

# On Issue of Algorithm Forming for Assessing Investment Attractiveness of Region Through Its Technospheric Security

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**Abstract.** The article examines the problematic aspects of assessing the investment attractiveness of a region associated with the consideration of methodological issues that require refinement from the point of view of its technospheric security. Such issues include the formation of a sound system of indicators for the assessment of man-made risk which has a particular impact on the level of investment attractiveness of the region. In the context of the instability of the economic situation in Russia, the problem of man-made risks assessing in the context of the regional investment attractiveness based on an integrated approach and taking into account such principles as flexibility, adaptability, innovative orientation has not only lost its relevance but was also transformed into one of the most important conditions for ensuring the effective management of all spheres of the regional activities. The article poses the classical problem of making decisions on the results of the assessment of the investment attractiveness of the region in a matrix format evaluating the utility function. The authors of the article recommended a universal risk assessment model with its subsequent synthesis into technospheric security for the comprehensive assessment of regional investment attractiveness. The principal distinguishing feature of the study results are the schemes for manipulation in the evaluation activity associated with the selection of the optimality criteria groups and models for their study. These iterations make it possible to substantiate the choice of the solution for preserving the technospheric security of the region, a field of compromises or an "ideal" solution to the problem of the regional investment attractiveness loss.

## 1. Introduction

Today, enterprises are perceived by investors not simply from the position of executors of the investment project, but from the point of view of the investment object, taking into account the territorial features of its location and possible man-made risks associated with the investment portfolio. Small and medium business is experiencing particular urgency in implementing measures to reduce man-made risks due to the difficulty with liquidity, limited orders and the maneuverability of capital. Moreover, the problems are aggravated by the aging of productive capacities in conditions of inadequate availability of funds and limited sources of financing for the implementation of planned measures to ensure its own technospheric security. At the same time, the existing level of business and investment activity of enterprises is insufficient to increase the production, intellectual and innovative potential of the region, which can provide the desired level of its investment attractiveness at a given level of technospheric security. In the conditions of an unstable and rapidly changing environment, the ability of managers of enterprises and executive bodies to correctly assess the existing environmental



situation in the region in real time and to take qualitative management decisions in order to minimize technogenic risks in the region is becoming especially topical. No less important is the long-term assessment of the effectiveness of the results of enterprises' activities. Without a clear strategy for the development of enterprises and the region is difficult to navigate in modern challenges and "tempting" proposals. However, the assessment of the technospheric security of the region for the investor is most often reduced to the use of a classic set of indicators placed on the website of the Russian Federal Service of State, rather than primary accounting, which, unlike the first, allows an objective assessment of the presence of internal risks and development reserves of the region.

Timeliness of evaluation results to the investor allows you to adjust the plan of measures to eliminate possible threats and prevent technogenic risks for the region. In addition, there is a lack of account of the environmental factor that significantly influences the level of technospheric security in the system of assessing the investment attractiveness of the region due to its impact on the processes of reproduction and functioning of all types of economic resources. Moreover, the low level of the company's environmental potential can have a very negative impact on the results of external monitoring and audit of the region's technospheric security. Despite the high production and financial performance of enterprises, a low level of technospheric security can reduce the market value of the enterprise and the investment attractiveness of the region in conditions of limited sources of financing with a high level of competition in the market. The foregoing emphasizes the relevance of modeling the system for assessing the investment attractiveness of the region through its technospheric security. The results of modeling allow to react in a timely manner to the uncertainties of the external environment and to adjust strategies, programs and plans for the further development of the enterprise and the region.

## 2. Literature Review

In domestic and foreign specialized literature, the system approach to the determination of the technospheric security of the region has received sufficient attention, which is emphasized by the high publication activity of this block in international and Russian bibliographic and reference citation bases. A high level of discussion activity around the raised problem of studying the region's investment attractiveness through its technospheric security in the scientific and theoretical environment exacerbates the problems of choosing a method for practice - a representative of the planning and economic and analytical services of enterprises, banks and other market participants. All market participants wish to minimize financial risks when forming their own investment portfolio when entering new markets and territories. The problem is explained by the complexity of choosing the most significant approach and the model for calculating a certain coefficient that claims to be an integrated one. Most theoretical authors agree on the need for a comprehensive evaluation of all the obvious and hidden factors that determine the direction of the development of the region. An integrated assessment is possible through the development of a composite (synthetic, integrated, etc.) indicator that includes all aspects of the region's development. According to the majority of scientists, the dynamics of the aggregate indicator of the technospheric security of the region allows us to signal in advance about possible technogenic risks, economic losses, or acquisitions, which in turn allows us to make timely management decisions aimed at preserving and multiplying existing reserves, rationally managing limited resources, Policy in the field of production, material support, environmental protection and vital activity of the population Region.

The theoretical and methodological basis of this study was the fundamental and applied scientific works of domestic and foreign authors in the field of ecology, technospheric security, economic theory, statistics and investments. To justify the results of the research, methods of economic and mathematical modeling, elements of resource and system approaches, statistical methods were used. Summarizing the results of the study of theoretical and practical material on available printed and electronic resources, it can be concluded that it is advisable to conduct appropriate research in the field of integrated assessment of the investment attractiveness of the region.

### 3. Theoretical model

The results of approbation of the recommended universal model for assessing the investment attractiveness of the region will make it possible to increase the level of indicators and timeliness of taking managerial, anti-crisis and other measures to prevent man-made risks and preserve business in the region. With regard to the peculiarities of the Tyumen region, we propose to allocate five blocks of investment attractiveness of the region: industrial and technological; property; financial; ecological; social. We propose to allocate an ecological block as an independent block, not in the context of an industrial-technological block, since a modern production enterprise needs to pay due attention to measures aimed at reducing the environmental impact of production factors, on the one hand, and take into account the effect of environmental pollution on production potential, accelerating wear and premature failure of the main production assets, on the other. We introduce the following notation:  $t = \overline{1, T}$  - period of time (observation);  $l = \overline{1, L}$  - directions of investment capital allocation (technological or reproductive structure of capital investments);  $j = \overline{1, 5}$  - blocks of the socio-economic component of the region's investment attractiveness;  $F_t$  - Integral criterion for assessing the investment attractiveness of the region in the  $t$ -th period;  $\beta_t$  - socio-economic component of the region in the  $t$ -th period;  $Risk_t$  - a risk-weighted average component of the region's investment attractiveness in the  $t$ -th period;  $Risk_{jt}$  - risk assessment of the  $j$ -th block for the  $t$ -th period;  $\lambda_j$  - the importance of the  $j$ -th risk assessment block, given expertly;  $VAP_t$  - the added value of the product (value added product) in the  $t$ -th period;  $Ilt$  - volume of investments in the  $l$ -th sphere in the  $t$ -th period;  $X_{ijt}$  - value of the  $i$ -th indicator of the  $j$ -th block in the  $t$ -th time period. Deterministic model of the integral criterion for assessing the investment attractiveness of the region:

$$F_t = \frac{\beta_t}{Risk_t} \rightarrow \max_{1 \leq t \leq T} \quad (1)$$

We propose to present the economic component with the ratio of the added value of production to the volume of investments reduced by the amount of inflow of money resources by depreciation deductions as part of the cost of production:

$$\beta_t = \frac{\sum_{i=1}^T VAP_t - AO_t}{\left| \sum_{l=1}^L I_{lt} - AO_t \right|} \rightarrow \max_{1 \leq j \leq m} \quad (2)$$

Next, we form the matrix of indicators for each of the five allocated blocks in the model for assessing the investment attractiveness of the region. The sources of information for developing evaluation criteria with the choice of the optimal solution from the initial compromise list were information from the Federal Service for State Registration, Cadastre and Cartography (rosreestr.ru), the Federal State Statistics Service (www.gks.ru), the Federal Service for Ecological, Technological and Atomic (Www.gosnadzor.ru), the Federal Service for Supervision in the Sphere of Nature Management (www.rpn.gov.ru), the Federal Service for Supervision of Consumer Rights Protection and Human Welfare (www.rospotrebnadzor.ru), The Ministry of the Russian Federation for Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters (www.mchs.gov.ru). In this regard, the risk component for assessing the level of aggregate risk of investment attractiveness of the region is calculated as the weighted average of the risk for each allocated block using the following formula:

$$Risk_t = \sum_{j=1}^5 Risk_{jt} \lambda_j \rightarrow \min_{1 \leq t \leq T} \quad (3)$$

where is  $Risk_{ijt}$  the normalized value of the  $i$ -th risk assessment index of the  $j$ -th block in the  $t$ -th time period:

$$R_{ijt} = \begin{cases} \frac{X_{\max i} - X_{it}}{X_{\max it} - X_{\min it}}, \\ \frac{X_{it} - X_{\min t}}{X_{\max it} - X_{\min it}}, \end{cases} \quad (4)$$

The first part of the equation (4) is used to estimate the indicators, the increase of which is positive (for example, the increase in output in kind), the second part is used to estimate the indicators, the increase of which has a negative effect (for example, the increase in mortality rates of the population of the region caused by technogenic risks ).

$$Risk_i = \frac{\max_{1 \leq t \leq T} \frac{R_{ijt}}{\frac{1}{nm} \sum_{i=1}^n \sum_{j=1}^m R_{ijt}}}{\sum_{t=1}^T \frac{R_{ijt}}{\frac{1}{nm} \sum_{i=1}^n \sum_{j=1}^m R_{ijt}}} \rightarrow \min, i = \overline{1, n}, j = \overline{1, m}. \quad (5)$$

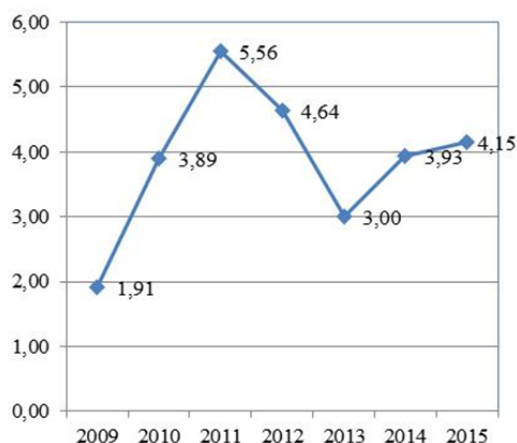
When applying the econometric device, it is expedient initially that those indicators ( $X_t$ ), expressed by cost units, lead to a comparable level in dynamics through discounting ( $q$ ):  $X_t \neq const$  ;

$$q = const ; X_t^{comparable \text{ price}} = \frac{X_t^{comparable \text{ price}}}{(1+q)^t}.$$

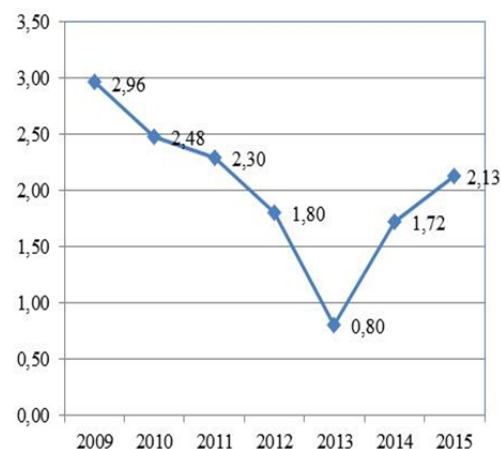
As a discount factor ( $q$ ), we accept the level of the key rate of the Central Bank of the Russian Federation, the price index of enterprises - producers of goods or consumer services, which allows us to indirectly assess the hidden level of inflationary phenomena and expectations. The ratio of risks of the equation (5) determines the proportion of the maximum risk ratio (volatility, volatility, instability) of the block to the average level of risk of the corresponding evaluation unit.

#### 4. Results of approbation

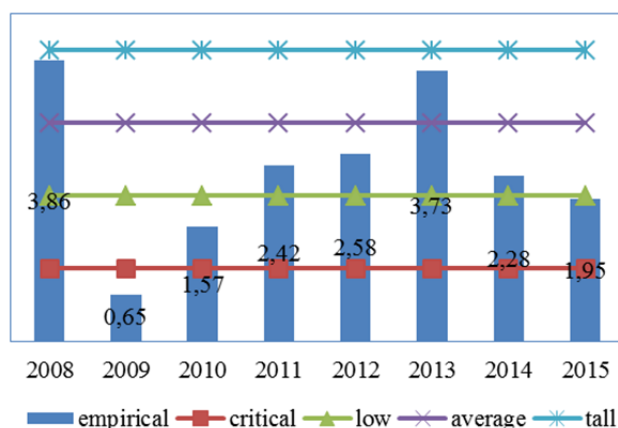
The results of the simulation have been tested in the Tyumen Region for a seven-year observation period. The model has features of universality, and the rating scale, according to the authors of the article, is accessible and understandable to the user. The management of one of the Tyumen enterprises that entered the survey, subsequently turned to the technical task to assess the current level of the technospheric security of the enterprise and its investment attractiveness in the market, in connection with the planning of entering a major contract. Since the presented evaluation algorithm is universal, it can be adapted to assess the investment attractiveness of a subject of different levels.



**Figure 1.** Dynamics of the economic component of the model.



**Figure 2.** Dynamics of the risk component of the model.



**Figure 3.** Dynamics of the integral criterion of investment attractiveness taking into account technospheric security in the Tyumen region.

Since 2013, the region has actively started to develop a new segment of the construction sector for the region - the demolition of the dilapidated and emergency fund in order to free space in the central part of the cities under modern construction. This segment entailed the growth of corresponding technogenic risks for selected blocks of investment attractiveness of the region. The integral criterion for assessing investment attractiveness, taking into account the technospheric security in the Tyumen region, has declined from 3.73 to 1.95 points over the past three years, which is largely due to external factors rather than internal ones. Since 2015, the situation on the construction materials market is deteriorating sharply in view of the decline in business activity in the contract housing market of the Tyumen region. In this connection, we observe a "chain reaction" of the fall in the efficiency of using the region's material and labor resources in the industrial-technological block. With a year behind, there is a worsening of the indicators in the financial and social blocks. At the peak of the housing boom in 2005-2008, the Tyumen Region showed a social and economic component at the level of 3.0-4.1 points with an average level of the risk component. Top managers of the enterprises of the industry and construction industry have faced since the beginning of 2014 with the lack (or minimal level) of demand for industrial and construction products in the region over the past three years. The fall is largely due to macroeconomic factors (sanctions, unsanctions, austerity strategy at all levels of the Russian economy, a drop in household incomes, a "overheating" in the real estate market, etc.). The

existing production facilities and a limited fleet of special equipment do not allow the region to take part in the complex construction of the urban microdistricts released from the dilapidated and emergency fund and restore the level of business activity at the pre-crisis level in the coming years. At the same time Tyumen enterprises are able to increase the turnover of working capital and financial sustainability within the framework of diversification of their own production programs and reduce the likelihood of man-caused risks of various nature with minimal costs. Under the conditions of import substitution, Russian defense enterprises were re-qualified for civil engineering products, which is why there is a saving in investment portfolios on domestic supplies. Recommendations on the possibility of an expanded reproduction of the existing material and technical base of the region and a more reasonable use of its property potential will allow enterprises in a limited period to reduce the cost of purchasing imported goods, giving preference to their own producer. According to the Russian Federal State Statistics Service, only for the period from February 2016 to February 2017 in the Tyumen region, imports amounted to \$ 7 billion, of which 86% fell on the article "machinery, equipment and equipment," and 63% of the chinese manufacturer. When implementing an innovative scenario for the development of the region in the conditions of diversification of production programs by its enterprises, the integral value of the criterion for assessing the investment attractiveness of the Tyumen region will grow in 2017-2018 up to 3.75 points.

The authors of the article tried to formulate a universal evaluation algorithm with the demonstration of the results of its testing in the conditions of limited printed materials of this publication.

## 5. Conclusion

On the one hand, the results of assessing the investment attractiveness of the region, taking into account its technospheric security, provide the investor with an opportunity to minimize the risks of a different nature, starting from the idea and design of the project, ending with the stage of liquidation of the result of the project. On the other hand, any investment project should bear not only commercial efficiency, but also budgetary, social and social. The latter directly depend on the level of technogenic security in the region, in which the investor came, who often forgets about the "makeweight". The results of the research confirm the objectivity of the conclusions that the region (society, population) can and should monitor and manage the social, economic and risk components of its own investment attractiveness. This approach should acquire special significance for Russian business at the present stage of forming an active civic position of the society. The application of the iteration method and the modeling of trends in the construction of an integral criterion for assessing the investment attractiveness of the region makes it possible to make informed and timely managerial decisions both at the level of the investor and at the level of executive bodies.

Since the integral criterion takes into account the impact of all spheres of activity of the region and society, it is possible to state with full confidence that an integrated assessment of the region's investment attractiveness, taking into account its technospheric security, meets the requirements of complexity, systemic nature, provides interpretation of the results and the formation of meaningful conclusions on them. The model allows you to assess the attractiveness in dynamics, to identify trends and weak positions in the region and to respond in a timely manner to internal and external challenges.

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