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

PREDICTIVE ANALYTICS IN SINGLE-INDUSTRY TOWN RISK MANAGEMENT

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Abstract

The relevance of using predictive analytics tools in the process of forecasting and analyzing risks in the field of solving problems of single-industry towns is due to the fact that the existing arsenal of identifying these threats does not always allow us to notice negative trends in time besides, no single-industry towns support programs were implemented during the period of 2016-2018 in the Russian Federation.
The results of ranking the risks and development factors of territories of socio-economic development (TOSED) in single-industry towns are presented (on the example of the city of Yurga, Kemerovo region). The effectiveness of the use of predicative analytics in the risk management of TOSED of single-industry towns is substantiated. The types of classification, the possibility of their use in identifying threats to the development of a single-industry town are considered. The sources of data collection and accumulation of data for forecasting threats to the creation and development of TOSED in the single-industry towns of the Russian Federation are identified. Recommendations are offered to potential residents of TOSED and municipal authorities of single-industry towns with such status on forecasting the risks of creating and progress of TOSED. The obtained results contribute to the development of risk management, project management in the field of regional and municipal economies.

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

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1. Introduction

The early completion of the priority program "Integrated Development of Single-industry Towns" ("Report on the results of the expert-analytical event …", 2019) due to the lack of significant results is largely since the risks of failure of program activities and the factors of their low efficiency were not predicted. As a result, the problems of many single-industry territories of the Russian Federation have not been resolved, entrepreneurs have not been able to implement their investment projects, TOSER, created in single-industry towns have not received an influx of residents and investments. Obvious and applicable threat indicators did not ensure timely detection of negative trends. For example, in the city of Yurga, Kemerovo Region, LLC "United Woodworking Commercial and Industrial Company" planned to invest 626.6 million rubles in the creation and development of their business at TOSER "Yurga". However, the agreement was terminated. A TOSER resident from Tomsk, "Mir" company, planned to build a propolystyrene concrete production plant at TOSER of Anzhero-Sudzhensk, Kemerovo Region, worth about 100 million rubles. But excessive interference of the TOSER resident in the business through tax audits and the imposition of interim measures on the company's accounts led to the loss of this investor. Obviously, in this case, traditional risk management tools are not effective both for enterprises - potential investors and residents of TOSER, and for authorities. It makes sense to look for patterns in the phenomena and processes taking place in the territories of single-industry towns not only with the help of well-known classification features and risk factors. Otherwise, the decision currently being discussed on the integration of all measures to support single-industry towns into one priority national project will not bring the desired benefit either to the state, or to entrepreneurs, or to the population of single-industry towns. In the meantime, the lack of innovation in the field of risk forecasting has led to the fact that the amount of tax revenue decreased in 2018 in 70 single-industry towns of the Russian Federation, the number of residents of all single-industry towns decreased by 38.6 thousand people in the period of 2016-2018, and the unemployment rate increased and in some cases exceeded the average Russian rate by 3 times ("Report on the results of the expert-analytical event …", 2019). In this regard, the integration of modern forecasting tools and risk management of TOSER monotowns, as well as potential residents and investors of such territories, becomes urgent.

2. Problem Statement

The traditional arsenal of risk management methodology in modern conditions does not cope with the tasks of finding effective solutions in the field of regional and municipal management. Foreign and Russian companies in various industries are beginning to use predictive analytics actively, in particular, to reduce risks, increase business efficiency, marketing, and logistics. However, such a methodology has not yet been used to anticipate trends in the development of single-industry towns (Ivanova, Trifonov, & Nesteruk, 2019). The adaptation of predicative analytics tools to the tasks of managing the development of single-industry towns, in particular in the field of development risk management, is in demand. The authors solve the problem of selecting predictors that make it possible to make high-quality forecasts of changes in the situation in single-industry settlements depending on the support measures applied, for example, obtaining TOSER status, the behavior and interests of investors, potential residents of such

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territories, city residents, and authorities. The objects of the research presented in this article were the problems of single-industry towns, the characteristics and features of TOSER in single-industry towns, affecting the sustainable development of TOSER and the activities of residents in such territories. The research information base was research of the practice of solving the problems of single-industry towns, officially published statistical data relating to the establishment and operation of TOSER in the Russian Federation, the functioning of single-industry towns, the implementation of various instruments to diversify their economies, empirical data collected through questionnaires, surveys and interviews of real and potential residents of TOSER single-industry towns of Kemerovo region.

3. Research Questions

The article presents the results of a classification (a type of predictive analytics) that studies both predictor variables and classifier response variables that allow predicting risk events in the trajectory of creating and developing TOSER single-industry towns.

4. Purpose of the Study

The authors chose the selection of predictors and risk-classifying variables that ensure the prediction of risk situations in the decision-making process on creating a TOSER single-industry town, developing and implementing a TOSER development program, interacting with investors, potential residents of the territory, as well as in the process of developing and implementing investment projects entrepreneurs in single-industry settlements as a goal of the study.

5. Research Methods

5.1. Methods of analysis, forecasting risks and choosing anti-risk decisions in the regional economy

The issues of forecasting and risk analysis in the regional economy are closely related to the topic of regional security. Thus, Ogorodnikov, Zaloznaya and Borovsky (2018) emphasize that regional security is highly important for the sustainable development of the Russian Federation, and the problem of studying the security of enterprises operating in the regions is complicated by the uncertainty caused by changing external and internal threats. The study “Risk Analysis and Safety Research” (Broder & Tucker, 2006) presents a model for quantifying the safe condition of an object. The necessity of taking into account the social factor in the procedure for determining the level of socio-economic security of the region is substantiated; methodological approaches to modeling and forecasting the socio-economic security of the region are described in the work of Chichkanov and Belyaevskaya-Plotnik (2016). The regional security system should be proactive, include monitoring - a system of collecting, accumulating and analyzing statistical data, conducting surveys of residents, diagnosing trends in the development of the regional economy and public health (Senchagov, 2002). What is important is the prevention of threats by isolating changes in regional processes that significantly and negatively affect the socio-economic security of territories. The methodology for the analysis and forecasting of indicators of economic

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security includes not only methods for assessing the dynamics of macroeconomic indicators, as well as comparing them with threshold values (Glazyev, 1997), but also a methodology for assessing the rate of economic growth (Illarionov, 1998), tools for ranking regions by risk level based on expert assessments, methodological approaches based on multivariate statistical analysis, methods for determining the damage of risk situations that have already manifested.

The methodology for choosing anti-risk management decisions is developed within the framework of systemic economic theory, the operational theory of risk level management (Kleiner, 2013, 2015; Kachalov, 2012). Threat analysis of the economic strategy and plans to create special economic zones (TOSER in single-industry towns, in particular) is possible using the spatio-temporal structuring of events and the environment in which the project of creating TOSER is implemented (Kleiner, 2013, 2015). The operational theory of risk management (Kachalov, 2012) proposes to analyze risk factors as a prerequisite for the occurrence of obstacles, as well as indicators of the level of economic risk to not solve the planned tasks.

The presence of the developed risk analysis and forecasting tools, risk management methodology, however, does not reduce the relevance of improving the prognostic risk management tools by introducing innovative technologies, in particular the arsenal and ideology of predictive analytics in the field of municipal and regional management.

5.2. Risks of creating and developing TOSER of single-industry towns

An analysis of the practice of creating and operating TOSER in single-industry towns of the Russian Federation showed that the risk of disruption of the programs for the initiation and development of territories with special status is the most significant. It is caused by the difficulty of attracting residents and investors. First, the reason lies in the fact that a single-industry town is a closed structure in which, as a rule, there are no special advantages for an investor in the form of labor, or excess capacity. In addition, there are personnel risks. If the city-forming enterprise is functioning, the hiring of workers in the market for new TOSER enterprises has to be carried out on a common basis, and therefore is not cheaper. In addition, the quality of labor-free workers at the city-forming enterprise is doubtful, because, as a rule, qualified personnel work at the city-forming enterprise, and those who could not meet the requirements of the industrial city-forming enterprise, organize their own business or leave the town in search of work in large settlements look for a job in the labor market. This means that people in a job search may not be suitable by qualification requirements for the newly opened production of TOSER of a single-industry town. Risks are not only high requirements to the level of qualification of workers in modern factories, but also the outflow of the population from single-industry municipalities, limited labor resources in single-industry towns, and the low level of entrepreneurial initiative of single-industry residents. Another risk (Tarasova & Rudneva, 2017) is due to the fact that cities with TOSER status can negatively influence neighboring municipalities, drawing resources, especially labor, from them, which leads to increased intermunicipal asymmetry. The problem of attracting investment in Russia is also significant. The demand for investors is so high and there are so few of them that it does not make much sense to build a new business in a troubled single-industry town, even if it has the status of TOSER: a new enterprise can also be organized in a large, prosperous city. A high entry threshold for investors, a narrow list of types of

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businesses allowed for TOSER can be listed as restrictions and problems of creation and development of TOSER in Russian single-industry towns. The problem, in particular, is that when forming and filing an application for obtaining the status of TOSER, the single-industry town needs to prepare a list of all investment projects planned for launch, and only their economic activity codes (OKVED - Russian Standard Industrial Classification of Economic Activities) will be included in the list of permitted by the government decree. The severity of the problem will appear when, for example, in six months, an investor with a different code of economic activity shows interest in a single-industry town. In this case, it becomes necessary to go through the same procedure again as for obtaining the status of TOSER (and this can last several months). So, in the Altai Territory, when analyzing the results of the operation of TOSER, created in the single-industry towns of Zarinsk and Novoaltaysk in March 2018, it turned out that the planned indicators for attracting residents and the volume of their investments in single-industry towns were determined even when applying for the creation of TOSER. Since the process of obtaining TOSER status is quite long, some of the potential residents refused to participate. Other investors submitted applications, but projects involve a smaller amount of financial investment in the creation of new enterprises.

Kachalov (2018) identifies the types of risk factors that appear in the process of creating a TOSER: incorrect selection of the totality of economic (or socio-economic) entities that are affected by the implementation of this program, the risk of circumventing or ignoring the restrictive measures provided for by regulatory acts; unlawful use of preferences by non-residents of TOSER, substitution of real economic policies with simulation measures (Kachalov & Sleptsova, 2017), violation of the deadlines for implementing the creation project activities, failure to achieve the targets planned in the draft by the single-industry town (in creating jobs, income level of resident enterprises, etc.), worsening of investment climate in the region and in the country.

We conducted a priori ranking of the characteristics of TOSER of single-industry towns by the degree of influence on the strengthening of factors of stable single-industry towns. Experts (scientists-economists, representatives of enterprises operating in TOSER of the single-industry town of Yurga, Kemerovo region) were asked to arrange the characteristics of TOSER of single-industry towns by the degree of influence on the emergence and strengthening of the factors of sustainable development of single-industry towns, as well as to supplement the list (if, according to the expert, it is incomplete). The factor, which (in the expert's opinion) has a more significant influence on the emergence and intensification of the factors of sustainable development of the single-industry town, is given the first place, the rest are given in decreasing order.

According to the degree of influence on the emergence and manifestation of factors of sustainable development of single-industry towns, factors (characteristics of a single-industry town and TOSER) are arranged in the following order (from larger to smaller):

1. Tax incentives for residents
2. Permitted activities
3. Requirements for the volume of capital investments
4. Platforms for investors
5. Requirements for the number of jobs

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6. Requirements for the volume of revenue from contracts with the city-forming enterprise
7. Requirement for a resident - not to be city-forming
8. Registration on the territory.

It should be noted that the results of such a ranking make it possible to formulate a list of risks according to the scheme: non-fulfillment (low quality of performance) of the declared indicators - characteristics of TOSER - risk of disruption of activities of the program for the creation and development of such TOSER in a single-industry town.

We ranked the risks of creating a TOSER in a single-industry town (table 01).

Table 01. Risk ranking of creation and development of TOSER in a single-industry town (on the example of Yurga, Kemerovo region

Expert	Risk, Challenge, and Limit Ranks**							
	1	2	3	4	5	6	7	8
1	1	5	4	7	6	3	2	8
2	2	6	5	1	7	4	3	8
3	2	5	4	6	7	3	1	8
4	2	1	5	6	8	4	3	7
5	2	3	1	6	7	5	4	8
Sum of ranks	9	20	19	25	35	19	13	47
Deviation of the sum of ranks from the average sum of ranks	-14.4	-3.4	-4.4	1.6	11.6	-4.4	-10.4	23.6
Deviation squares	207.36	11.56	19.36	2.56	134.56	19.36	108.16	556.96

*A priori ranking: experts (scientists, economists, representatives of enterprises operating in the TOSER of the monotown Yurga of the Kemerovo region) were asked to rank the risks according to their degree of influence, as well as to supplement the list (if, according to the expert, it is incomplete). The risk, which (in the expert's opinion) has a more significant influence on the creation and development of the TOSER of a single-industry town, is given the first place, the rest are given in descending order.

Average rank for 8 risks = 23.4

Concordance coefficient = 1.0 – high consistency of experts.

**Risks:

1. risks that the municipal single-industry entity will not be able to fulfill the criteria for creating a TOSER, in particular: to ensure the involvement of residents who confirm their readiness to implement investment projects;
2. risks that the municipal single-industry entity will not be able to fulfill the criteria for creating a TOSER, in particular: to provide residents with land and other property for the implementation of investment projects;
3. risks that the municipal single-industry entity will not be able to fulfill the criteria for creating a TOSER, in particular: to provide residents with the necessary resources, and in the case of existing infrastructural and other restrictions, develop measures to overcome them;
4. the risks that municipal single-industry entity will not be able to fulfill the criteria for creating a TOSER, in particular: justify the feasibility of creating a TOSER;
5. risks of excessive interference in resident business by government representatives;

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6. risks of disruption to the implementation of projects within the framework of the creation and development of TOSER of single-industry towns (high requirements for the level of qualification of workers in modern industries, outflow of people from single-industry municipalities, limited labor resources in single-industry towns, low level of entrepreneurial initiative of single-industry residents);
7. restrictions on the creation and development of TOSER in Russian single-industry towns - a high entry threshold for investors, a narrow list of types of businesses allowed for TOSER;
8. lack of qualified personnel.

Results of ranking by degree of influence (according to experts):

1. it is difficult to attract investors;
2. risks of disruption of project implementation (due to lack of resources, problems with infrastructure);
3. TOSER will not be able to provide land;
4. it is difficult to fulfill the criteria of TOSER and to obtain the status of TOSER;
5. risk of interference in the business of residents;

lack of qualified personnel.

6. Findings

6.1. Recommendations on the use of predicative analytics tools in risk management for creating and developing TOSER of single-industry towns

In the field of developing programs for creating and developing TOSER, it is necessary not only to introduce a culture of leadership in the processes of socio-economic transformation, but also tools for predicative analytics to ensure the validity of preventive anti-risk measures. Khasanov (2018) identifies types of predictive analytics: forecasting the present and shaping the future. In the first case, regularities are determined in the present tense, under existing conditions. In the second case, the identification of a new paradigm as a result of the accumulation of data on phenomena that are not typical for today takes place. Therefore, predicative analytics can not only predict, but also create data arrays and influence the situation in the future. A different methodology for collecting information is currently required for forecasting trends. Assumptions and scenarios should highlight risk and uncertainty. At the same time, it is important not only to formulate and define realistic assumptions, but also to use indicators that are subject to control, as well as uncontrolled variables that can only be tracked. In this regard, we propose to form data arrays that include not only statistical indicators generated by state statistics bodies in the process of making and implementing decisions on the development of single-industry towns. In many cases, data collected (or available), for example, by the tax inspectorate, police, banks, insurance companies, carriers, etc. can be used as predictor variables.

To anticipate risky events during the implementation of projects to create TOSER in single-industry towns, we propose the use of classification. Classification (Gutierrez, 2017) as a type of predictive analytics involves the use of answer options, divided into several categories (large, medium, small, for example). The classifier studies a set of indicators, including information about the response

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variable and predictor variables. With the help of staging (algorithm), combinations of variables associated with the answer are revealed. The set of indicators is a training set. Next, the algorithm explores new observations in which there is no information about the desired answer. The algorithm assigns a classification to new observations, based on the classification of the training set of indicators.

Classification methods are the method of nearest neighbors, decision trees that support vector machines, the naive Bayesian classifier, random forests. For large samples, approximate methods for finding nearest neighbors can be used. It should be borne in mind that the quality of the classification of nearest neighbors is determined by the number of neighbors, the metric of the distance between objects (Hamming metric, Euclidean distance, for example), the weight of neighbors. It is recognized that the method of nearest neighbors is simple to implement, well studied theoretically, amenable to interpretation. However, if there are a lot of features in the data set, this makes it difficult to select weights and cut off unimportant features. Decision trees are easily visualized, require a small number of model parameters, it is realistic to use both numerical and categorical features. However, the model allows only interpolation, but not extrapolation. The "random forest" method (Chistiakov, 2013) is based on the construction of many decision trees, each of which is constructed according to a sample formed from the initial training sample. In contrast to the classical algorithms for constructing decision trees (Breiman, Friedman, Olshen, & Stone, 1984; Quinlan, 1987), this method assumes that when constructing each tree at the vertex splitting points, a fixed number of randomly selected features of the training set are used. Это означает, что каждый лист дерева включает наблюдения исключительно одного класса. The naive Bayesian classifier (a set of classification algorithms that accept the assumption that each parameter of the classified variables is examined independently of other class parameters) can be quite accurate and can be used to filter in the field of predicting risk phenomena.

We determined the indicators and predictors proposed for the answer to predict the risks of implementation and achievement of the planned indicators of projects for the creation of TOSER in single-industry towns (see Table 02).

Table 02. Data for the classification of risks of implementation and achievement of the planned indicators of projects for creating TOSER in single-industry towns (fragment)

Sought answer	**Predictors**	**Predictor data source**
Number of residents of TOSER/volume of investments	OKVED codes in the TOSER creation program	The program (project) for the creation of TOSER (municipal authorities of the city)
	Benefits for residents (income tax)	
	Benefits to residents (property tax)	
	Benefits for residents (land tax)	
	PFR insurance premiums	
	SIF insurance premiums	
	FCMIF insurance premiums	
	VAT refund procedure	
	Inspections by supervisors (days)	City supervisory authorities
	Registration procedure (months)	municipal authorities of the city, statistics, expert assessments
	Infrastructure connection procedure (months)	
	Availability of resources in a single-industry town (number of procedures required to connect on an ongoing basis to the power supply system, units;	

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	length of period for obtaining permission to build industrial and (or) technological facilities, days; level of competition in the credit market, points; presence of administrative barriers and excessive regulation of business, points; the number of credit organizations operating in the territory, units; the number of branches of credit organizations operating in the territory, units, average monthly nominal gross salary of employees of enterprises and organizations in a single-industry town, rubles, share of the informal sector in total employment,%)	of entrepreneurs working in the city
	Land use benefits	
	The availability of qualified personnel in the city (labor force, structure of the employed population, average annual number of employees by type of economic activity, level of employment, unemployment rate)	Statistical bodies
	The presence and characteristics of infrastructure in the city (the amount of financing for the development of infrastructure from budgets of various levels, rubles; the number of constructed and commissioned infrastructure facilities, units; the density of public roads with hard surface, km; the share of free capacity of infrastructure facilities; total capacity of heat supply facilities put into operation, Gcal; total capacity of water supply facilities put into operation, cubic meters/hour; total capacity of wastewater disposal facilities put into operation, cubic meters/hour; total capacity of gas supply facilities put into operation, cubic meters/hour; total capacity of electricity supply facilities put into operation, MW; the share of completely worn out fixed assets by type of economic activity "Production and Distribution of Electricity, Gas and Water",%; the share of completely worn out fixed assets by type of economic activity "Transport and Communications",%; qualitative assessment of the level of significance of problems in the development of transport, energy, engineering, housing and social infrastructure in the development of a single-industry town (high, medium, low)*; free land for enterprises; housing commissioning volume)	Statistical authorities, municipal authorities, expert assessments
	The level of development of small and medium enterprises in a single-industry town (number of small and medium enterprises, units; structure of small and medium enterprises by type of economic activity; number of start-ups and spinoffs, units; number of employees in small businesses, people; number of small and medium-sized enterprises entrepreneurship per 10 thousand people, units; share of the average number of employees of small and medium enterprises (without external part-time workers) in the average number of employees (without external part-time workers) of all enterprises and organizations share,%; the share of tax revenues from small businesses in the revenue of the city budget, %)	
	Region's investment climate (rating)	National rating of the investment climate in the regions of the Russian Federation (Agency for Strategic Initiatives), rating of investment attractiveness of the regions of the Russian Federation (National Rating Agency), etc..
	The level of development of the production potential of a single-industry town (number of large and medium enterprises, units; structure of enterprises by type of economic activity; turnover of medium and large organizations per capita; volume of goods shipped per capita; investment	Statistical bodies, municipal authorities

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	in fixed assets; number of issued building permits; number of issued permits for commissioning; the total revenue of enterprises from the sale of non-oil products in the domestic and foreign markets; the share of small and medium-sized innovative companies in a single-industry town)	
	The level of diversification of the economy of the region, city (the number of organizations (enterprises) by type of economic activity; the share of gross value added in the total amount by region (city) by type of economic activity; per capita production rates for individual product groups; localization coefficients; Herfindahl - Hirschman index)	Statistical bodies, municipal authorities, calculated indicators according to statistics
	Scientific and technical potential of a single-industry town (number of personnel of enterprises and organizations engaged in research and development, people; share in the total number of personnel of enterprises and organizations engaged in research and development,%; number of graduated bachelors, specialists, masters, people; number of professional training institutions within a radius of 30 km from the city (cluster), units; number of engineers, people; number of scientists, people; availability, quantity and characteristics of laboratory equipment for R&D; incomes of universities from all sources per one scientific and pedagogical worker; indicators of financing fundamental research work (R&D), rubles; indicators of financing R&D, where the topics determined by the state task prevail, rubles; share of employees with higher education ,%; share of employees with secondary specialized education,%; number of employees with higher and secondary education, people).	Statistical bodies, municipal authorities

The presented predictors can be used in the classification to predict risks, not only if the planned indicators of the TOSER program are not fulfilled in the single-industry town, but also when risks are foreseen by potential residents in the decision-making process on the location of the enterprise in the city with a special status.

7. Conclusion

The presented results allow not only to form managerial decisions in the field of risk management for the development of TOSER of single-industry towns, but also develop the existing methodology for forecasting risks in the field of municipal and regional management.

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