs) operate in the region, based on mining, fishing, logging, the fuel and energy complex, the defense-industrial complex, and mechanical engineering. Given the remoteness from the center of the country, it can be assumed that the TPCs of the Far East have a fairly high potential for innovative development.

In current realities, the search for ways to improve the efficiency of management of various organizations is an urgent task. A considerable amount of research on this topic is presented in theory and practice; however, due to global transformations in various spheres of life and geopolitical events, not all issues are covered in equal detail.

The study of the economic state of the Russian Far East is insufficiently represented in the scientific literature; most research is devoted to evaluating

performance results. N.E. Latysheva and co-authors, analyzing the results for 2022, concluded that the mining and metallurgical industries in the region were in decline, while electric power, wood processing, and the mineral industry, on the contrary, showed positive dynamics. Moreover, investment activity turned out to be higher than the national average, while the pace of innovative development slowed down [1]. O.M. Prokapalo noted that in 2023, the overall industrial development in the region had a negative trend due to an increase in entities with negative dynamics, with the smallest growth observed in construction and the mining industry. Investment activity was also above national indicators. The author identified information technology, energy development, logistics, and mineral extraction as the main directions of innovative development [2]. The results for 2024 were also presented by O.M. Prokapalo: a slight growth in industrial production was noted, with growth observed only in the mining sector, while other TPCs showed negative dynamics. Based on the analysis results, the author pointed out the continued accumulation of investment resources, while the directions of innovative development remained the same. Compared to the previous period, O.M. Prokapalo noted minor changes in the structure of the economy [3].

Furthermore, it is noteworthy that most researchers focus on the significant impact of sanctions on the economic development of the region, despite its remoteness, which is expressed in reduced production and trade turnover, logistics restrictions, and the outflow of specialists [4].

There are few studies dedicated to examining the innovative potential of the region's TPCs. I.S. Bessonova and co-authors can be noted, who examined the international (access to the ASEAN market, expansion of influence in the countries of the Asia-Pacific region as a commodity market) and regional (reduction of migration outflow, development of small and medium-sized entrepreneurship) development of the region [5]. S.V. Doroshenko and co-authors emphasized that the main planning and forecasting tool for the development of the Far East is the state program "Strategy for the Socio-Economic Development of the Far East and the Baikal Region" (2022–2030), where the innovative potential includes reforming the tax system, developing the transport network, exporting raw materials, tourism, and digitalization of technologies [6].

An analysis of the literature shows that the method of scenario-situational modeling is not used when forecasting the innovative development of the Far East's TPCs. This method facilitates the study of the outcomes of certain events using a model, with subsequent possibilities for analysis, parameter changes, and optimization. Scenario-situational modeling also allows for considering external and internal influencing factors and building medium-term and long-term forecasts. Today, there are platforms based on the method under consideration, for example, "Alt-Invest", "Project Expert", and others [7].

The aim of the study is to develop scenarios for forecasting the innovative development of territorial production complexes of the Far East using scenario-situational modeling.

Materials and Methods

Analytical reports on the economic activity of the Far East for 2020–2024¹, as well as the rankings of innovative regions of Russia for 2020–2024², were used as research materials.

The research methods were the analysis of statistical reports and scenario-situational modeling.

Results

The Far Eastern Federal District includes 11 constituent entities; the region occupies 40.6% of the entire territory of Russia, making it the largest in the country. Each subject of the Far Eastern Federal District has its own resources, based on which territorial production structures differ: the Republic of Buryatia is a leader in mechanical engineering and mining; the Republic of Sakha (Yakutia) and the Chukotka Autonomous Okrug — in mining; in the Trans-Baikal Territory, the main industry is mining; the Kamchatka Territory is dominated by the fishing industry; in the Primorsky and Khabarovsk Territories — transport and communications; in the Amur Region — mining; in the Sakhalin Region — the oil and gas industry; the Jewish Autonomous Region leads in mechanical engineering and light industry³.

The analysis of economic indicators is presented in fig. 1.

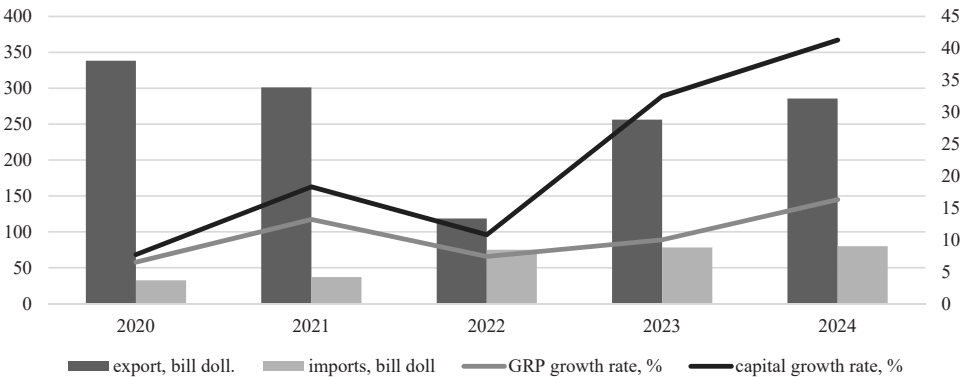


Fig. 1. Economic indicators of the Far Eastern Federal District, 2020–2024

Source: made by A.P. Nochevka, S.B. Sborshchikov according to the Eastern Center for State Planning⁴ with the use of MS Excel.

¹ The results of the socio-economic development of the regions of the Far East: analytical report for 2020–2024. *The Eastern Center for State Planning*. Vladivostok: VTSE; 2024. (In Russ.).

² Rating of innovative development of the subjects of the Russian Federation. *Official website of the Higher School of Economics. Statistical collections*. URL: <https://www.hse.ru/primarydata/rir> (accessed: 08.11.2025). (In Russ.).

³ Far Eastern Federal District. *Official website of the Ministry of Regional Development of Russia*. URL: <http://dfo.gov.ru/district/> (accessed: 08.11.2025). (In Russ.).

⁴ Vostochnyi tsentr gosudarstvennogo planirovaniya. Rezul'taty sotsial'no-ehkonomicheskogo razvitiya regionov Dal'nego Vostoka : analit. otchet za 2020–2024 gg. [Results of Social and Economic Development in the Far East Regions: analytical report for 2020–2024]. Vladivostok: VTsGP publ.; 2024. (In Russ.).

The average annual growth rate of the Far East economy is 4%. We see that in 2022, almost all indicators sharply declined due to major geopolitical events; despite this, an increase in indicators is observed in 2023–2024. The export volume in 2020 amounted to 7% of the all-Russian total, and by 2024 — 8%; the main export categories are raw materials (petroleum products, energy, minerals). Imports increased sharply in 2022 and continue to grow due to the introduction of sanctions and the need for production and information technologies in the region. The growth rate of the GRP increases annually, except for 2022, which indicates the economic development of the region and the growth of its potential. It should also be noted that in 2023 compared to 2021, despite the downturn in 2022, the capital growth rate almost doubled, indicating the effectiveness of the region's development.

Next, we assessed the Far East's ranking in terms of innovative development (Fig. 2).

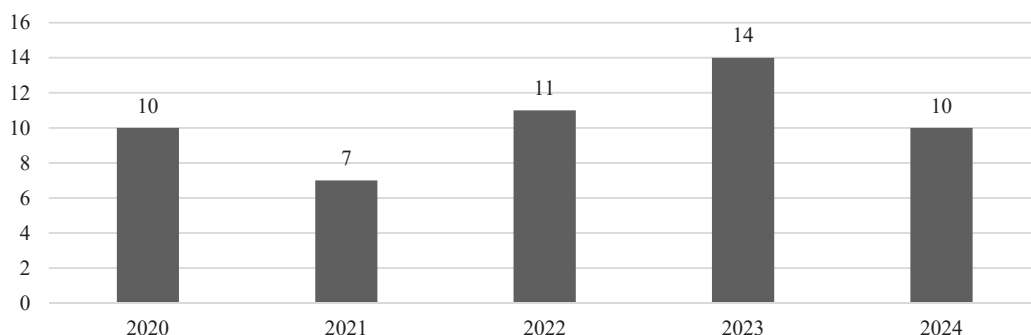


Fig. 2. Far Eastern Federal District Innovation Ranking, 2020–2024

Source: made by A.P. Nochevka, S.B. Sborshchikov according to the HSE⁵ Innovative Development Ranking of Russian Federation Regions with the use of MS Excel.

We found that the Far Eastern District occupies various positions in the context of economic development, staying within the top 20 places of the ranking. In the structure of subjects, the Khabarovsk Territory and Primorsky Territory consistently hold the highest positions annually. Also, based on the ranking, the subjects of the Far Eastern Federal District are grouped into: medium-strong innovator — Khabarovsk Territory; medium innovators — Republic of Buryatia, Republic of Sakha, Primorsky Territory; medium-weak — Kamchatka Territory, Sakhalin Region, Trans-Baikal Territory, Jewish Autonomous Region, and Amur Region; Chukotka Autonomous Okrug is classified as a weak innovator. It can be concluded that the innovative potential is quite high, although there are spatial unevenness and weakness of the resource base.

⁵ Reiting innovatsionnogo razvitiya sub"ektov Rossiiskoi Federatsii [Rating of Innovative Development of Russian Regions]. *Ofitsial'nyi sait NIU VShE. Statisticheskie sborniki*. URL: <https://www.hse.ru/primarydata/rir> (accessed: 08.11.2025). (In Russ.).

Using scenario-situational modeling, we presented a forecast for the innovative development of the Far East TPCs (Fig. 3). The purpose of developing the model was to forecast the innovative potential of the region’s TPCs, contributing to export growth until 2030.

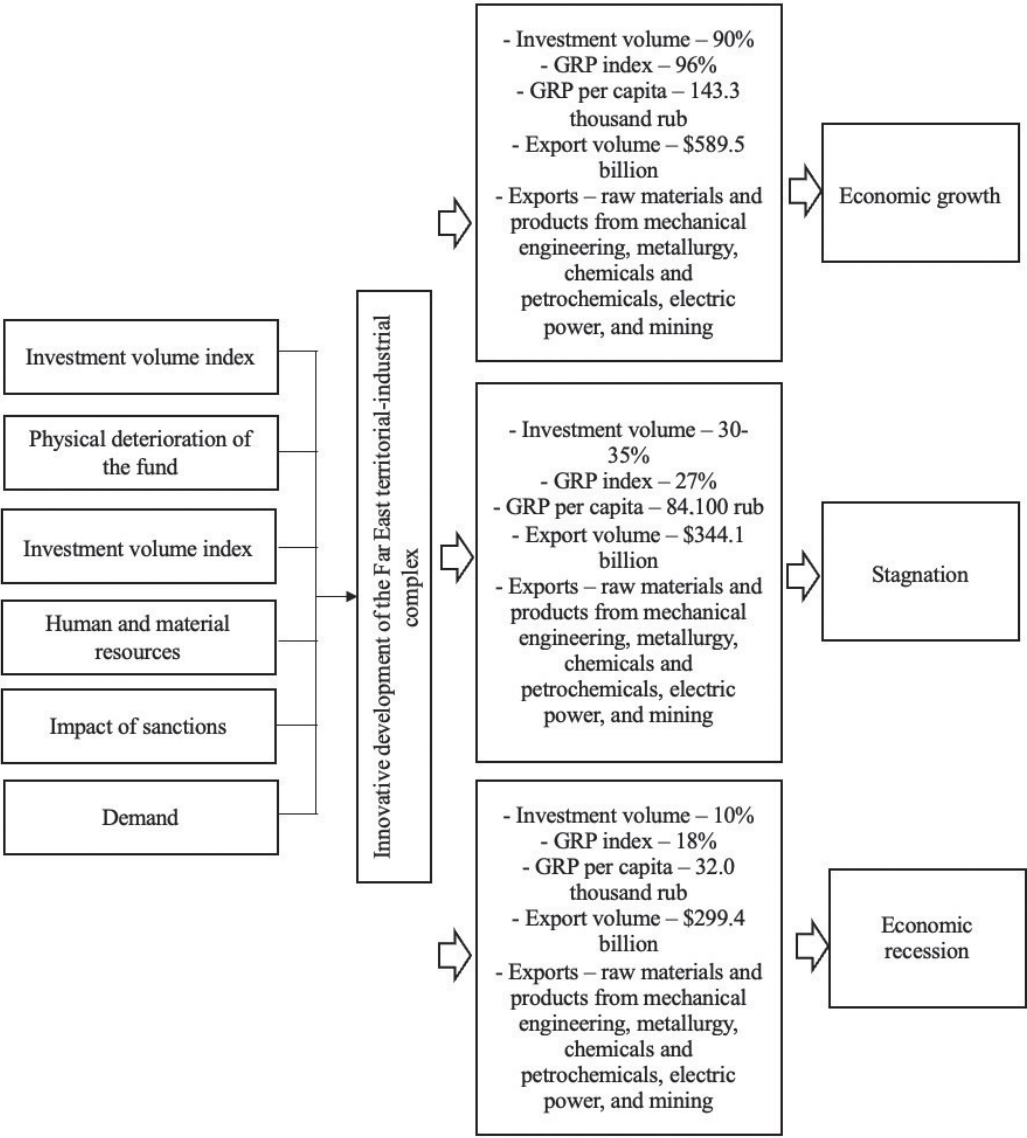


Fig. 3. Scenarios for forecasting the innovative potential of territorial production complexes in the Far East

Source: compiled by A.P. Nochevka, S.B. Sborshchikov independently with the use of MS Word.

Influencing factors: physical volume index of investment (In the region for 2025 amounted to 5.8 trillion rubles (growth of 9.3%); level of physical depreciation of fixed assets (about 37% in 2024); dependence on external conditions, including sanctions; demand for raw materials and products produced in the region (petroleum

products — 2 million tons/year, minerals — 7 million tons/year, timber — 8 million tons/year, food industry products — 27 million tons/year).

We obtained 3 scenarios: the result of the optimistic model will be a sharp growth in the economy and GRP, an increase in investments in the development of industry and infrastructure, and an expansion of the presence zone; according to the optimal scenario, the growth of indicators will be slow but steady; the pessimistic model shows slow growth and limitation of innovative potential at the level of the current situation.

Conclusion

The research conducted shows that scenario-situational modeling is an applicable tool for forecasting the innovative development of territorial production complexes of the Far Eastern Federal District. Analysis of data for 2020–2024 records generally positive dynamics of economic indicators, with a sharp deterioration in 2022 and subsequent recovery, which confirms the sensitivity of the regional trajectory to external conditions and the quality of management decisions.

The assessment of innovative potential based on ranking data revealed its spatial unevenness: the Khabarovsk and Primorsky Territories demonstrate the most stable positions, while several subjects maintain limitations in terms of human resources, technological base, and infrastructure. This reduces the pace of implementation of technologically new projects in basic industries and intensifies differences within the district.

The scenario forecast until 2030 reflects three possible development trajectories: accelerated under a favorable combination of factors (growth in productivity and investment activity), basic (inertial) while maintaining existing barriers, and unfavorable under increasing risks. The scenarios obtained can be used to justify the priorities of the region's innovation policy and to assess the sensitivity of target indicators to changes in investment, fixed asset depreciation, demand, and external constraints.

The limitations of the work are related to the aggregated nature of available statistics and the dependence of the results on the assumptions made. Further research should be directed towards sectoral detailing of scenarios and expanding the system of indicators of innovative potential (including parameters of R&D and technological renewal).

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