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СТРАТЕГИЧЕСКОЕ УПРАВЛЕНИЕ ИНТЕЛЛЕКТУАЛЬНЫМ КАПИТАЛОМ В ИНТЕРЕСАХ ИННОВАЦИОННОГО РАЗВИТИЯ РЕГИОНА

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Аннотация.
В статье раскрываются управленческие аспекты формирования и использования интеллектуального капитала региона, имеющие стратегический характер в интересах его инновационного развития. Целью работы является разработка методических рекомендаций по управлению интеллектуальным капиталом в интересах инновационного развития.
Для этого авторы предлагают подход к определению стратегии управления интеллектуальным капиталом на основе оценки интеллектуального капитала и его компонентов, определения сценариев и выбора стратегии. В качестве методов исследования использованы методы сравнительного и системного анализа, линейного масштабирования, расстановки приоритетов, сценарного планирования. Визуализация результатов расчетов произведена с использованием программного пакета пространственного моделирования GeoDA.
Предложенные наработки апробированы на данных 72 регионов России, для которых разработаны рекомендации по определению сценария формирования и использования интеллектуального капитала и по выбору стратегии управления интеллектуальным капиталом в интересах инновационного развития.
Предложенный подход отличается методом оценки, подразумевающим оценку не только уровня интеллектуального капитала, но и степени сбалансированности его структурных компонентов, что в виде двух основных критериев ложится в основу матрицы выбора стратегии управления интеллектуальным капиталом и позволяет учесть особенности взаимодействия человеческого, структурного и отношенческого капиталов каждого рассматриваемого субъекта. Согласно полученным результатам исследования сценарий формирования и использования интеллектуального капитала для большинства российских регионов определен как основанный на системообразующем компоненте в виде человеческого капитала. Выявлено, что большая часть регионов характеризуется средним уровнем интеллектуального капитала и низкой сбалансированностью структурных компонентов, что определяет целесообразность разработки рекомендаций по управлению интеллектуальным капиталом на базе стратегии активной поддержки.
Полученные результаты могут быть полезны для представителей региональных органов власти, отраслевых министерств и ведомств для определения стратегий управления интеллектуальным капиталом в интересах инновационного развития.
Дальнейшее развитие исследований может быть направлено на построение системы количественной оценки влияния интеллектуального капитала и сбалан-

сированности его структурных компонентов на результаты инновационного развития регионов.

Ключевые слова: интеллектуальный капитал региона; инновационное развитие региона; оценка интеллектуального капитала; человеческий капитал; структурный капитал; отношенческий капитал; стратегии управления интеллектуальным капиталом

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INTELLECTUAL CAPITAL STRATEGIC MANAGEMENT FOR REGIONAL INNOVATIVE DEVELOPMENT

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Abstract.

The article is devoted to the issue of intellectual capital management in the interests of innovative development of the region. The purpose of the work is to develop methodological recommendations for the management of intellectual capital in the interests of innovative development.

To do this, the authors propose an approach to defining an intellectual capital management strategy based on an approach to assessing intellectual capital and its components, scenarios and a strategy selection matrix. Methods of comparative and system analysis, linear scaling, prioritization, scenario planning was used as research methods. Visualization of the calculation results was performed using the GeoDa spatial modeling software package.

The proposed developments were tested on data from 72 regions of Russia, for which recommendations were developed to determine the scenario of formation and use and the choice of an intellectual capital management strategy in the interests of innovative development.

The proposed approach differs in the method of assessing intellectual capital, which implies an assessment not only of the level of IC, but also of the degree of balance of its structural components, which, in the form of two main criteria, forms the basis of the matrix for choosing an intellectual capital management strategy and allows taking into account the peculiarities of the interaction of human, structural and relational capitals of each subject under consideration. According to the results of the study, the scenario of the formation and use of intellectual capital for most Russian regions is defined as based on a system-forming component in the form of human capital. It is revealed that most of the regions are characterized by an average level of intellectual capital and a low balance of structural components, which determines the feasibility of developing recommendations for intellectual capital management based on an active support strategy.

The results obtained can be useful for representatives of regional authorities, line ministries and departments to determine strategies for managing intellectual capital in the interests of innovative development.
Further development of research can be aimed at building a system of quantitative assessment of the impact of intellectual capital and its balanced structural components in the results of innovative development of regions.

Key words: intellectual capital; innovative development; assessment of the level of intellectual capital; human capital; structural capital; relational capital; intellectual capital management strategy

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1. Introduction

Regional management system is a multi-element totality of social and economic relations and processes management systems. One of the key tasks of the management subject, i.e., public authorities, is to ensure efficient use of available tangible and intangible resources in order to achieve regional economic growth, increase prosperity and competitiveness in modern conditions. Intellectual capital, being the object of management and one of the main resources of innovative development, requires a systematic approach to management. However, it is limited by the lack of a sufficiently developed scientific and methodological base, as well as empirical, practical results of the implementation of approaches to regional intellectual capital (RIC/ICR) management. The questions of explicit identification of RIC, its measurement and use as a full re-source of development remain open.

Given the above, the aim of the work is to develop methodological recommendations for managing intellectual capital in the interests of innovative development. For this purpose, the work offers approach to assessment of intellectual capital and its components, matrix of intellectual capital management strategy choice.

Reviewing the various interpretations of the concept of «intellectual capital», many of which relate to the corporate intellectual capital, we can conclude that most scientists are inclined to its interpretation as a set of knowledge, skills, employees and intangible assets that create added value and increase the welfare of stakeholders.

Considering the development of views on the intellectual capital of the region, it is possible to identify several areas of research – an assessment of intellectual capital and its functioning in the context of regional clusters.

Among the works devoted to the evaluation of IR we can distinguish two directions:

1. Theoretical and methodological research aimed at finding a way to measure the IR itself.

These include, for example, the works of Ante Pulic, who considers in his research the issues of measuring IC through the definition of intellectual value added, the approbation of the approach covered the regions of such countries as Croatia, Slovenia, Hungary, Czech Republic and Poland [Pulic, A. 2000]. Klaus North and Stephanie Kares, who developed a methodology for measuring the degree of backwardness of regions in the use, management and reproduction of IC [North K., Kares S., 2011].

A study on the research of IC as a factor of economic growth in the region and the development of a mechanism based on the assessment of indicators of the state of structural components of IC, authored by P.Y. Makarov [Makarov P. Yu., 2015].

The research project of Albert A. Angehrn, considering the issues of reproduction of IC in the field of human capital (CHK) and offering a way to change the vector of "innovative" behavior of people [Bontis N., 2004].

M. Marhaichuk and I. Zhuchkovskaya propose to consider the processes of distribution of IR regions. To do this, the authors propose a model based on the provisions of percolation theory [Markhaichuk M., & Zhuckovskaya I., 2019] and an approach to assessing the national IC of D. Andriessen and K. Stam, when each component of the IR is considered from three points of view: assets, investments and effects [Stam C, Andriessen D., 2009]

A team of authors from China conducted a study on the assessment of the regional intellectual capital (RIC) of Chinese provinces. This approach is based on multi-criteria decision-making methods: Delphi method, GDANP method, TOPSIS method [Liu C., Li K., Jiang P., Li D., Su. L., Lu S., & Li A., 2021]. Comparing the ratings of China's provinces by the level of RIC and GRP, the authors revealed a positive correlation [Liu C., Li K., Jiang P., Li D., Su. L., Lu S., & Li A., 2021].

In the work of A. Chursin, A. Yudin, P. Grosheva, an approach to the assessment of IC regions of Russia is revealed, based on determining the predisposition of regions to transition to a new technological order, the advantage of the approach can be considered the classification proposed by the authors, according to which, depending on industrial and technological specialization, the type of IC is defined as extractive, monoinclusive, multiinclusive [Angehrn A. A, 2011.].

T. Dyr and K. Zhukowska evaluate the IC of the regions of Poland using the method of assessing information capabilities (Z. Hellwig`s method)) [Angehrn, A. A.].

P. Pachura, T. Nitkevich, K. Matlovichova and R. Matlovich proposed an approach to the assessment of the IC region based on the method of analysis of the functioning environment or ASF (DEA), which allows you to build distance functions describing the effectiveness of IR [Pachura, P., Nitkiewicz, T., Matlovičová, K., & Matlovič, R., 2018]

To assess the IC region using the index method, the authors T. Ostashchenko and I. Dubina consider its index as an average assessment of such aggregators as "the intellectual potential of the region, the intellectual capital of the region and the innovative activity of the region" [Ostashchenko, T.V., Dubina I.N., 2020].

S. Grudina's work reveals the concept of "intangible capital of the region" related to the concept of "intellectual capital of the region" and the process of rent formation from the use of this type of capital [Grudina, S.I., 2020]

A group of Spanish scientists represented by D. Pena, J. Navarro, V. Lopez consider IC as a managerial prism for studying the phenomenon of smart cities. As a result of applying the approach to the assessment of 26 Spanish cities, the authors came to the conclusion that access to intangible resources and benefits is distributed more unevenly across territories than access to elements of material infrastructure [Nevado Peña, D., Alfaro Navarro, J.L. i López Ruiz, V.R., 2017].

Many authors attempt to study the impact of IC on the economic growth of the region.

In their work, Qun Zeng, Zhenhai Tang and Chunnian Liu described the relationship they studied between the RIC and the indicator of economic development of the region for 14 Chinese cities of Guangxi Province. The results of the analysis of the constructed regression model showed a positive correlation between the level of IC and GRP of the region, where structural capital (SC) has a greater influence on the resulting indicator [Qun, Zeng, ZhenHai, Tan, Chunnian, Liu, 2021].

P. Veselinovich and M. Veljkovich base their research on the search for links between the human resource, which acts as a carrier of IC, and the economic development of regions, which is somewhat different from the most popular among researchers' triune system of IC and tends more to the concept of the re-

gional human development index [Veselinović P. & Veljković M., 2011].

Liu, C., Li, X., & Xu, L. when assessing the RIC, four elements are distinguished in its structure: HC, SC, relational capital (RC) and innovative capital – which form the consolidated indicator of the RIC. Of interest are the results of the correlation analysis of the RIC level and the regional economic growth indicator, demonstrating a positive correlation explaining 29.9% of GDP growth [Liu, C., Li, X., & Xu, L., 2014].

Currently developed approaches and models for assessing IC at the national level also influence developments aimed at the meso-level. Among the authors studying approaches to the assessment and management of IC at the national level are N. Bontis, P. Ståhle and A. Pöyhönen, D. Weziak, whose works are devoted to the assessment and analysis of IC of Arab countries, Finland, European Union countries, respectively [6; 20; 25]. Recent studies include works on the measurement of national IC authored by Yu. Paszko, which allocates HC, social and environmental capitals in the structure of the NIC, uses the TOPSIS method to diagnose variables describing the identified components on data from EU countries [Paszko, J.], 2020.

It is also possible to cite a study by S. Stan, in which the author presents the results of a correlation analysis between the variables of intangible resources and Romania's GDP. At the same time, as intangible resources, the author allocates HC, SC, RC and innovative capital, which often act as elements of IC in the interpretations of other authors [Stan, S.E., 2018].

2. Research aimed at analyzing and evaluating the practical experience of IC management at the level of regions and countries.

For example, a study by Dmitry Korpakis, who describes and analyzes the practical experience of Lisbon in developing a state program aimed at improving the competitiveness of Europe in the field of IC and innovative development [Corpakis, D. A., 2011]. The research project of Jose Marti Maria Viedma, which presents a comparative analysis of the results "before" and "after" using the benchmarking method in the field of IC reporting and management in Mataro, Barcelona [Viedma, Marti Jose Maria, 2011].

Also, a practical model of IC reporting for Madrid J. Pomeda, K. Merino, S. Rivera and L. Villard, proposed in 2002 and focused not on the assessment of IC, but on the development of policy management tools in the field of intangible resource management [Pomeda, J. Moreno, C., Rivera, C., Villar, L., 2002].

From the analysis it is possible to define the intellectual capital of the region as an intangible resource of regional innovative development, formed and reproduced as a result of interaction of human, structural, relational capitals, which forms the basis of competitiveness and well-being of the territory in the transition to an innovative economy [Roze, N.Sh., 2021].

Structural components of intellectual capital interact with each other, reproducing spent resources and forming intellectual capital. Cyclical reproduction of intellectual capital of the region due to the triune structure determines the self-growing nature of its functioning and use in the interests of innovative development.

The identified features of formation and reproduction of intellectual capital in the interaction of its structural components should be considered as part of management model designing process. In this case, the concept of "intellectual capital management in the interests of regional innovative development" in this study means the impact of the subject of management represented by the authorized regional authorities on the processes of formation and use of intellectual capital and ensuring the balance of its components within the implementation of innovation policy to enhance their contribution to the results of innovative development aimed at satisfying the interests of innovative development.

Main part

2.1 An approach to the evaluation of intellectual capital structural components balance.

Based on the analysis of approaches to assessing IC, assess the algorithm for evaluating the impact of the level of intellectual capital in the processes of innovative development.

Determine the level of human capital of the region, the structural capital of the region, the relational capital of the region, using the system of indicators of the com-ponents of intellectual capital presented by the authors in previous studies [Roze, N.Sh., 2021].

Determine the level of intellectual capital of the considered region, using the method of volumes, namely, the calculation of the volume of a rectangular parallelepiped, which is formed by XYZ axes indicators, reflecting the levels of structural com-ponents.

Gradations and corresponding numerical values of the level of regional intellectual capital are determined on the basis of the method of natural boundaries. Criteria for assessing the level of intellectual capital are as follows:

- High level of intellectual capital – the value of the estimated index lies in the range of 0.25 and above.
- Average level of intellectual capital – value of calculated index lies in the range [0,045; 0,25].
- Low level of intellectual capital – the value of the estimated index lies in the range from 0.045 and below [Roze, N.Sh., 2021].

Evaluate the level of balance of the structural components of the intellectual capital of the region. Based on the results of an empirical study of the distribution of actual values of the calculated data, the structure of intellectual capital should be considered balanced if, as a result of the calculation of summary indicators of structural components at least one of the following conditions is met:

- the composite index of human capital ranges from 0.45 to 0.6;
- the composite index of structural capital ranges from 0.25 to 0.5;
- the composite index on the relational capital ranges from 0.3 to 0.55.

When, according to the results of the calculations of the summary indicators of structural indicators, their values do not correspond to the values lying in the specified ranges, which means that when none of the conditions is met, the structure of intellectual capital can be characterized as unbalanced [Roze, N.Sh., 2021].

Based on the ratio of intellectual capital and the level of balance of its structural components for the region under consideration it is necessary to define a scenario of formation and use of intellectual capital, and the most optimal strategy of behavior in these conditions, which will increase the efficiency of intellectual capital for innovative development.

2.2 Strategy of IC management for innovative development

Taking into account the aforementioned, as well as the results of the assessment of the level of intellectual capital and the balance of its structural components, we can identify several options for the behavior of the region in these scenarios presented in Figure 1, where the criteria of balancing the structural components of intellectual capital are on the ordinate axis, the level of intellectual capital in the region – on the abscissa axis. Thus, the field of co-ordinates is divided into 9 sectors, assuming the presence of 9 different strategies for managing the intellectual capital of the region in the interests of innovative development.

1. Sector I. The comprehensive growth strategy. The need for a comprehensive growth occurs when the level of intellectual capital is assessed as low, and none or only one condition of balance of its structural components is fulfilled, which leads to the strongest disproportion.

2. Sector II. The moderate growth strategy. In this case, the possible situations are characterized by a low level of intellectual

capital with an average balance of its structural components.

3. Sector III. The active growth strategy. It is characterized by the situation, when the level of intellectual capital remains low at a high level of balance of structural components. It can be connected with economic activity of the region and its industrial orientation.

4. Sector IV. The active support strategy. The situation when at the average level of intellectual capital, the balance of structural components remains low.

5. Sector V. The comprehensive support strategy. Strategies of support are characterized by a more positive situation, but limited opportunities to invest in the structural components of intellectual capital of the region.

6. Sector VI. The moderate support strategy. The case when the level of intellectual capital is estimated as average, and the balance of components as high, is one of the most favorable.

Sector VII. The active optimization strategy. These sectors are characterized by an imbalance in the direction of structural capital or human capital, so the second and third scenarios are most likely, when structural or human capital are optimized de-pending on the effects obtained earlier, or the scenario of passive build-up of structural components is implemented.

8. Sector VIII. The comprehensive optimization strategy. This strategy is used in a situation where a high level of intellectual capital, there is a risk of reducing the level of balance due to imbalance strategic structural component.

9. Sector IX. The moderate optimization strategy. The strategy of moderate optimization is suitable for regions that have built a mechanism of the most balanced structural components of intellectual capital of the region, and the main task in this case is to maintain the existing level of interaction and maintain a balance between the influence of structural components on the change in the level of intellectual capital.

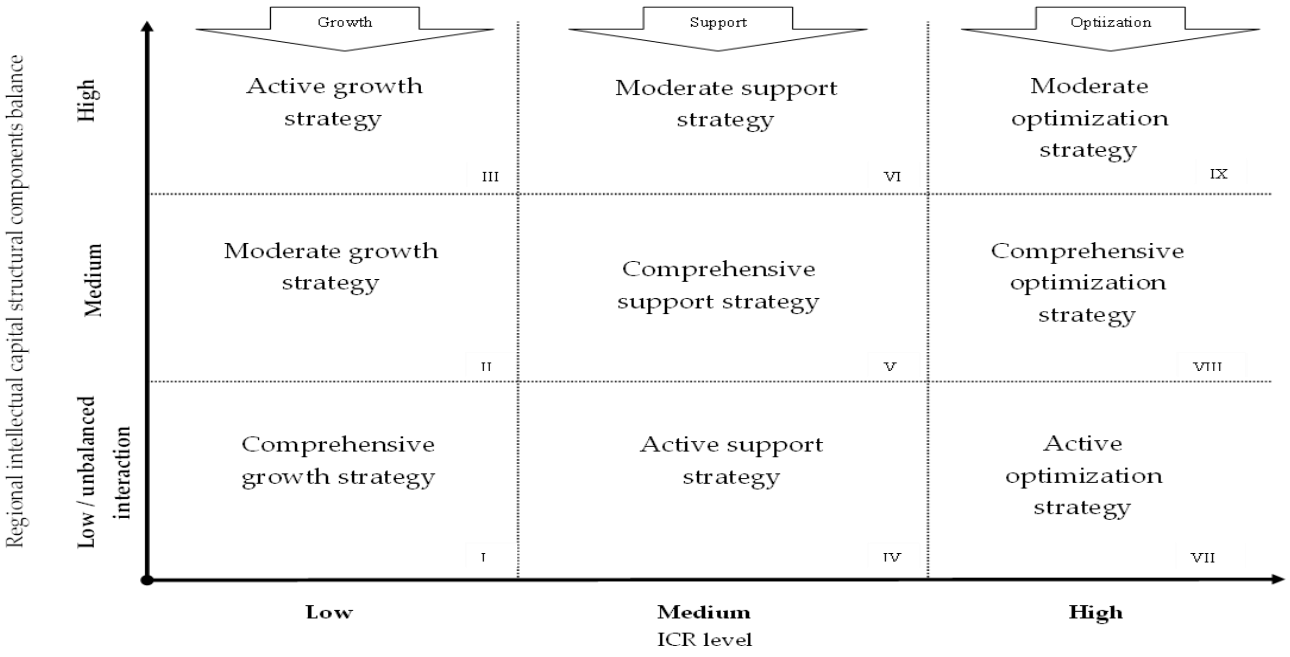

Рис. 1. Матрица выбора стратегий управления интеллектуальным капиталом в интересах инновационного развития

Fig. 1. Matrix for choosing strategies of RIC management for innovative development

3. Results and Discussion

The proposed assessment approach was tested on data from 72 regions of Russia for the period from 2000 to 2019. Figure 2 shows the maximum, minimum and average values of the composite index of human capital for the period under consideration. We can see that the maximum and minimum values often have multidirectional drops, which demonstrates the uneven distribution of human capital in the country.

Figure 3 shows the dynamics of changes in the maximum, minimum and average values of the composite index of structural capital for 20 years.

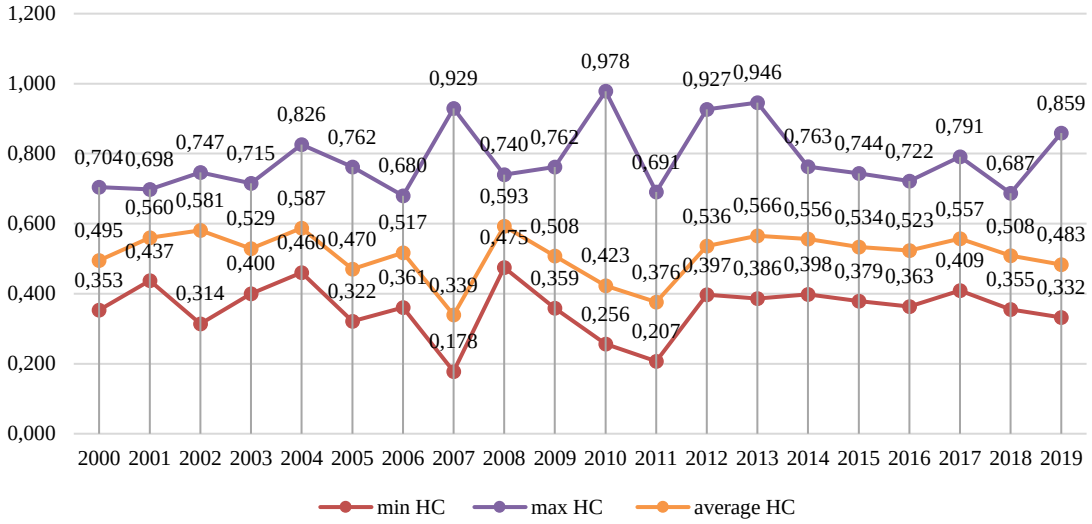

Рис. 2. Максимальные и минимальные значения сводного показателя человеческого капитала регионов России с 2000 по 2019 годы
Fig. 2. Maximum and minimum values of the composite index of human capital of the regions of Russia in the period from 2000 to 2019

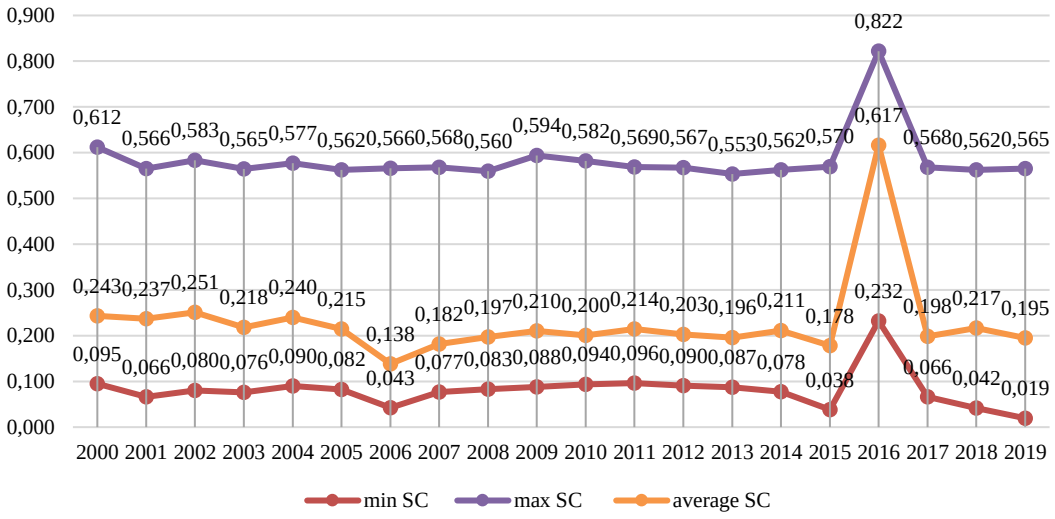

Рис. 3. Максимальные и минимальные значения сводного показателя структурного капитала регионов России с 2000 по 2019 годы
Fig. 3. Maximum and minimum values of composite indicators of structural capital of Russian regions in the period from 2000 to 2019

Compared to a similar graph of human capital, the graph of values of aggregate indicators of structural capital looks the most stable, having a sharp increase in 2016. This may be due to the fact that structural capital has the most formalized structure and therefore has a longer life cycle, while human capital is subject to changes due to the change of generations.

The graph of values of attitude capital indicators has an upward trend, demonstrating the growth of maximum, minimum and average values, which indicates the increasing role of attitude capital in the system of intellectual capital indicators (Figure 4).

Figure 5 shows heatmaps of summary indicators of human, structural, relational capital for 2019.

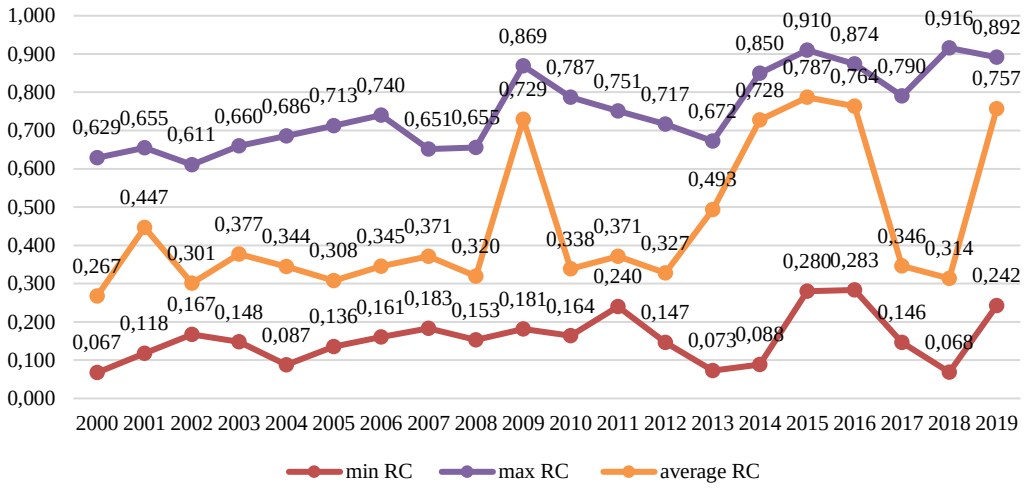

Рис. 4. Максимальные и минимальные значения сводного показателя отношенческого капитала регионов России с 2000 по 2019 годы
Fig. 4. Maximum and minimum values of summary indicators of relational capital of Russian regions in the period from 2000 to 2019

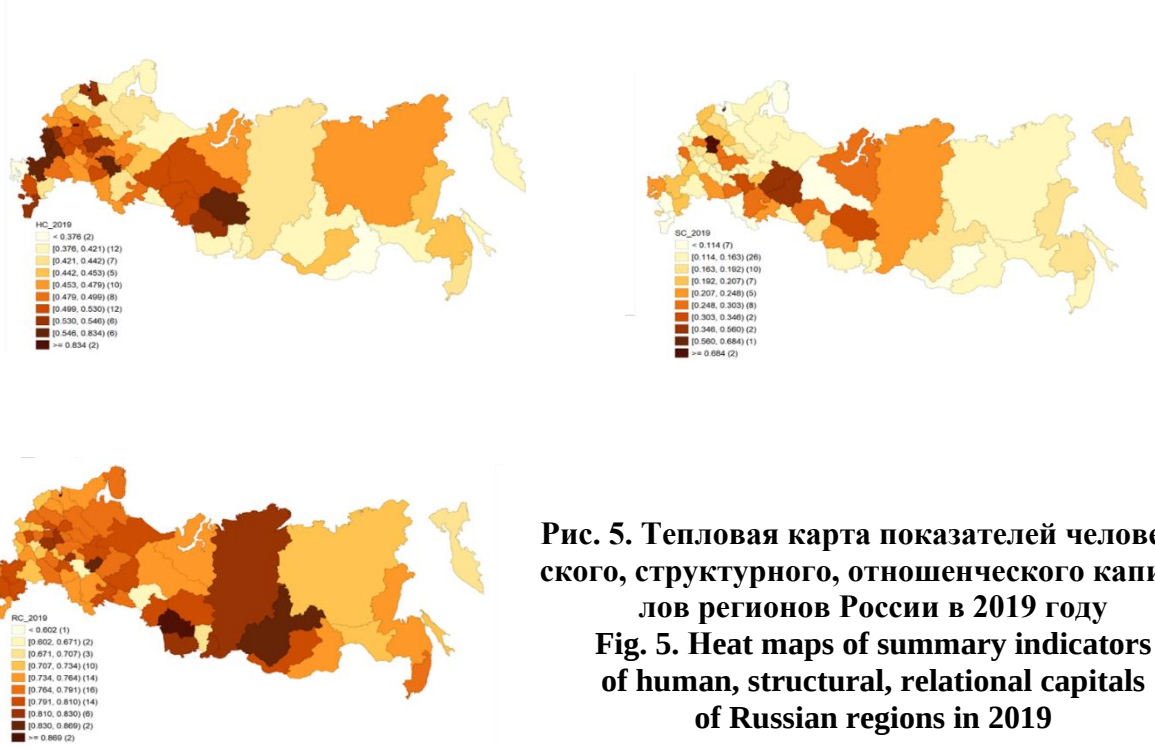

Рис. 5. Тепловая карта показателей человеческого, структурного, отношенческого капиталов регионов России в 2019 году
Fig. 5. Heat maps of summary indicators of human, structural, relational capitals of Russian regions in 2019

Visualization of the obtained data was performed using the GeoDA spatial modeling software package, which allows automatic grouping of geo-objects based on the criterion of natural gradients. Visualization results are presented in the format of heat maps of Russian Federation, except for inverted regions and Kaliningrad Region.

Figure 6 presents heat maps reflecting the level of intellectual capital and the results of the assessment of the balance of structural components of IC of a number of Russian regions in 2019. For the grouping of regions, the criteria corresponding to the aforementioned evaluation criteria of the level of intellectual capital and the balance of its structural components are set.

Considering the results of evaluation of the level of intellectual capital structural components balance in the dynamics over 20 years, it is clear that almost half the number of regions, the balance of components of intellectual capital which can be characterized as medium or high, has decreased. Nationwide, the balance has de-creased, but at the same time the polarization of values has practically disappeared.

Comparing the values of summary indicators of the structural components of intellectual capital for 20 years, we can see an imbalance in the direction of human and relational capitals, which leads to an unbalanced structure of IC.

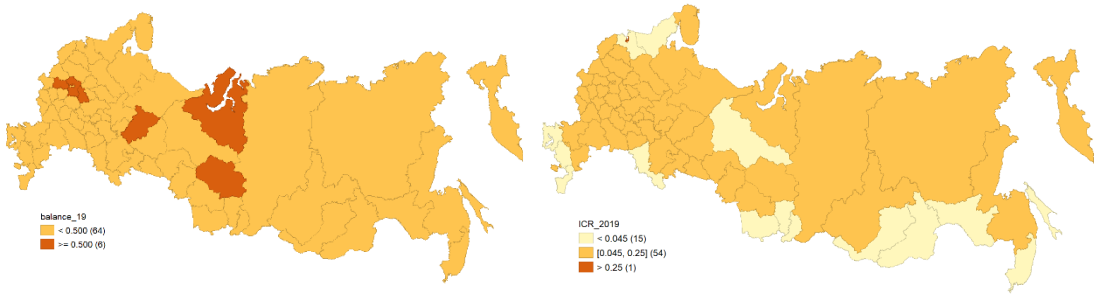

Рис. 6. Тепловая карта уровня интеллектуального капитала и сбалансированности его компонентов регионов России в 2019 году
Fig. 6. Heat maps of the level of intellectual capital and the balance of its structural components of the regions of Russia in 2019

Thus, based on the above scenarios of formation and use and strategies of intellectual capital management in the interests of innovative development and the results of calculations, we can develop recommendations for the analyzed regions, based on the calculated data for 2019. The regions under consideration are grouped into 4 groups according to the evaluation results (Table 1). It is noteworthy that none of the considered regions fell into the groups characterized by a high level of intellectual capital and high or average balance of its components. This signals a complex problem of intellectual capital management at the regional level.

This table allows to determine the position of the region and the strategy of intellectual capital management on the basis of the current state of interaction of its structural components. Thus, at a low level of intellectual capital the region seeks to in-crease intellectual capital by increasing the system-forming structural component, at an average level – to maintain its state, and at a high level – to optimize resources.

Таблица 1

Варианты стратегий управления интеллектуальным капиталом в интересах инновационного развития в регионах

Table 1

Variants of strategies of intellectual capital management in the interests of innovative development of the region

Groups of regions	Strategy
Group 1, Region 1: St. Petersburg	Active optimization strategy
Group 2, 49 regions: Arkhangelsk Oblast, Belgorod Oblast, Bryansk Oblast, Volgograd Oblast, Vologda Oblast, Voronezh Oblast, Moscow. Moscow, Ivanovo region, Irkutsk region, Kamchatka region, Kirov region, Kostroma region, Krasnoyarsk region, Kurgan region, Kursk region, Lipetsk region, Murmansk region, Nizhny Novgorod region, Novgorod region, Novosibirsk region, Omsk region, Orel region, Penza region, Pskov region, Republic of Bashkortostan, Republic of Kalmykia, Komi Republic, Mari El Republic, Mordovia Republic, Republic of Sakha (Yakutia), Republic of North Ossetia-Alania, Republic of Tatarstan, Rostov region, Ryazan region, Samara region, Saratov region, Sakhalin region, Sverdlovsk region, Smolensk region, Tambov region, Tula region, Tyumen region, Udmurtia region, Ulyanovsk region, Khabarovsk region, Chelyabinsk region, Chuvash Republic, Yaroslavl region	Active support strategy
Group 3, 15 regions: Altai Krai, Amur Oblast, Astrakhan Oblast, Trans-Baikal Krai, Kemerovo Oblast, Krasnodar Krai, Leningrad Oblast, Orenburg Oblast, Primorsky Krai, Republic of Buryatia, Republic of Dagestan, Republic of Karelia, Republic of Khakasia, Stavropol Krai, Khanty-Mansi Autonomous District	Comprehensive growth strategy
Group 4, 6 regions: Kaluga Region, Moscow Region, Perm Region, Tomsk Region, Yamalo-Nenets Autonomous District, Vladimir Region	Comprehensive support strategy
Group 5, Region 1: Kaliningrad Region	Moderate growth strategy

Conclusion

Thus, as a result of the analysis the scenarios of formation and use of intellectual capital of the region were defined, strategies of intellectual capital management were described and recommendations for improving the balance of structural components and multiplying the intellectual capital of the region in the interests of innovative development were developed.

One of the most significant limitations of the proposed approach to the definition of scenarios and strategies of intellectual capital management in the interests of innovative development is the way of determining the boundaries of the level of IC on the basis of empirical calculations, tested on the data of regions in Russia. This does not exclude the change of the boundaries determining the level of IC for the regions of other countries.

In addition, this approach does not make it possible to trace the direct influence of the IC level and the balance of its structural components on the quantitative results of innovative development. Therefore, the development of mathematic-economic model, reflecting the impact of the level of IC on the results of innovative development in quantitative or monetary terms should be outlined as the direction of further research.

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