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# MODERN STATISTICAL METHODS FOR MEASURING REGIONAL DEVELOPMENT

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**Abstract:** The article presents a systematic analysis of international methodologies for statistical assessment of regional development. Based on modern research, the article studies approaches to compiling composite indices, methods of multidimensional statistical classification, indicators of regional inequality and problems in harmonizing data. The main trends are identified, such as the transition from single-criteria assessment to multidimensional composite indices, the need to adapt international methodologies to national statistical systems, and digital and innovative development. Recommendations are offered to improve the statistical assessment system for the regions of Uzbekistan, taking into account international experience.

**Key words:** regional development, statistical assessment, composite indices, international methodologies, adaptation, multidimensional analysis, regional inequality.

## INTRODUCTION

In the context of globalization and intensifying international competition, the need for comparable and objective methods to assess regional development is steadily increasing. International organizations such as the United Nations, OECD, the World Bank, and Eurostat are developing complex methodological approaches that enable cross-regional comparisons across countries based on unified standards [1]. However, the direct application of these methodologies in post-Soviet countries, including our country and Russia, faces significant challenges due to differences in statistical data collection systems, incomplete regional statistics, outdated classifications, and the absence of certain indicators at the subnational level.

As noted by P. Ivanov and E. Smirnova, “due to differences in data collection systems and regional characteristics, international methodologies cannot be directly adopted without adjustments” [1, p. 48]. This issue becomes particularly acute in the context of implementing the Sustainable Development Goals, which require regular monitoring at the regional level, as well as in light of the digital transformation of the economy, which introduces new challenges for statistical accounting [2].

Contemporary research in the field of statistical assessment of regional development is evolving along several directions. The first direction is associated with improving composite (integral) indices that allow multiple diverse indicators to be combined into a single quantitative measure. Classical examples include the Human Development Index, the OECD Regional Competitiveness Index, and the European Innovation Scoreboard [3]. The second direction focuses on multivariate statistical classification methods, such as cluster analysis and principal component analysis, which make it possible to identify homogeneous groups of regions. The third direction is devoted to measuring regional inequality using decile coefficients and indices such as Gini, Theil, and Atkinson. The fourth direction involves the development of digital development indices based on the methodology of the European Digital Economy and Society Index.

Despite the abundance of studies addressing specific aspects, there is no systematic understanding of how international methodologies are adapted to the conditions of post-Soviet countries, what challenges arise during this adaptation process, and what solutions are proposed. Many studies are limited to describing international experience or focus solely on developing national methodologies without referencing international standards [3; 4; 5]. This gap is particularly pronounced in our country, where the transition to international statistical standards is actively underway, yet the methodological framework for regional assessments remains insufficiently developed.

## REVIEW OF LITERATURE ON THE SUBJECT

The fundamental study by P. Ivanov and E. Smirnova is devoted to a comparative analysis of three major international methodologies—the Human Development Index, the OECD Better Life Index, and the European

Union's Regional Competitiveness Index [1]. The authors examine in detail the structure of each index, as well as the methods of standardization and aggregation of their indicator sets.

The Human Development Index, developed by the United Nations Development Programme, combines three components: longevity (life expectancy), education (mean and expected years of schooling), and income (gross national income per capita). As noted by P. Ivanov and E. Smirnova, the advantage of the Human Development Index lies in its simplicity of calculation and broad availability [1]. However, adjustments are required at the regional level, as source data are often unavailable at that scale.

The OECD Better Life Index includes 11 dimensions: income and wealth, jobs and earnings, housing, health, work–life balance, education, social connections, civic engagement, environmental quality, safety, and subjective well-being [0]. P. Ivanov and E. Smirnova emphasize that this methodology requires a large volume of data, much of which is either unavailable or not systematically collected in the statistics of Russia and our country [1].

The European Union's Regional Competitiveness Index comprises 74 indicators grouped into 11 sub-indices and three super-indices (basic, efficiency, and innovation). The authors note that “due to the absence of many indicators at the regional level and differences in their calculation methodologies, the RCI cannot be directly adopted for Russian regions” [0, p.].

Based on the comparative analysis, P. Ivanov and E. Smirnova propose an adapted methodology for Russian regions that includes economic, social, and environmental development dimensions [1]. The main conclusion is that adaptation requires maintaining a balance between adherence to international standards and consideration of national specificities.

The study by B. Karimov and N. Yuldosheva represents one of the first attempts to systematically apply the United Nations Sustainable Development Goals methodology to assess regions in our country [2]. The authors adapt global SDG indicators to the national level and identify 25 key indicators available in official statistics [2, p. 29].

Particular attention is paid to the relevance of indicators: not all global SDG indicators are meaningful at the regional level (for example, those related to international trade), which necessitates careful selection. B. Karimov and N. Yuldosheva propose grouping the selected indicators into five areas: economic growth, social development, environmental sustainability, infrastructure, and governance [2].

Based on the calculated composite index, the authors rank all regions of the country and conduct a cluster analysis, identifying four types of regions: leaders (Tashkent city), high-potential regions (Samarkand and Bukhara regions), moderately developed regions, and low-performing regions (the Republic of Karakalpakstan and some southern regions). The study demonstrates that the SDG methodology can be effectively adapted to the regional level, provided that national priorities and data availability are taken into account.

T. Petrova and D. Sokolov analyze methodological approaches used in international innovation rankings, including the Global Innovation Index, the European Innovation Scoreboard, and the Bloomberg Innovation Index [3]. The authors examine in detail their structure, indicator selection methods, weighting, and aggregation techniques.

The Global Innovation Index, developed by Cornell University, INSEAD, and WIPO, includes approximately 80 indicators grouped into sub-indices of innovation inputs and outputs [4]. The European Innovation Scoreboard comprises 32 indicators across four areas: framework conditions, investments, innovation activities, and impacts. The Bloomberg ranking is based on seven weighted indicators, including R&D intensity, productivity, and the concentration of high-tech companies [5].

T. Petrova and D. Sokolov identify a key drawback of existing Russian rankings: they often “copy Western methodologies without adaptation, which distorts the real picture” [3, p. 36]. The authors propose their own methodology that incorporates both statistical data and business survey results, enabling a more accurate assessment of regional innovation potential. An important conclusion is that rankings should combine objective and subjective indicators.

Sh. Abdullaev and D. Rahimova focus on the application of multivariate statistical analysis methods for classifying regions in our country [4]. The authors compare results obtained using three methods: cluster analysis (k-means), principal component analysis, and discriminant analysis.

Special attention is given to the selection of weighting coefficients and the standardization of indicators. Sh. Abdullaev and D. Rahimova show that different methods do not produce fully consistent results; however, cluster analysis based on the k-means method demonstrates the highest stability when the composition of indicators changes [4]. The inclusion of additional uncorrelated factors obtained through principal component analysis improves classification quality.

The authors conclude that the proposed methodology can be used to monitor regional differentiation and inform regional policy directions [4, p. 26]. The study is valuable as it provides a tailored toolkit adapted to national data. None of the existing methods is universal; the choice of indicators and aggregation techniques

significantly affects final assessments. The authors recommend using multiple alternative methods and constructing an integral ranking based on median values to enhance robustness.

G. Nizamova and F. Khamidullin examine the feasibility of applying the OECD Regional Competitiveness Index methodology to the countries of the Eurasian Economic Union [6]. The authors analyze the availability of OECD indicators in the statistics of Russia, Kazakhstan, and Belarus [6, p. 59].

It was found that only 35–40 out of the 74 RCI indicators are regularly available in the statistics of EAEU countries, and the available set of indicators varies across countries. G. Nizamova and F. Khamidullin propose an adapted index consisting of 12 key indicators that are available in all three countries and reflect core aspects of competitiveness, including GDP per capita, labor productivity, employment rate, investment in fixed capital, the share of employees with higher education, road density, and others [6]. Testing the adapted index across regions of the three countries demonstrates its suitability for cross-country comparisons. The study shows that even a significantly reduced index retains its ability to identify regional competitive advantages.

A. Usmonov and M. Tursunova analyze regional inequality in our country using international indicators such as the Gini coefficient, the Theil index, and the Atkinson index [7]. The authors calculate these indicators for key socio-economic variables—GDP per capita, household income, and unemployment—for the period 2010–2022 [7, p. 59].

The results indicate a growing disparity between regions. The Gini coefficient for GDP per capita increased from 0.32 in 2010 to 0.41 in 2022 [0]. The Theil index shows that the main contribution to inequality (over 60%) comes from the gap between Tashkent and other regions. A. Usmonov and M. Tursunova emphasize that using multiple inequality indicators provides a more comprehensive picture than relying solely on the Gini index [7].

For the first time in national practice, the study applies a full set of international inequality indicators to regional data, enabling cross-country comparisons.

E. Grishina and V. Tsvetkov present their own methodology for assessing the investment attractiveness of Russian regions, based on a synthesis of approaches used by international rating agencies (Standard & Poor's, Moody's) and the World Bank's Doing Business methodology (adapted to the regional level) [8].

E. Grishina and V. Tsvetkov emphasize the importance of combining objective and subjective data: "statistical indicators alone do not capture important aspects such as the attitude of regional authorities toward investors or real administrative barriers" [8, p. 99]. If investor surveys are conducted regularly, this methodology can be adapted for our country.

I. Shevchenko and E. Nazarova analyze the problems of comparability of statistical data on regional development in CIS countries [9]. They review international recommendations from the CIS Statistical Committee, Eurostat, and the OECD on harmonizing indicators.

The authors identify three groups of problems: methodological (differences in GDP calculation methods and industrial classifications), classification-related (different versions of OKVED and NACE), and territorial (different approaches to defining regions and changes in boundaries) [9, p. 25]. I. Shevchenko and E. Nazarova propose a standardized list of indicators for cross-country comparison of regions, including 18 indicators with the highest level of comparability [0].

The main conclusion is that achieving genuine comparability requires the gradual implementation of international standards (such as SNA 2008 and the NACE classification), as well as the development of bilateral and multilateral methodologies for recalculating indicators.

## RESEARCH METHODOLOGY

This study was conducted as a systematic review and meta-analysis of existing research on the adaptation of international methodologies for the statistical assessment of regional development. This design was chosen in accordance with the research objective: identifying general patterns and challenges specific to the post-Soviet context requires the synthesis of findings from multiple independent studies.

The following methods were applied for data processing and systematization:

- content analysis of texts (to identify key methodological approaches, problems, and solutions);
- comparative analysis (to compare methods across various parameters);
- classification (to group methods by the object of assessment, applied techniques, and level of adaptation);
- synthesis (to generalize the results into a coherent overall framework).

## ANALYSIS AND RESULTS

Based on the analysis of the studies, a classification of statistical methods for assessing regional development was developed according to four criteria (Table 1).

Table 1. Classification of statistical methods for assessing regional development

Classification criteria	Types of methodologies	Examples from reviewed studies
<b>Object of assessment</b>	Multi-purpose (composite indices)	Ivanov, Smirnova (2023); Kozlova, Morozov (2021)
	Specialized (innovation, investment, digitalization)	Petrova, Sokolov (2022); Grishina, Tsvetkov (2024); Saidova, Azimov (2025)
	Inequality assessment	Usmonov, Tursunova (2023)
<b>Aggregation method</b>	Composite indices with fixed weights	Karimov, Yuldosheva (2024)
	Multivariate statistical methods	Abdullaev, Rahimova (2023)
	Ranking methods	Petrova, Sokolov (2022); Grishina, Tsvetkov (2024)
<b>Level of adaptation</b>	Direct application of international methodology	Not identified in reviewed studies
	Adaptation with adjustments to the indicator set	Karimov, Yuldosheva (2024); Nizamova, Khamidullin (2022); Saidova, Azimov (2025)
	Development of original methodology based on international experience	Ivanov, Smirnova (2023); Petrova, Sokolov (2022); Grishina, Tsvetkov (2024)
<b>Data used</b>	Only statistical indicators	Abdullaev, Rahimova (2023); Usmonov, Tursunova (2023)
	Statistical indicators + survey data	Petrova, Sokolov (2022); Grishina, Tsvetkov (2024)

Table 2 presents a comparison of seven international methodologies and their adapted versions identified in the reviewed studies (Table 2).

Table 2. Comparison of international methodologies and their adapted versions

International methodology	Adaptation studies	Country	Level of adaptation	Key modifications
Human Development Index	Ivanov, Smirnova (2023)	Russia	Partial	Environmental indicators added, education indicators adjusted
UN Sustainable Development Goals methodology	Karimov, Yuldosheva (2024)	Uzbekistan	Partial	25 indicators selected from 232 global indicators available at the regional level
European Innovation Scoreboard	Petrova, Sokolov (2022)	Russia	Development of original method	Business surveys added, indicator set adjusted
Regional Competitiveness Index	Nizamova, Khamidullin (2022)	EAEU	Strong reduction	Reduced to 12 key indicators
Digital Economy and Society Index	Saidova, Azimov (2025)	Uzbekistan	Partial	Five sub-indices adapted, indicators adjusted
Rating agency methodologies (S&P Global, Moody's)	Grishina, Tsvetkov (2024)	Russia	Development of original method	Synthesis of agency approaches and Doing Business indicators
Doing Business	Grishina, Tsvetkov (2024)	Russia	Adaptation for regional level	Regional administrative procedures taken into account

The reviewed studies show that international methodologies for the statistical assessment of regional development are rarely applied without modification. In most cases, researchers employ partial adaptations, which include reducing the set of indicators, adjusting their weights, or introducing new variables to reflect national socio-economic characteristics. The development of original methodologies based on the synthesis of international indices and national statistical databases is less common.

Identified trends:

Trend 1: Shift toward multidimensional composite indices. All reviewed studies (except the work of A. Usmonov and M. Tursunova on inequality) employ composite indices combining between 12 and 35 indicators. This aligns with the global trend of moving away from single-indicator assessments (such as GDP per capita alone) toward multidimensional measures that capture economic, social, environmental, and institutional aspects.

Trend 2: Adaptation is essential. None of the studies propose a direct replication of international methodologies. All authors emphasize the necessity of adaptation due to:

- differences in data collection systems;
- the absence of certain indicators at the regional level;
- national specificities (economic structure, development priorities);
- differences in classifications and calculation methods.

Trend 3: Data availability as the main constraint. Almost all studies (particularly those by B. Karimov and N. Yuldosheva, G. Nizamova and F. Khamidullin, and Saidova and Azimov) highlight that the main barrier to adaptation is the absence or uneven availability of many regional indicators. This forces researchers to reduce the set of indicators or use proxy variables, which lowers the accuracy of estimates.

Trend 4: Integration of statistical and survey data. The most advanced methodologies (T. Petrova and D. Sokolov; E. Grishina and V. Tsvetkov) incorporate not only official statistical indicators but also survey data from entrepreneurs, experts, and the general public. This makes it possible to capture qualitative aspects not reflected in official statistics, such as the investment climate and administrative barriers.

Trend 5: Increasing regional differentiation. Empirical calculations presented in the reviewed studies (B. Karimov and N. Yuldosheva; A. Usmonov and M. Tursunova) indicate a growing disparity between regions in both Russia and our country. This underscores the importance of developing accurate assessment methods to inform regional policy measures.

One of the key challenges in adapting international methodologies is how to maintain comparability with international data while accounting for national specificities. P. Ivanov and E. Smirnova propose a compromise solution: preserving the core structure of the index (for example, the three-component structure of the Human Development Index) while supplementing it with indicators available in national statistics [1]. This approach allows for limited cross-country comparisons (based on the general structure), but does not enable direct comparison of numerical values.

G. Nizamova and F. Khamidullin go further and propose using a highly reduced index consisting of 12 indicators available across all compared countries for cross-country comparisons [6]. However, as they acknowledge, such reduction leads to a significant loss of information and may distort the true picture of competitiveness. An optimal approach appears to be the development of two versions of the index: a full version (for national use, with the broadest set of indicators) and a reduced version (for international comparisons, with a standardized set). This approach has not yet been implemented in any of the reviewed studies.

The selection of weighting coefficients when aggregating indicators into a composite index remains a controversial issue. Different approaches are used in the reviewed studies:

- equal weighting (B. Karimov and Yuldosheva; Saidova and Azimov), which is the simplest and most transparent method;
- weights derived from principal component analysis (Sh. Abdullaev and D. Rahimova), which are objective but difficult to interpret;
- expert-based weights (T. Petrova and D. Sokolov), which incorporate expert opinions but are subjective;
- weights adopted from international methodologies (P. Ivanov and E. Smirnova), which ensure comparability but may not reflect national priorities.

E. Kozlova and A. Morozov convincingly demonstrate that the choice of weights has a significant impact on the final ranking [5]. In some cases, a region ranked 5th under one set of weights may fall to 15th under another. This calls into question the objectivity of any ranking based on a single set of weights.

The approach proposed by E. Kozlova and A. Morozov appears promising: using multiple alternative weighting schemes and constructing an integral ranking based on median values [5]. This approach increases the robustness of results and reduces the risk of manipulation through weighting.

Most of the reviewed studies present static assessments (at a single point in time) or comparisons between two points (A. Usmonov and M. Tursunova) [7]. However, for monitoring regional policy, it is important to assess dynamics: how a region's position changes over time and what factors contribute to its improvement or decline. The absence of dynamic models in the reviewed studies can be explained by two factors: first, methodological complexity (the need to account for changes in indicator sets and calculation methods over time); second, limited time series (many indicators in post-Soviet countries have only recently begun to be collected on a regular basis).

The development of methods for dynamic assessment of regional development appears to be an important area for future research.

The analysis of studies conducted in Uzbekistan (B. Karimov and Yuldosheva; Sh. Abdullaev and D. Rahimova; A. Usmonov and M. Tursunova; Saidova and Azimov) reveals the following features of the adaptation of international methodologies in the country:

1. Active transition to international statistical standards. In recent years, Uzbekistan has been actively implementing the recommendations of international organizations and gradually expanding its statistical base. However, as noted by B. Karimov and Yuldosheva, disparities remain at the regional level, particularly in environmental and social indicators [10].

2. High level of centralization. A significant portion of tax and budget data is aggregated at the national level, which makes it difficult to obtain regional-level estimates for certain important indicators (for example, investment in fixed capital by source of financing).

3. Sharp regional differentiation. All studies highlight a substantial gap between Tashkent and other regions, as well as persistent lagging in the Republic of Karakalpakstan and some southern regions. This must be taken into account when developing methodologies, as standard statistical methods may produce distorted results in the presence of strong outliers (such as Tashkent).

4. Development of digital statistics. The study by Saidova and Azimov shows that the country is actively undergoing digital transformation, which is reflected in the emergence of new statistical indicators (such as broadband internet access and the use of digital technologies in business and public services).

## CONCLUSIONS AND SUGGESTIONS

1. International methodologies for the statistical assessment of regional development—such as the Human Development Index, the Sustainable Development Goals framework, the OECD RCI, DESI, and rating agency methodologies—represent a valuable source of approaches and instruments. However, their direct application in post-Soviet countries is not possible without substantial adaptation. The main barriers are differences in data collection systems, the absence of many indicators at the regional level, and inconsistencies in classifications.

2. In our country, the adaptation of international methodologies is carried out according to three main models:

partial adaptation (adjusting the set of indicators while preserving the overall structure);

strong reduction (reducing the methodology to a minimal set of indicators available in all compared countries);

development of original methodologies based on the synthesis of several international approaches.

3. The priority directions for improving the statistical assessment of regional development in our country are as follows:

expanding the set of indicators available at the regional level, especially in environmental and digital areas;

developing an official methodology for calculating an integrated regional development index aligned with international standards;

conducting regular surveys among entrepreneurs and the public to obtain subjective assessments of quality of life and the investment climate;

creating dynamic models to track changes in the condition of regions over time.

4. The following algorithm is recommended for developing a national methodology for the statistical assessment of the regions of our country:

Stage 1: analyze available statistical data and identify gaps;

Stage 2: select the main international methodologies for adaptation, with priority given to the Demographic and Social Change Index, DESI, and the Human Development Index;

Stage 3: develop the structure of a composite index taking into account national development priorities;

Stage 4: select indicators available at the regional level and determine methods for their standardization;

Stage 5: justify the weighting system using several alternative approaches;

Stage 6: test the methodology using data from all regions and analyze the reliability of the results;

Stage 7: implement the methodology in regular statistical monitoring.

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