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Modern Tools for Sustainable Development of Territories. Special Topic: Project Management in the Regions of Russia

PREDICTIVE MODELS FOR THE DEVELOPMENT OF A SINGLE-INDUSTRY TOWN

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Abstract

The relevance of forecasting the results of the application of state measures to support the solution of the problems of single-industry towns is substantiated in this paper. The implementation of programs for creating territories of priority social and economic development (TOSED) has proved to be necessary. The lack of effectiveness in implementing the priority program "Integrated development of single-industry towns" has been identified by the authors of this research. The choice of the trajectory and development scenarios of territories with a mono-structure of production requires profound consideration of various and numerous factors, which determines the adaptation of modern forecasting tools to the strategic management of single-industry towns. The presented article contains the research findings that demonstrate the possibility and effectiveness of the use of predicative analytics for strategic management of the development of single-industry territories is substantiated. The methods used in this study include statistical analysis, economic and mathematical modeling, questionnaires. Predictive models for the development of single-industry towns are developed, taking into account factors significant from the perspective of residents, investors, regional and municipal authorities and residents of single-industry towns. The obtained results make it possible to work out a methodology for strategic and project management of the regional and municipal economies.

Keywords: Development, forecast, predicative analytics, single-industry town, territory of advanced social and economic development.

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1. Introduction

The relevance of forecasting the prospects for the use of support measures by single-industry towns, the implementation of programs for creating TOSER is due, in particular, to the results of the implementation of the priority program "Integrated development of single-industry towns" (Report on the results of the expert-analytical event, 2019). For example, the Accounts Chamber of the Russian Federation revealed that most of the subsidies allocated by the Monotown Development Fund to finance measures to solve the problems of single-industry territories were used inefficiently, since the economy of such territories was already diversified to a certain extent. Small depressed towns with low investment attractiveness remained without support from the federal budget. Infrastructure facilities built with subsidies do not affect the economy of single-industry towns and many of them are not in demand at all. The size of tax revenues in single-industry towns in the period of 2016-2018 increased by 228.76 billion rubles. Taxes from enterprises of 236 single-industry towns accounted for 37.7% of the increase in tax revenues. However, a significant part of this increase was given by city-forming enterprises. In addition, the number of stable city-forming enterprises has increased. The negative fact is that the volume of tax revenues decreased in 70 single-industry towns. In (Report on the results of the expert-analytical event, 2019), it is noted that support measures for single-industry territories did not provide significant and sustainable positive results. The task of diversification and development of single-industry towns has not been solved. In addition, the program itself did not take into account the country's strategic national priorities; there was no idea of what measures are needed for specific territories, taking into account their specifics and the state of the economy. As a result, in the period of 2016-2018 the number of inhabitants of all single-industry towns of the Russian Federation decreased by 38.6 thousand people. There was an outflow of the population. So about 6 thousand people left the city of Prokopyevsk, Kemerovo region, and almost 4 thousand people left the city of Anzhero-Sudzhensk in the same region. In 2018, the average monthly nominal wage in 271 single-industry towns fell below the average Russian level and made 43, 4 thousand rubles. At the beginning of 2019 the unemployment rate was higher than the national average and in 27 cities it exceeded by more than 3 times in 182 single-industry towns. For the period of 2016-2019 the number of closed enterprises was more than the number of newly registered ones by 28 thousand (or 52.2%). The program expected an investment in fixed assets of 170 billion rubles of investment resources by the end of 2018. The real investment was 1.8 trillion rubles. In the period of 2016–2018 investment growth made 0.6%. Four monotowns received almost a quarter of the total investment: Norilsk, Naberezhnye Chelny, Magnitogorsk and Mirny. Entrepreneurial and investment activity in single-industry towns decreased. Sixty-five single-industry towns received the status of territories of advanced development (TOR) from July 2016 to January 2019. The list of TOR residents at the end of 2018 totaled 246 enterprises. But the formation of the TOR as a support measure is not used systematically and reasonably, since there is no analysis of the characteristics and features of single-industry towns that need the status of TOSER more than other territories. During the existence of TOSER in 2018-2018, 50 enterprises left the monotowns due to migration. That is why the demand for attracting effective prognostic tools for making informed decisions in the field of support of single-industry towns has increased by many times lately.

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2. Problem Statement

The area of managerial decision-making to support single-industry towns and TOSER of single-industry towns does not use modern forecasting tools. The lack of a systematic analysis and forecast of the development of territories with a monostructure of production led to the early completion of the support program for single-industry towns and aroused a discussion by scientists and practitioners of the possibility of integrating all measures of support for single-industry territories into one priority national project. The development of this project, its effective management requires not only the implementation of project management in the field of regional and municipal economies, but also the formation of predicative models for the development of single-industry towns.

3. Research Questions

The article presents the predicative models of the level of development of TOSER of a single-industry town, the level of innovativeness of the economy of a single-industry town, the social development of a single-industry town, using regression. Predictors are selected that determine the result of the development of the social, economic, innovative spheres of the territory with a monostructure of production and the status of TOSER.

4. Purpose of the Study

The main objective of the study is to develop predictive models for the development of a single-industry town (for example, TOSER of the town of Yurga, Kemerovo region), taking into account the mutual interests and expectations of the population, business, investors, residents of TOSER, regional and municipal authorities and allowing to predict sources of danger to society and the economy.

5. Research Methods

Methods for assessing and predicting the development of single-industry towns Russian and foreign scientists propose various methods to assess the socio-economic situation of single-industry towns. So, the methodological approach to analyzing the state and level of solving the socio-economic problems of a single-industry town (Khvan & Bulkina, 2018) is based on the choice of indicators, their standardization and integration of indicators using factor analysis. The methodology proposed by Khvan and Bulkina allows identifying stable aggregates of single-industry towns based on differentiation of the level of their socio-economic development. Kayl, Epinina, Bakhracheva, Velikanov and Korobova (2017) propose using a model that takes into account antitrust, tax policies, anti-inflationary measures, stimulating investment inflows, developing entrepreneurial firms, and creating jobs to assess the effectiveness of public administration of the state of social and economic processes in a single-industry town.

However, the forecasting of directions and scenarios for solving the problems of single-industry towns, in particular, in the conditions of obtaining the status of TOSER and other support measures, is of great importance for federal, regional, municipal authorities. It should be noted that the arsenal of

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economic and mathematical modeling is used to a certain extent in the practice of forming programs for the development of single-industry towns. Russian researchers propose a modification of the regression analysis method for these purposes (Rizov, 2014; Sargidzhyan, 2014). For example, the depression level of single-industry towns is modeled using factors such as the population with incomes below the subsistence level, retail turnover, and unemployment in the regression model (Rizov, 2014). Sargidzhyan (Sargidzhyan, 2014), uses the following indicators when modeling a complex index of investment attractiveness of single-industry towns: general mortality rate of the population, indicator of the development of the vocational education system, migration balance and unemployment rate. Trusova (2013) proposes a methodology for analyzing hierarchies. She bases modeling the quality of life criterion on the use of indicators of the poverty level of the population, the provision of residents with comfortable housing, the number of unemployed per one available vacancy, the share of the employed population in the city's economy, the level of depreciation of fixed assets of the city's infrastructure, the share of production of the city-forming enterprise in the total volume of production, the share of unprofitable companies, the level of city pollution. Manaeva and Rastvortseva (2016) use econometric methods to predict the development of single-industry towns. An analysis is made of the impact of endogenous and exogenous factors on the situation in a single-industry town and a conclusion is drawn about a greater influence on the level of socio-economic problems of a single-industry town of endogenous nature. Rogachev (2017) uses a two-level modeling, characterized by the use of a cognitive approach, which allows identifying the relationship of complex environmental factors of single-industry towns, including investment and human resoursing. The article of Guseva and Dmitrieva (2020) is devoted to optimisation of the digital transformation of a monotown depending on the model of its development and based on the analysis of its competitiveness. Shafirov and Tanaka (2017) offer a model for forecasting the creation of household assets by lending housing in depressed single-industry towns based on the synergy of project management theory, institutional approach and the approach of sound actions to economic development. It is possible to use the model of technological changes to predict the diversification and innovative development of the economy of single-industry towns (Bagrinovsky, Nikonova, & Sokolov, 2016), in particular, to select options for new technologies that are more profitable from the standpoint of economic efficiency.

Given the practical demand for justifying the choice of projects for modernizing the economy of single-industry towns, the use of prognostic tools is necessary, which allows creating scenarios of territorial development with a greater degree of reliability. Therefore, the study of the authors' team is focused on the development of a methodology for managing the economic modernization of single-industry towns using predicative analytics first used to solve the problems of such cities.

At the first stage of the study, we justified the use of predictive analytics (Ivanova, Trifonov, & Nesteruk, 2019) in solving a number of issues related to the justification of projects and programs for the development of single-industry towns and a list of predictors was determined. The selection of predictors was carried out as a result of a survey of representatives of TOSER enterprises-residents in the monotown of Yurga of the Kemerovo Region, potential investors expressing the desire to place production in the cities providing favorable conditions, residents of the city and authorities. The survey was conducted from March to May 2018 in the urban district of Yurga, Kemerovo region. An analysis of the results of a

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survey of representatives of resident enterprises, potential investors and municipal authorities of the municipality showed that 46% of respondents consider an increase in the number of enterprises organized for the first time in the city as the most significant , 76.7% - growth in investment in fixed assets, 57.7% - provision of permits by authorities for the construction and commissioning of industrial facilities, 54% - provision of permits by the authorities for the construction and commissioning of industrial facilities, 89.7% - a reduction in the terms for granting of building permits by authorities in a single-industry town. Representatives of investors and authorities consider the share of R&D workers (67.5%) as a more important factor influencing the diversification of the economy of a single-industry town by developing innovative industries, and they less value the importance of the funding factor for scientific and research work at universities (43,6%). 79.6% of respondents consider that it is important to collaborate with scientists, practitioners, and engineers by creating joint project teams. The unemployment rate and the size of average per capita income are of greater importance in assessing the impact on the social well-being of residents of a single-industry town (87% and 76.8% respectively).

It is proposed to use the following predictors to formulate an industrial policy in the city and ensure a balance of interests of stakeholders in urban development strategies and projects, to forecast the development level of the TOSER of single-industry towns: the number of newly opened enterprises, the number of jobs created, the size of investments in fixed assets, the number of construction, commissioning permits granted by the municipal authorities, deadline for obtaining construction permits and others. We justified the use of the following predictors as indicators to justify the directions of diversification of the economy of a single-industry town: the number of personnel of companies engaged in research and development, the volume of research and development, the volume of production of new products, etc. A definition of risks, in particular, threats to disrupt the activities of the programs of creation and development of TOSER is important in predicting the future of single-industry towns in terms of obtaining measures of support. In this case, the predictors are as follows: the number of economic activities for which preferential conditions are provided in the single-industry town, the number of refusals of the city authorities to give access to resources, land use to residents of TOSER, etc.

Prediction of the social well-being of residents of a single-industry town should be based on the use of the following predictors: indicators of population migration, number of reported offenses, real disposable income, unemployment, absolute poverty, average per capita income, proportion of households with minor children, etc. Moreover, in our opinion, it is important to choose an effective model of urban development. Various models of urban development are indicated by Longworth (2016): green cities, cultural cities, creative cities, cool cities, cities of opportunities, cities of sustainable development, adaptive cities, sports cities, smart cities, healthy cities, cities of the future. The model of a social city (De Lange & de Waal, 2015) is based on the assumption that digital technologies will provide residents with opportunities for collaboration and participation in the progress of their cities. Cooperation of government, business, and city residents is important to solve social problems. The model of a social city is based on the idea of forming communications and reaching compromise solutions between residents, authorities, and enterprises through the use of city portals and social networks. The key idea is the openness of information on urban development, the involvement of stakeholders in the discussion and

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coordination of interests. It makes sense to focus on the desire for a model of a social city in the process of choosing forecast scenarios for the development of single-industry towns.

6. Findings

Predictive models for the development of a TOSER of a single-industry town (on the example of the town of Yurga, Kemerovo region):

Regression was chosen as the form of predicative analytics. In the process of regression, we apply a quantitative response variable (what we need to predict), as well as several predictor variables. The predicative model is based on the relationship between the variable sought and the predictors. We have adopted the hypothesis of a linear relationship between the desired response and predictors. So, to determine the level of development of the TOSER of a single-industry town, we use the formula:

$y = a0 + a1\ x1 + a2\ x2 + a3\ x3 + \ldots + an\ xn$ (1).

x1 – the growth rate of the number of enterprises organized for the first time in the city;

x2 – fixed investment growth rate;

x3 - growth rate of building permits granted by municipal authorities;

x4 - growth rate of permits granted by municipal authorities for commissioning of industrial facilities;

x5 - growth (decrease) rate in the period for obtaining a permit for the construction of facilities.

We propose using the following indicators as predictors to predict the innovation level of the economy of a single-industry town (which determines the diversification of the economy of a single-industry town):

x1 – share in the total number of personnel of enterprises and organizations engaged in research and development;

x2 – share of new products in total production;

x3 – share of employees with higher education;

x4 – growth rate of research funding at universities in a single-industry town;

x5 – growth rate of joint project teams.

The following predictors are used when forecasting risks, in particular, threats to disrupt the program events for the development of TOSER of single-industry towns:

x1 – the number of economic activities for which preferential conditions are provided in a single-industry town;

x2 – the number of refusals of services of city authorities to give access to resources, land use to residents of TOSER;

x3 – the number of registered residents at TOSER of a single-industry town.

The predicative model of the social development of a single-industry town includes predictors:

x1 – growth (decrease) rate of population migration;

x2 – growth (decrease) rate of unemployment;

x3 – growth (decrease) rate of per capita income.

The use of statistics for the period of 2003-2018 as source data (the studied part of the indicators is reduced to the 2003 base), it was possible to calculate matrices of pair correlations, the use of regression analysis made it possible to construct statistically significant regression equations (models):

Model of the development level of the TOSER of a single-industry town:

$y = -9,56 + 0,57x3 + 0,22x4 + 0,33x5$ (2),

model of the innovation level of a single-industry economy:

$y = -23,46 + 0,57x1 + 0,22x3$ (3),

social development model of a single-industry town:

$y = -67,56 + 0,57x2 + 0,22x3$ (4).

Use of the simulation results will provide reasonable decisions in the field of project management support and development of single-industry towns.

7. Conclusion

Predictive analytics can be integrated into development management system of single-industry towns, in the system of choosing the most effective tools to stimulate investment inflows and developing innovations at enterprises organized within the framework of TOSER. Forecasting of employment and income will allow building sound social policies in depressed single-industry towns.

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