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Holistic Approach to Managing Socially Secure Development of a Regional Socio-Economic System

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Abstract

This paper considers the matters of regional governance and how it can be improved in social and economic aspects to ensure that people have a socially secure life. The insights highlighted here have been aggregated through a holistic research study that includes a theoretical framework and methodological results with regard to the posed problem and determines the goal setting. We clarified the concept of the socially secure development of a regional socio-economic system and elaborated a methodology for quantifying the state of human resources when the socially secure development of a regional socio-economic system is managed. We present an economic and mathematical description of a management model that ensures socially secure development of a regional socio-economic system, and developed and tested an algorithm for managing the development of a regional socio-economic system based on the proposed tools. In this study, we used general scientific methods, as well as economic and mathematical methods, including regression analysis. To quantify the unstructured information, we applied artificial intelligence technologies. The results of the study were tested on the case study of St. Petersburg, the federal city of the Russian Federation. In particular, we proved that the construction of a logistics hub as a major infrastructure project would influence the core of the social security of this region in the near future.

Keywords: management, regional socio-economic system, social security, human resources

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Комплексный Подход к Управлению Социально Безопасным Развитием Региональной Социально-Экономической Системы

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Аннотация

Статья посвящена вопросам совершенствования управления регионами в социальном и экономическом аспектах для обеспечения социально безопасной жизнедеятельности населения. В ней агрегированы отдельные наработки автора и в этом смысле предложено целостное законченное исследование, включающее как теоретические основы, так и методические результаты применительно к решаемой проблеме, что характеризует целеполагание исследования. Так в работе уточнено понятие социально безопасного развития региональных социально-экономических систем; сформирована управленческая модель обеспечения социально безопасного развития региональной социально-экономической системы; разработана методика квантификации состояния человеческих ресурсов в контексте управления социально безопасным развитием региональной социально-экономической системы; приведено экономико-математическое описание управленческой модели обеспечения социально безопасного развития региональной социально-экономической системы; разработан и апробирован алгоритм управления развитием региональной социально-экономической системы на основе предложенных инструментов. В исследовании использованы как общенаучные методы, так и экономико-математические, включая регрессионный анализ. Для квантификации неструктурированной информации применены технологии искусственного интеллекта. Результаты исследования апробированы на примере субъекта РФ – города федерального значения Санкт-Петербурга. В частности, доказано влияние на ядро социальной безопасности данного региона строительства в ближайшей перспективе логистического хаба, как крупного инфраструктурного проекта.

Ключевые слова: управление, региональная социально-экономическая система, социальная безопасность, человеческие ресурсы

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1. Introduction

Regional economics traditionally deals with the problems of economic territorial development (Gutman, 2021). Studies on the digitalisation of regions (Yanovskaya et al., 2022) and the ecological state of territories (Liu et al., 2022) have become increasingly important. However, the development of regions is not only about the targets for the growth of the economic potential and competitiveness of a particular territory or strengthening technological advancement, including the use of technological innovations for environmental protection. The social environment of the regional system and related matters of social security are equally important (Li et al., 2021), the same as healthcare (Rodionov et al., 2022) and education. The development of the economic and social components of the region in its traditional sense does not yet mean that the functioning regional system is secure (Zaytsev et al., 2021). Security matters also concern the environment where the population of the region lives, and business is done and is of particular importance for society. According to international statistics, growing crime, suicide, and alcoholism are observed in economically and socially developed countries. Such consequences should be taken into account when territories are governed in the context of social security. In addition, the primary measure of the social security of a regional socio-economic system should be the personal security of the people in this system. This aspect is very important today for any country, as demographic problems are aggravating, resources are limited, and the influence of the social environment on the economy is growing.

2. Literature review

A literature review on the problems of the socially secure development of regions highlights the following.

First, there are a number of research studies concerning the sustainable development of territories that assign an important role to social sustainability (as a basis for social security) in connection with economic and environmental sustainability. For example, Yang Ding et al. (2014) applied a modified method for assessing coordinated regional development on the example of Hubei Province in China. The authors focused on the simultaneous stimulation of economic growth, social well-being, and preservation of the environment. Waidelich et al. (2022) proposed a science-based approach towards the creation and further development of a regional innovation ecosystem focused on the future of the economy and society in the Northern Black Forest.

This study examined the problems of sustainable agricultural development in Anhui Province in China (Liu et al., 2022). The authors relied on the theory of systems and considered three subsystems in relation to each other—economy, society, and environment. The study resulted in two models. The first model can be used to assess the coordination of interactions between the three subsystems of regional agriculture. The second model is helpful for identifying the factors that prevent sustainable development: use of pesticides, lack of achievements in agricultural science and technology, use of agricultural plastic film, lack of technical training schools for farmers, and a small share of animal husbandry. An empirical study by Pan and Misha (2022) assessed the security of sustainable livelihoods in 30 districts of the Indian state of Odisha. A composite index used in the assessment includes an environmental safety index, a social justice index, and an economic efficiency index. The authors included the following indicators in the social justice index: female literacy, student–teacher ratio in primary school, dropout rate in primary school, sex ratio, electrified households, households using clean fuel for cooking, households with improved sanitation and drinking water, and infant mortality rate. The study used a min–max normalisation method. As a result, the districts were grouped in terms of their level of sustainability.

The above-mentioned findings directly relate to the social aspect of the ESG concept. However, in some studies, this aspect is observed indirectly through the influence of economic or environmental aspects (increasing number of jobs, improved public health). For example, the work by Xiaoa et al. (2022) empirically justifies the growth in green development in Hubei Province after 2014 and the reduction of regional differences. The relationship between the balanced economic growth of regions and environ-

mental pollution caused by industrial emissions was demonstrated in another study (Sueyoshi and Goto, 2014) conducted on sample prefectures in Japan. According to the authors, environmental problems can be solved if we invest more in technological innovations. Marine spatial planning (MSP) is the subject of another study dedicated to the regional development of the "blue economy" (Erkkilä–Välimäkia et al., 2022). This study is based on a survey of MSP members representing coastal fisheries in the Satakunta region of Finland. The survey focuses on three main topics: regional cooperation and synergy, conflicts, and threats, and interest in regional cooperation or setting up secondary enterprises. The authors indicated that MSP processes and the growth of a sustainable "blue economy" are part of regional development that require equal playing conditions and mutual trust between stakeholders.

According to Cui et al. (2022), it is possible to protect the environmental security of cities and simultaneously achieve social justice, including better quality urban environmental services and improved well-being of city dwellers. The study was conducted using the example of Wuhan (China). Marin (2021) analysed the concept of urban resilience in terms of the socio-technical markers of sustainability models and the position of Latin America in the production of knowledge related to sustainability. This work considers the problems of closed sustainability modelling and the gap between the northern and southern parts of Latin America in the production of knowledge.

Second, some studies have investigated the organisation of regional governments from the perspective of the social development of a territory and the social security of its population. For example, Chinese scientists (Wang et al., 2023) proposed a model of system dynamics that studies the relationships between water resources, energy, and food in the context of political goals for the development of a territory (a case study of Hunan Province). The time horizon of the modelling is from 2021 to 2035. The model focuses on the environmental aspect and allows regional authorities to shape a compromise policy within the framework of intersystem interactions and social effects. Another work demonstrated that the creation of economic opportunities for territorial development by the government stimulates the growth of culture and provides support for the values of the indigenous population of the Kativik region in the north of Quebec, thereby improving their quality of life (Jacobs, 1985). Uribe-Sierraa et al. (2022) considered the problems of functional regionalisation that contribute to the creation of corporate territories, which is beneficial for business but harmful to the population and the environment. The study concerns the activities of mining enterprises in Latin American countries on an intra-national and interregional scale, using a territorial and environmental approach. This proves that uneven development prevails on an interregional scale, which makes some regions isolated, impoverished, and subjected to environmental damage. One of the authors' key proposals is that a comprehensive policy should be developed to mitigate the processes of territorial inequality and the subsequent reconfiguration of power.

Halonen et al. (2022) focused on forest bio-economics in Eastern and Northern Finland. The authors examined the ways in which regional development actors interpret dominant forest-related policies and reproduce or challenge forest-related discourses. They extensively examined the dependences between macroeconomic policy and regional development and the uncertainties caused by the practical implementation of the policy, as well as conflicts and balance of powers between policy, practice, and the actors behind them. Critical discursive analysis was used as the research method. The authors concluded that conflicts arise due to the disharmony between policy and regional needs, cultural clashes, and misunderstanding of regional prospects. Troisia et al. (2019) proposed a model of meta-management in territorial ecosystems. The empirical study touched on a specific case of the Italian non-profit association *Libera*, which fights organised crime. The study results in the elaboration of a service ecosystem that includes *Libera*, its members, and the territory. The authors show an approach to solving one of the social security problems in the region.

Third, some studies have aimed to identify the factors that influence the social security of territories, as described below.

1) Environmental factors: The problems of water security and health of indigenous American Indians are considered in the work by (Mitchell, 2019).

2) The impacts of the COVID-19 pandemic on the economic and social consequences for communities of fishermen at Oxbow Lake (Bar) due to reduced fish catch were analysed by Samad et al. (2022).

3) Political factors. Analysing 91 Spanish, French, and British colonies, as well as former colonies from 1820 to the present day, Schmitt (2015) demonstrated that the colonial legacy is a crucial factor in explaining the adaptation and form of social security programmes outside the OECD. In terms of political tension, Batniji et al. (2009) considered the problems of social security of Palestinians in occupied territories and suggested that international levers be used to influence the situation. Heydemann (2020) investigated the relationship between the state and society after the Arab uprisings in the Middle East and North Africa in the context of the possibilities provided by a social contract as a tool for reducing social threats.

4) Legal factors: Guarantees of secure land ownership as a social opportunity for people were the subject of a study by Valkonen (2021). The author pointed out that the sources of security spring from land policy and are connected with the relationships between government authorities, state policy, social dynamics, and ownership.

5) Psychological factors. De Backer (2022) analysed the factors that bind young people to a certain territory from the perspective of their social security. Ellis et al. (2020) considered the problems of the emotional security of children who stayed in territories that used to be controlled by the ISIL. This work proves that such children need systemic therapy.

6) Technological factors. Ustugova et al. (2016) assessed the problem of collecting and processing information about the state and development of the city environment using geo-information technology. They described the process of analysing people's social preferences and providing support in decision making when development problems in city districts are managed. In particular, the authors referred to the development of bicycle and pedestrian routes as an element of a healthy lifestyle that reduces social tension. The authors proposed CityRoutes, a specialised application for computer devices.

7) Geographical factors. In the concept of geographical development, Deng et al. (2022) highlighted the differentiation characteristics, diffusion state, and convergence mode as elements that underlie the investigation of specific regional development and affect, among other things, the social security of a region.

Based on this literature review, the theory of regional economics clearly lacks works that characterise territories, taking into account their socially secure development. Hence, the ***purpose*** of this study is to improve the methodological approach and tools for managing the socially secure development of regional socio-economic systems (using the example of St. Petersburg, the federal city of the Russian Federation). The main idea of the study, which is focused on the elaboration of management tools, is connected with the hypothesis of the influence of the population's responses, expressed in socially dangerous acts, on the socio-economic policy implemented by the government authorities of the region.

3. Materials and Methods

This study systematises the authors' exploratory work (Karpenko, 2021a; Karpenko, 2021b; Rodionov et al., 2021a; Rodionov et al., 2021b). As a synergy of scientific, theoretical, and methodological results on the problems of socially secure development of regional socio-economic systems, the research combines the following interconnected elements arranged in a logical sequence (with the methodology described for each element).

1. Clarification of the term "socially secure development of a regional socio-economic system" using the following algorithm of actions. First, based on the analysis of the definitions of "region" and "socio-economic system", we identified the essential features of these concepts. Second, we determined whether the essential features of the terms "region" and "socio-economic system" were reflected fully and completely in such definitions. Third, we proposed our original definition of a "regional socio-eco-

nomic system", which includes all the essential features of the concepts of "region" and "socio-economic system". Fourth, we identified the main social security and selected indicators for measuring it. Lastly, we summarised the results obtained into our ideal definition of a regional socio-economic system.

2. Formation of a management model for socially secure development of a regional socio-economic system. This model includes 1) centroid, core (human resources), 2) input factors characterising the current socio-economic state of the regional system as a result of management decisions of the regional government authorities, and 3) a system of resultant indicators reflecting the social danger of the region. Using analysis and synthesis methods for processing the data from normative legal acts and scientific literature, we select the indicators to be included in the model and propose a graphical image of the model.

3. Development of a methodology for quantifying the state of human resources for managing the socially secure development of the regional socio-economic system. This involved 1) assessment of the primary and complex characteristics of tonality regarding the state of the regional socio-economic system; 2) measurement of the human resources' response to the state of the regional socio-economic system; and 3) estimation of the indicators of the emotional gap of the information unit. The methodology was automated with Python programming language and implemented in the following sequence. First, we searched for and aggregated information. Second, we processed the aggregated information. The source of reactive information is the social media *VKontakte*. The news information hub is the community *St. Petersburg Vesti* (officially registered media that covers news information of regional significance only, unifies the most communicatively active audience, and generates a significant amount of reactive content). The tonality of the news and reactive information was evaluated using the Dostoevsky tool library. The approbation was carried out using the example of the federal city of St. Petersburg.

4. An economic and mathematical description of the management model for the socially secure development of the regional socio-economic system, which is based on regression analysis. This was partially implemented in MS Excel and IBM SPSS, with the following quality criteria for regression models:

i) The significance of the models was assessed using the F-test, with a limit value of the criterion being 0.1 or 10%;

ii) The quality of the model was primarily determined by the volume of the explained variance of an endogenous variable, which is indicated by the coefficient of determination (R2);

iii) The significance of the relationship between the endogenous variable and the exogenous variables included in the model was determined by the p-significance of each variable (the limit value was 0.2 or 20%);

iv) The applied quality of the description of the variance of an endogenous variable by the variance of exogenous variables was determined by a variety of potential indicators, namely, the average approximation error, standard deviation, characteristics of structural outliers and structural breaks, etc.;

v) The most significant binary criterion for the quality of the regression model was a logical justification for the direction of action of an exogenous variable on an endogenous one.

The official statistics for the city of St. Petersburg for 2008-2020 are used as source data.

5. Development and testing of an algorithm for managing the development of a regional socio-economic system that is based on the proposed tools and consists of three stages. In the *first stage*, we predicted that the key indicators of input influence identified during the regression analysis would change. In the *second stage*, the predicted value of the gap in the positive tonality of the information environment of the regional socio-economic system was estimated based on the regression equations. In the *third stage*, we selected decisions aimed at the socially secure development of regional socio-economic systems and offered a set of recommendations. The subject of the approbation is the federal city of St. Petersburg. The purpose of the approbation was to assess the expected impact of a logistics cluster on

the core of the region's social security.

The research used general scientific methods and economic and mathematical methods of regression analysis.

4. Results

In what follows, we consider the results of each of the five elements of the study outlined in the Methods.

Results for the first element: A key concept of the study—socially secure development of a regional socio-economic system—was clarified. This is important for further scientific and methodological work. For this, we analysed over 20 of the existing definitions and identified the essential features of concepts such as "region" and "socio-economic system" as elements of the concept of a "regional socio-economic system" (Figure 1).

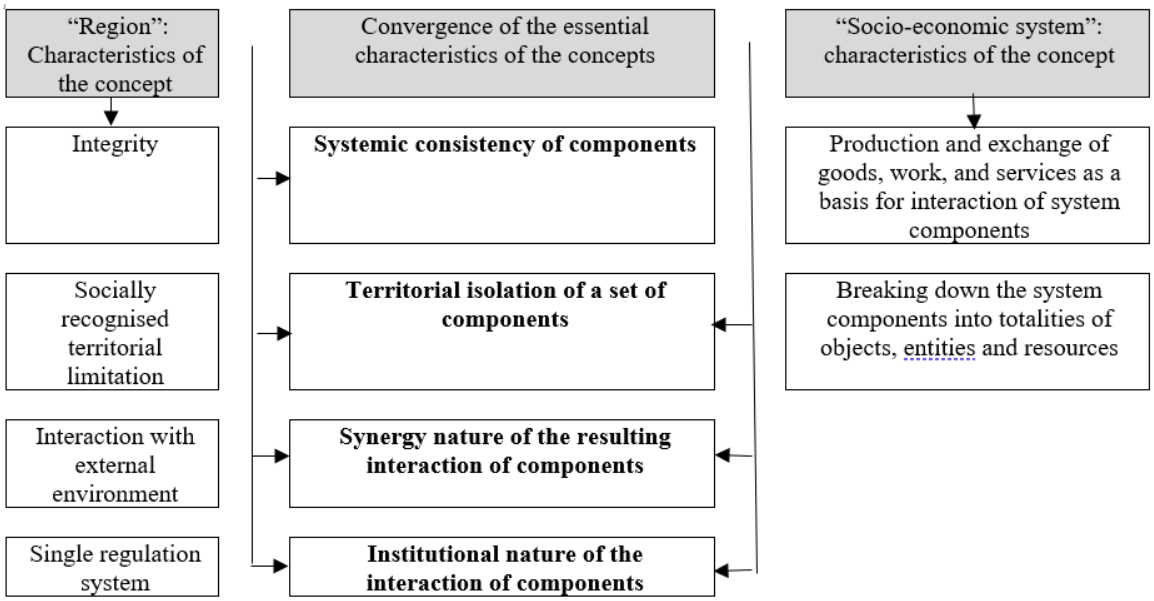

Figure 1. Convergence of essential features of the concepts of "region" and "socio-economic system"
compiled by the author

Further, the existing definitions of the term "regional socio-economic system" were analysed to identify all their essential features. We have demonstrated that the extant literature lacks a comprehensive definition of the term. We propose the following interpretation: A regional socio-economic system is understood as a socially recognised geographically limited integral set of systemically related entities and resources that are united in institutions, interact within the synergy of production and exchange of goods, work, and services and have a single regulatory system. We then singled out the main ideas in the scientific definitions of social security, in particular homeostasis (preservation) of society (Buzan et al., 1993), human risk management (Frevel, 2013), and self-sufficiency of the state in the social sphere (Doyle, 1994).

Given all the iterations, we propose the following definition: Socially *secure development of a regional socio-economic system* is such a change in the state of the system, in which the growth of economic indicators results in increased social security of the population of the region, being the basis for achieving a high quality of life. At the same time, we should highlight the core of the social security of the population of the region, which is the absence (low level) of threats to personal security (crimes against persons), and prevention of threats of a sharp loss of social status (in particular, due to unemployment).

Result for the second element: A management model of the socially secure development of a regional socio-economic system is aggregated. The model focuses on human resources (the region's pop-

ulation). Table 1 shows the relationships embedded in the model. Input factors have an external impact on human resources that characterise the current socioeconomic state of the regional system as a result of management decisions taken by the regional government authorities.

Table 1. A set of indicators of input influence (compiled by the author)

No.	Indicator	Symbol	Units
Environmental factors			
1.	Emissions of harmful (polluting) substances into the atmospheric air from automobile transport	N_1	tons
2.	Investments in fixed assets aimed at environmental protection and rational use of natural resources (protection of atmospheric air)	N_2	thousand rubles
3.	Investments in fixed assets aimed at environmental protection and rational use of natural resources (protection and rational use of water resources)	N_3	thousand rubles
Production factors			
1.	Use of production capacities	P_1	%
2.	Gross regional product (GRP) per capita	P_2	thousand rubles
Infrastructural factors			
1.	Automobile transport (buses)	I_1	units
2.	Automobile transport (cars)	I_2	units
3.	Length of public roads	I_3	km
Social factors			
1.	Number of students in general education institutions that provide catering	S_1	people
2.	Share of healthcare institutions using the Internet in the total number of healthcare institutions	S_2	%
3.	Real accrued wages as a percentage of the corresponding period of the previous year	S_3	%

In turn, how the population reacts to regional governance can be traced if we use a system of resulting indicators of a low-level nature (Table 2), reflecting the social danger of a region (crimes, suicides, unemployment). The low-level indicators reflect the immediate reaction of the population, which can be monitored continuously online and used in managerial decision-making.

Table 2. A set of the resulting indicators (compiled by the author)

No.	Indicator	Symbol	Units
1.	Number of crimes registered in the reporting period under Article 105 of the Criminal Code of the RF (Homicide)	R_1	units
2.	The number of crimes registered in the reporting period under Article 111 of the Criminal Code of the RF (Intended Bodily Harm)	R_2	units
3.	The number of crimes registered in the reporting period under Article 131 of the Criminal Code of the RF (Rape)	R_3	units
4.	The number of crimes registered in the reporting period under Article 213 of the Criminal Code of the RF (Disorderly Conduct)	R_4	units
5.	The number of deaths by major classes and individual causes of death per 100,000 (Suicide)	R_5	people
6.	The number of deaths by major classes and individual causes of death per 100,000 (Cases of Alcohol Poisoning)	R_6	people
7.	Total number of unemployed according to the ILO methodology	R_7	people

The input and output indicators are selected considering the current Decree of the President of the Russian Federation dated February 04, 2021 No. 68 “On assessing the efficiency of senior officials (heads of the highest executive bodies of state power) in the subjects of the Russian Federation and executive government authorities of the subjects of the Russian Federation”. The strategy of socio-eco-

nomic development of the region and the scientific publications dedicated to the assessment of the state of regional socio-economic systems were considered. Thus, the connection of regional socio-economic policy with the state of the social environment of the region is made through the response of the population. The above set of indicators is aggregated into a management model (Figure 2).

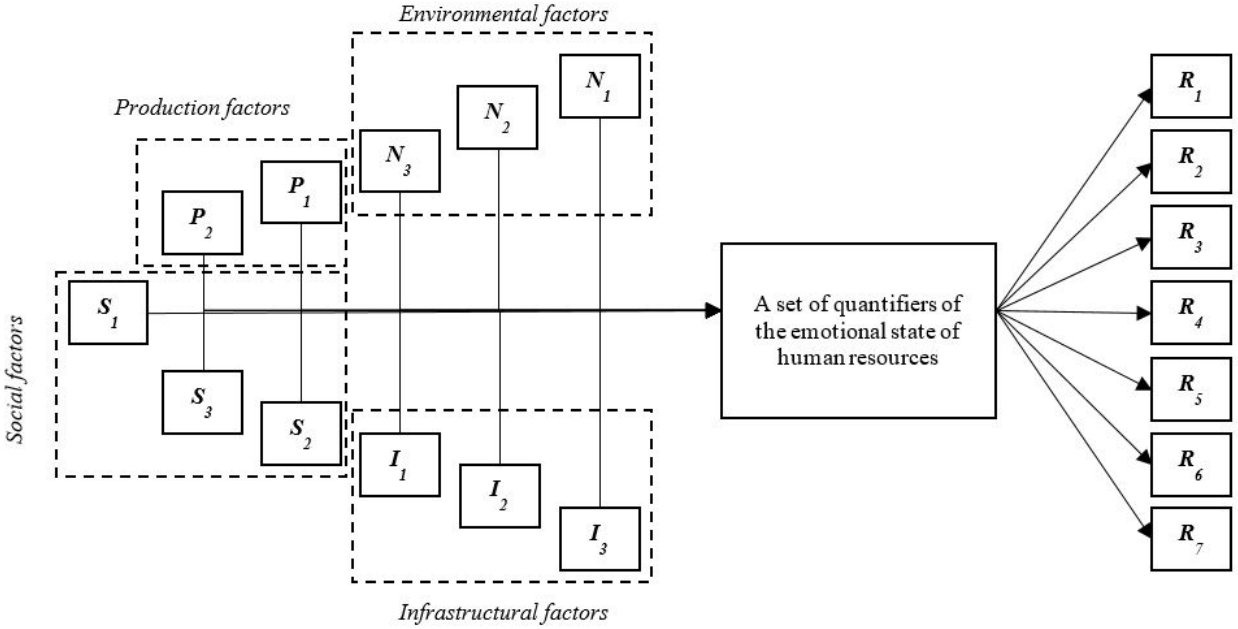

Figure 2. The management model of the socially secure development of a regional socio-economic system

compiled by the author

The central element of the model is an aggregate of quantifiers that measure the impact of management decisions on human resources in the region. These quantifiers can be aggregated based on an analysis of the comparative state of the population's communications in the region. The model can be used to determine how management action on the development factors of regional socio-economic systems indirectly influences the change in the resulting development indicators related to the core of the region's social security.

Results for the third element: A methodology was developed for quantifying the impact that management decisions about regional development have on the information environment generated by the region's population, given social security.

The study highlights the emotional characteristics of human resources as indicators of the responses that the region's population makes to management decisions that change regional development. We propose the following method of their quantification: 1) assess the primary and complex characteristics of tonality as applied to the state of the regional socio-economic system; 2) evaluate the response of human resources to the state of the regional socio-economic system; and 3) calculate the emotional gap indicators of the information unit (Figure 3). The methodology uses mathematical techniques and natural language processing (NLP) methods. Rodionov et al. (2021b) described the methodology in more detail.

The methodology was automated using the Python programming language as follows: stage 1 – search and aggregation of information; stage 2 – processing of aggregated information. The source of reactive information is the social media *VKontakte*. This information resource was chosen due to its width of coverage, which is, on average, 90% at the regional level.

The methodology was tested on the example of the federal city of St. Petersburg. The city was chosen because it demonstrates the significant information activity of the digital media and has significant network coverage of the population. The *Vesti Saint Petersburg* community was selected as a hub of

news information. It is officially registered mass media that provides only news information of regional significance and concentrates on the most communicatively active audience, which results in significant amounts of reactive content.

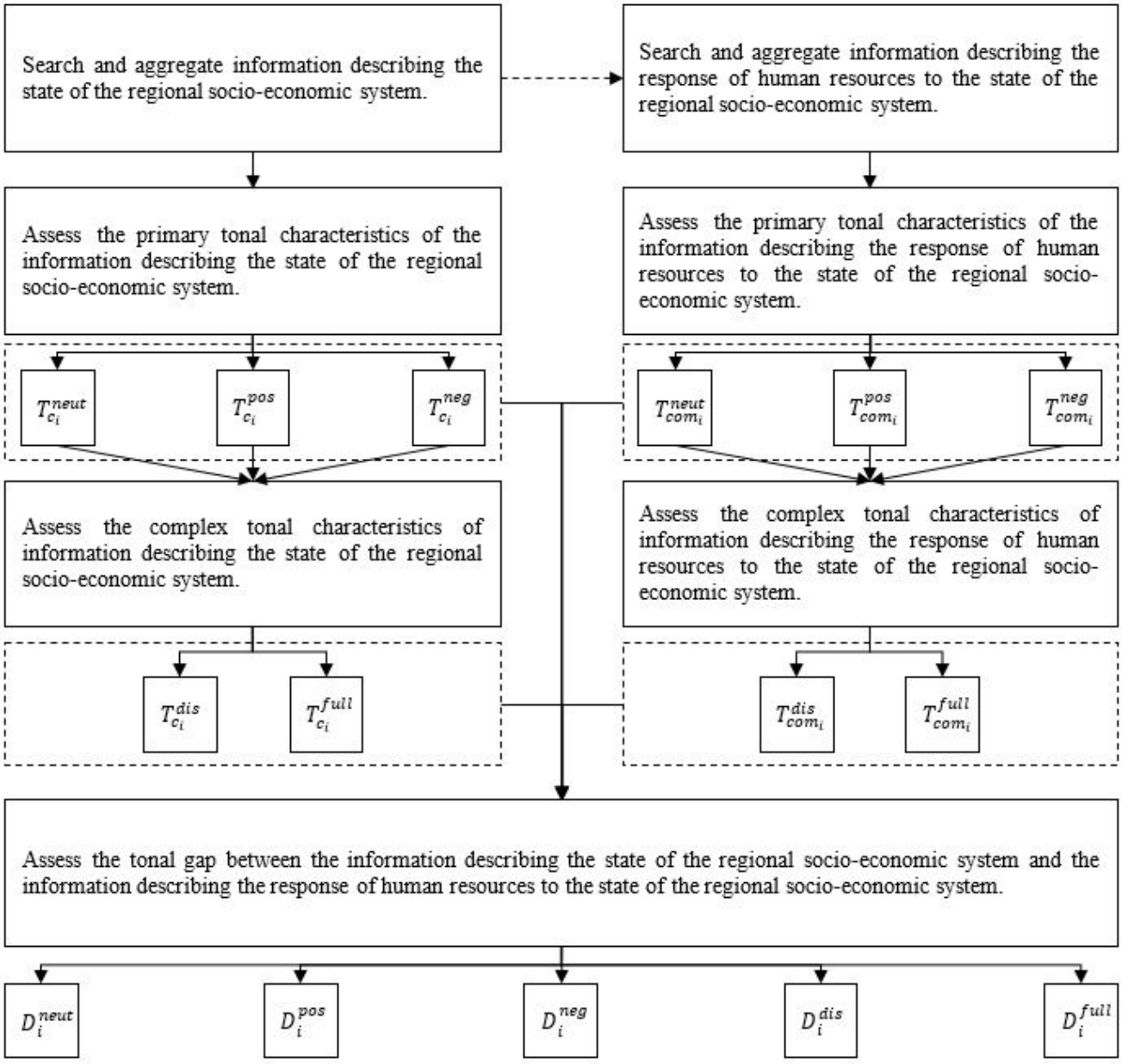

Figure 3. Methodology for assessing the impact of the state of the regional socio-economic system on the information environment generated by human resources

compiled by the author

The presented algorithm was applied to the selected web community, and 56 thousand information units were obtained. The Dostoevsky tool library was used to assess the tonality of the news and reactive information, after which a single data frame was formed. It contains both the tonal characteristics of the source information and indicators of the tonal gap. The results obtained were averaged for the purposes of searching for and describing regression relationships. This methodology, which is based on the extraction of up-to-date information generated by human resources on social media and automated through the Python programming language, can be used for continuous online monitoring of the impact that management decisions have on human resources in the region.

Results for the fourth element: We propose a quantitative tool for implementing the management model of the socially secure development of a regional socio-economic system. For this purpose, we

worked out a system of regression equations that are inscribed in the model (Figure 2). Thus, a mathematical interpretation of the model (Figure 4) is provided for the federal city of St. Petersburg.

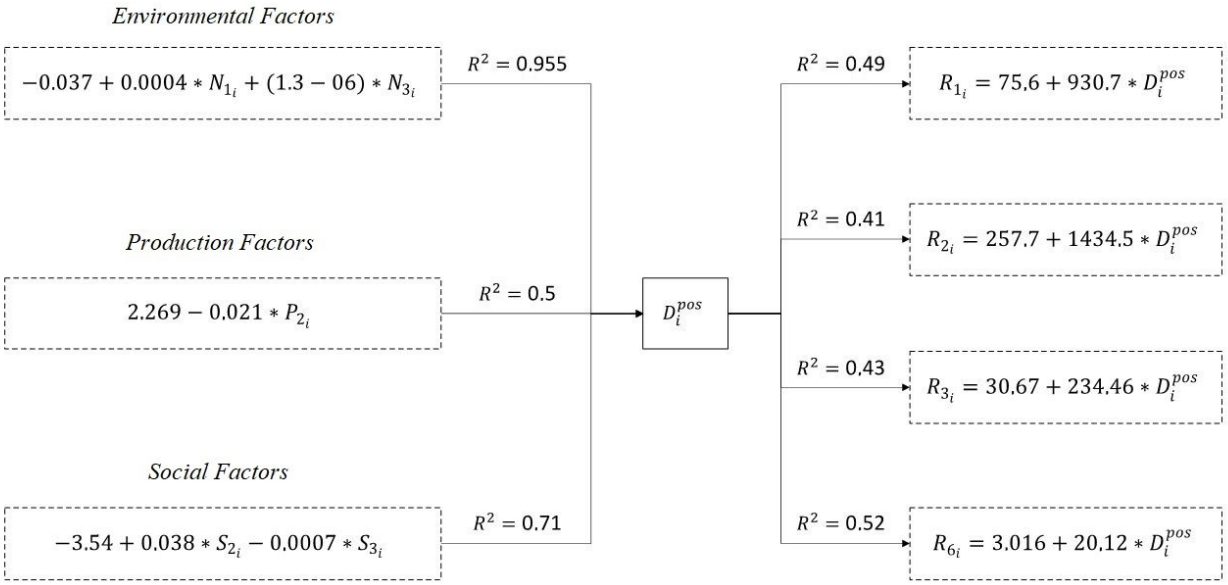

Figure 4. Formalisation of the management model of the socially secure development of the regional socio-economic system

compiled by the author

According to the results of the system of regression equations, the highest quality was achieved when the gap in the level of positive tonality of the information environment was used as a centroid (endogenous variable); therefore, the study presents the analysis of this variable only. The formalised model allowed us to interpret the mutual influence of social, environmental, production, and infrastructural factors of regional socio-economic systems, to establish a hierarchy of the factors in terms of the significance and variability of the management results and to differentiate management decisions given the regional specifics and the level of social security.

Results for the fifth element: Based on the method of online monitoring and evaluation of management decisions, an algorithm was formed for managing the development of regional socio-economic systems, given their social security. Managing the development of regional socio-economic systems implies two processes: analytical and generative. In the analytical process, the tonal gap indicators are continuously monitored, taking into account the information environment of the regional socio-economic system. In turn, the generative process influences the continuous formation of a set of decisions aimed at the development of the regional socio-economic system. Hence, the following control algorithm is proposed (Figure 5).

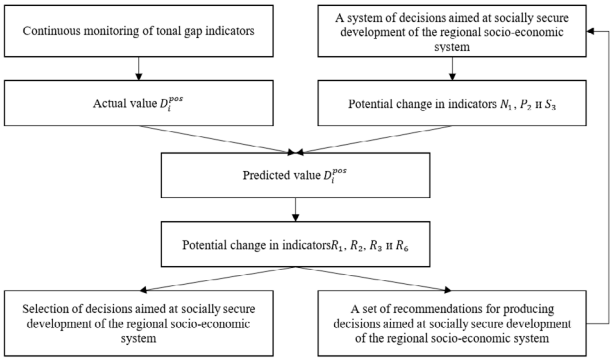

Figure 5. Algorithm for managing the socially secure development of regional socio-economic systems

compiled by the author

The management process includes three stages.

First stage. To assess the potential effectiveness of the analysed decisions, we predicted the change in the key input influence indicators, which were identified during the regression analysis: GRP per capita (P2), emissions of harmful (polluting) substances into the atmospheric air (N1), and real accrued wages as a percentage of the corresponding period of the previous year (S3). Further, we determined the hierarchy of these indicators using the coefficient of determination and the modulus of elasticity. For comparative purposes, we used a weighted approach grounded in the average percentage of change in the base value of the indicator. As a result, we formed a rating, where the indicator with the highest value of the significance coefficient had the highest position, and the indicator with the lowest value of the significance coefficient had the lowest position (Table 3).

Table 3. Conditional rating of input influence indicators

compiled by the author

No.	Influence indicator	Coefficient of determination	Modulus of Elasticity	Average percentage of change	Coefficient of indicator significance	Indicator conditional rating
1	P_2	50	16.6	0.87	954.02	1
2	S_3	71	0.52	3.23	11.43	2
3	N_1	95	1.008	19.24	4.98	3

Second stage. The predictive value of the gap in the positive tonality of the information environment of the regional socio-economic system was estimated on the basis of the previously formed regression equations. The result of the prediction illustrates the impact of the proposed system of decisions on the human resources of the region. The conversion of this change is based on the change in the key resulting indicators of the development of the regional socio-economic system that determines social security.

Third stage. We selected decisions aimed at the socially secure development of regional socio-economic systems and proposed a set of recommendations.

The algorithm we built for managing the development of regional socio-economic systems allows us to continuously monitor the effectiveness of decisions, select from these decisions, and formulate a set of recommendations to clarify the content of decisions aimed at the development of regional socio-economic systems and ensuring the social security of such systems. The algorithm was tested on the example of the regional socio-economic system of St. Petersburg. We assessed the influence that the logistics cluster is expected to have on the core of the region's social security. To determine the changes in the above input influence indicators (Table 3), we used a heuristic approach. We assume that the following changes in these indicators are possible.

The indicator of gross regional product (GRP) per capita is a complex indicator. The development of the logistics cluster means the involvement of many participants, from logistics companies to universities and research institutes. This complexity is expected to produce a synergistic effect that can significantly influence the indicator. Therefore, we should consider a change in this indicator, given the possible alternatives, and assume that the change may range from 0.1% to 0.3%.

The indicator of real accrued wages as a percentage of the corresponding period of the previous year is a pure economic indicator. The increment in this indicator is determined by the increase in demand for skilled labour. The cluster will stimulate such demand, which will also make the indicator of real accrued wages grow from 0.1% to 0.3%.

If the initiative is undertaken, the indicator of emissions of harmful (polluting) substances into the atmospheric air will increase, which will invariably have a negative impact on the regional so-

cio-economic system. However, it can be assumed that better general logistics will prevent inefficient movement of goods, and the gradual development of vehicles powered by electric or hybrid traction will compensate for the overall increase in harmful (polluting) emissions. Thus, we can perhaps ignore the change in this indicator.

In accordance with certain potential changes in the key input influence indicators, we can establish that the actual value of the gap in the positive tonality of the information environment of the regional socio-economic system of St. Petersburg will change by a total of 1.7%. This change will reduce the number of crimes registered in the reporting period under Article 105 of the Criminal Code of the Russian Federation (Homicide) by 1.054%, the number of crimes registered in the reporting period under Article 111 of the Criminal Code of the Russian Federation (Intentional Bodily Injury) by 0.714%, the number of crimes registered in the reporting period under Article 131 of the Criminal Code (Rape) by 0.85%, and the number of deaths by major classes and individual causes of death per 100,000 people (Cases of Alcohol Poisoning) by 0.799%. This example demonstrates the potential effectiveness of the proposed decision aimed at the socially safe development of the regional socio-economic system.

5. Discussion

The findings of this study are logical and consistent. The theoretical results are the basis for obtaining practical scientific results. The study focused on one aim of investigating the socio-economic regional system from the perspective of its social security. This aspect is analysed via the prism of the state of human resources. It is a human being that is the end recipient of the regional socio-economic policy, and it is he who expresses his attitude to what is going on around, doing this unconsciously through his reactions and thus influencing the social situation in the region. The main message of the region's socio-economic policy is to improve the quality of people's lives. Ensuring social security in the region is one of the conditions for implementing this message. It is one of the key ideas of this research study that is put into practice with specific tools.

The state of human resources has been evaluated using non-structured information from social sources, which is not very common in economic scientific research and is usually grounded on structured financial and non-financial information, for instance (Xiaoa et al., 2022: Wang et al., 2023). This information was quantified (turned into quantity expression) using Python. Artificial intelligence technologies have allowed us to include continuous online monitoring of the state of human resources in the management model. Progressive technologies are increasingly utilised to obtain scientific results. For example, Ustugova et al. (2016) applied geo-information technology. However, most studies use traditional economic and mathematical tools for modelling processes (Halonen et al., 2022; Samad et al., 2022). Quite often, researchers work out integral indicators (Pani and Mishra, 2022) that offset some specific features of individual economic entities. To justify the results obtained, given the growing flow of information, we should move to tools that combine classical methods and modern technologies.

The question of selecting input and output indicators for the management model may be debatable in this study. The input indicators are included in four groups: environmental, industrial, infrastructural, and social. The number of indicators is limited in each group (2–3 indicators) and does not fully reflect the state of regional development in each area. This is done so that the model is correct, while these very indicators have been chosen due to their universality, regardless of the specifics of the region and their connection with human resources (the central element of modelling). In the future, input indicators may have to be selected, considering the specifics of a particular region, but this will be another study with a different purpose. In this study, the model was tested on the example of the federal city of St. Petersburg because the development of human resources in this region is a showcase due to a serious scientific and educational base. In this respect, it is one of the reference subjects of the Russian Federation. The resulting indicators were selected due to their low-level nature, which is important in terms of the speed of management of human resources' responses to the socio-economic policy pursued in the region. However, not all social problems common to today's society are included in the modelling with indicators that characterise them. Thus, there are good prospects for improving the management model of the socially secure development of

the regional socio-economic system. It is important that such problems be studied by the scientific community (Troisia et al., 2019) so that practical solutions needed by the state and society are elucidated.

6. Conclusion

The findings of the study present the following conclusions:

1. To manage the socially secure development of regional socio-economic systems in an effective way, we need methods that combine traditional approaches and modern technologies based both on the analysis of statistics and non-structured data from the internet about the activities of the region (reactionary and news components).

2. This study proposes a management model for the socially secure development of a regional socio-economic system based on a comprehensive methodological approach. It presents a methodology for quantifying the impact of management decisions on human resources in the region and on social security. Quantitative tools were developed for modelling, and an algorithm for using these tools was suggested. The tools were tested on data about a specific region.

3. The suggested methodological provisions can be used in the process of managing the development of regional socio-economic systems for evaluating and choosing management decisions, given their impact on the core of the social security of the region's population.

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