

## An Assessment Methodology for the Development of Higher Education in Russia

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### Abstract

*The paper presents a methodology to assess the status of the higher education (HE) system. A monitoring system for HE in Russia is proposed using the indicative figures grouped in two units. In the first methodological unit entitled "The Conditions of Operation and Status of Infrastructure of the HE System" are included indicators characterising the conditions of financing, human resources, the status of fixed assets and the learning environment in the HE institutions. The second methodological unit entitled "State Educational and Research Activities of the HE System" includes indicators characterising research capacity, the effectiveness of faculty research activities and the educational and research capacity of students of the HE institutions. On the basis of the proposed methodological tools, the status of the HE system of the Ural Federal District is evaluated and classified. The calculations were based on primary statistical data from the Russian Federal State Statistics Service and the Ministry of Education and Science. The analysis conducted over a time period of 12 years has shown that, unfortunately, a direct correlation between the growth of investments and an increase in quality is not observed. The growth rate of financing of regional HE was in some cases several times higher in one region than another, increasing the visibility of the results. It is clear that the leaders in terms of financing and the leaders in terms of improving the quality of education are two different things. This demonstrates the need to reform regulation of HE, particularly with regard to prioritising its development and improving the financial and economic mechanisms required to achieve this.*

**Keywords:** system of Higher Education; indicative analysis; UFD; operating conditions and the status of the infrastructure of HE; status educational and research activities in HE

### 1. Introduction

The intensification of globalisation processes and the formation of an international labour market are having a significant impact on the patterns of development of national systems of vocational education. The result of this influence in Russia has been a wide-ranging reform of the entire education system, the final stage of which was the adoption of the new Federal Law "On Education in the RF" (№ 273-FZ of December 29, 2012). Entering into force on 1 September 2013, the law significantly changed the structure of HE in Russia, securing the legislative implementation of the basic principles of the Bologna Declaration. In terms of the goals of Russia's accession in 2003 to the Bologna process and the consequent adoption of this law, can be mentioned, firstly, support for the formation of and adherence to a common European educational space, and secondly, the creation of the necessary conditions to change the country's role in the international division of labour and the emergence of possibilities for integration into the global labour market.

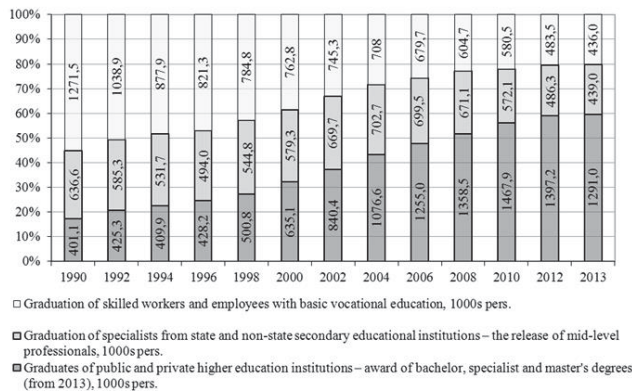
The education system in Russia includes general and professional education. The general education is divided into pre-school and school education. The school education comprises three successive stages (the first two stages being compulsory for Russian citizens): four-year primary general education; five-year basic general education, and two-year secondary (full) general education. The professional education is divided into secondary education, tertiary (higher) education and post-graduate education. Until 2013, there existed initial vocational education; educational programmes of this kind are currently included into secondary vocational training, therefore the diagram in figure 1 consists of three segments. Secondary vocational education lasts from 2 to 4 years; it can be entered after completing the second or the third stages of school education.

Higher education in Russia can be received in higher education institutions in four-year bachelor degree programmes, five-year specialist degree programmes, and two-year master's degree programmes, with the latter allowed after completing bachelor or specialist degree programmes. Post-graduate training of highly-qualified personnel lasts three, five or more years. Over 27.3% of Russia's population aged 25 to 64 years have university degrees, compared to

32.5% in Israel, 32.6% in the United States, and 31% in the UK (according to 2012), (Education in the RF., 2014)

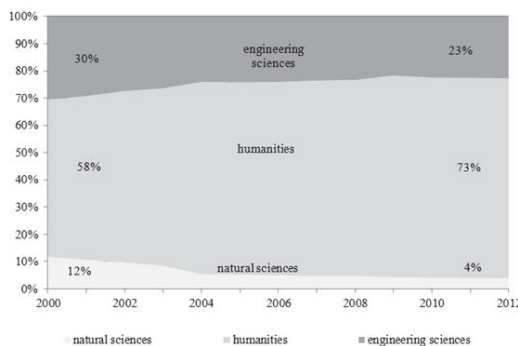
The task of creating a single European educational system that is competitive in relation to other global education systems (American and Asian) is forcing changes in approaches to the functioning of the national system of vocational education, directing it towards the creation of a unified, tiered, transparent system of training of qualified specialists.

At present, economists are facing acute questions concerning the economic feasibility of the structure of the educational process, in terms of supply and demand of the labour market and educational services and an optimisation of the activities of HE institutions in terms of attracting school leavers towards careers prioritised by the requirements of economic development. Ongoing problems remain: an imbalance in the structure of the producing specialisms by education level (higher-middle-vocational) and a poor orientation of educational institutions towards the actual needs of the national economy, leading to a decrease in the effectiveness of the vocational education system (see Fig. 1). Every year, the proportion of HE graduates grows at the same time as the proportion of mid-career professionals declines: in 1990, the number of graduates from secondary and primary vocational education was 4.8 times greater than HE graduates, whereas in 2013 those graduating with HE degrees were 1.5 times more numerous than secondary and primary vocational education graduates.



**Figure 1.** The structure of graduates by level of vocational education in Russia for the period 1990-2012 (compiled from Regions of Russia. Socio-economic Indicators, 2001, 2004, 2008, 2010, 2013)

Likewise, one of the problems facing Russian professional education consists in a contradiction between individual preferences and the needs of the real economy in terms of the choice of educational paths. A striking example of this is the periodic statements by the representatives of public authorities and articles in the press about the “overproduction” of lawyers, economists and managers at a time of an acute shortage of skilled workers and specialists with special secondary technical education. By 2012, the number of HE graduates majoring in social sciences and humanities accounted for 73% of the total output, with 33% having opted for Economics and Management (see Fig. 2).



**Figure 2.** Structure producing a special system of HE (compiled from Education in the RF, 2010, 2013)

Currently, there are quite a number of different Russian and international rankings providing a diverse assessment of HE institutions. Analysis of the status of HE in foreign and Russian practice consists of directly assigned ratings, typically carried out by outside organisations. Among foreign ratings services, the following are notable: the Academic Ranking of World Universities (ARWU rating, or Shanghai Ranking, Shanghai Jiao Tong University); Times Higher Education (THE, a British journal specialising in HE); QS University Rankings by the British educational consulting company Quacquarelli Symonds. The following are prominent among Russian ratings services: National Ranking of Universities (IA Interfax) (National Ranking of Universities); the "Expert RA" rating agency university ranking (Rating Agency "Expert RA" Methodological Approaches of the Rating of Russian Universities); the ranking of universities compiled by the Ministry of Education and Science of the RF (Russian Ministry of Education) in the monitoring of the effectiveness of educational institutions of HE (Methods of Calculating Indicators for Monitoring the Effectiveness of Educational Institutions of HE in 2014), (Koksharov V.A., Sandler D.G., Kadochnikov S.M., Tolmachev D.E., 2012) etc. In the international rankings, the positions of education establishments are weighted as follows: ARWU – quality of research (40%) and quality of teaching staff (40% (Florian R.V., 2007), (ARWU, 2013); THE – quality of teaching (30%), quality of research (30%) and scientific impact of universities (30%) (World University Rankings 2013-2014 methodology, 2014); QS – academic reputation (40%), quality of research (20%) and quality of teaching (20%) (Andrejs Rauhvargers, 2014).

Domestic ratings also introduced weighted scores that apportion the importance of proposed indicators; these are oriented towards a comparison of Russian universities between Russian institutions and those universities identified as world leaders in the provision of educational services. The criterion of the efficiency of the universities estimated ratings consists of the impact of the HE institution in this rating and occupies a position in it. In addition, the Ministry of Education and Science of the RF evaluates the effectiveness of the Russian universities according to the given criteria, oriented towards an identification of inefficient state educational institutions and following their subsequent reorganisation. The drawing up of various kinds of ratings is now both a widespread as well as a polemical analysis tool; for this reason, the different approaches to the rating of HE institutions are periodically criticised by the expert community (Hazelkorn E., 2007), (Rauhvargers A., 2011), (Leading Rankings of Universities, 2014), (Carnoy M., 2014). The objective of forming global university rankings is seen in terms of providing assistance to consumers of educational services in making a selection from the best universities in the world. The purpose of monitoring conducted by the Ministry of Education of the RF is to evaluate the performance of Russian universities. The authors set themselves a different kind of challenge, offering a methodology to assess the status of the Russian HE system as a whole on the example of some of its regions.

The RF is a country covering over 17 million square kilometres, with a population of 143,700,000 people (Leading Rankings of Universities, 2014) having 8 climatic zones and 11 time zones; as a result, it has quite a varied system of administrative-territorial division. The structure consists of 85 subjects of Russia (regions), 46 of which are referred to as regions (regions), 22 as republics, 9 as krajs (or "edges"), 3 as federal cities, 4 as autonomous districts and 1 as an autonomous region. All RF Subjects are united in 9 groups, called Federal Okrugs (Districts). Of course, the heterogeneity and size of the country affects the features of the development of its regions; often, in order to keep track of events taking place in any field of the processes, it is necessary to carry out the analysis at the regional level (the level of the Federal Subject). Therefore, a necessary step in the implementation of the strategy for reforming the HE system, aimed at fulfilling the basic principles of the Bologna Declaration in Russia, is to carry out a large-scale monitoring of the status of HE at the regional level. The purpose of this monitoring entails a definition of parameter criteria of the system in the RF as a whole, as well as the actual level of its development in the country. This monitoring also permits an evaluation of the accessibility of HE and its quality in the regions of Russia.

Worldwide, access to education increased from 19 per cent in 2000 to 26 per cent in 2007. Many countries have programmes that provide access to HE for some segments of the population (Altbach, P., L. Reisberg, and L.E. Rumbley, 2009). However, when examining the question of access to education, it should be noted that even if given free education, that is, eliminating the direct payment of fees for participating in educational programmes in universities, other related expenses (accommodation, meals, etc.) remain high (Murakami, Y. and Blom, A., 2008). Another equally important issue is the quality of education. Despite the broad definition of education quality, which is regarded as a multi-dimensional, multi-level, and dynamic concept that relates to the contextual settings of an educational model, to the institutional mission and objectives, as well as to the specific standards within a given system, institution, programme, or discipline (Vlasceanu, L., Grünberg, L. and Pârlea, D., 2007), nevertheless, in practice, the quality of education is evaluated through specific indicators and a system of norms. The technology for evaluating the system of HE and presentation of results and the results (on the example of Subjects of the RF including in the UFD) are presented by the authors.

The system of higher education in Russia includes public and private higher education institutions, which may have an academy, a university or an institute status. In 2013-2014 there were 969 institutions of higher education in Russia,

including 578 state universities, and 391 private universities. Besides, universities have regional branches; in the 2013/2014 academic year there were 1,482 branches of higher education institutions, running higher education programmes (bachelor degree programmes, specialist degree programmes, and master's degree programmes), including 949 public institutions, and 533 private establishments.

The subject matter of this research is the system of higher education in the Ural Federal District, which is represented by state higher education institutions located in the Kurgan, Sverdlovsk, Tyumen and Chelyabinsk regions – 23 establishments, including 15 universities, 4 academies, and 2 institutes.

## 2. Method

For the purpose of forming ratings – the comparing of different universities and the choice of a “better” one – the research focused on monitoring the status of HE in every region of Russia in order to take account of the regional particularities of its operation and evaluate the changes taking place in it. As a tool for such monitoring the authors propose a methodology for diagnosing the HE system. This methodology has been designed to assess the conditions of its operation as well as the status of the infrastructure, education and research activities in HE institutions. The resulting data allow for a participatory approach to be taken in the first stage in order to compare the level of development of HE in the territory, and, in the future, to assess its impact on the economy and the population for all subjects of the RF on the basis of the data obtained. As a result, it will be possible to define key directions of the development of HE institutions for each subject of the RF by adjusting existing targets for their activities as well as establishing new ones.

In order to assess the status of HE in Russia, it is proposed to use an indicative analysis method (G.A. Kovaleva, A.A. Kuklin, 2003), which allows a determination of the degree of compliance achieved at a specific moment of time or the predicted values of the indicator thresholds that meet the relevant requirements of the development of society and to ensure the sustainable development of the regions of the country, taking into account the level of progress and developmental goals.

A diagnosis of the status of the HE system in the region is presented in the following order:

- selection of the objects of study (list of Russian Federal Subjects);
- formation of the composition and structure of the system of performance indicators;
- creation of a database of baseline characteristics, calculated on the basis of the indicative values for each object of the study;
- formation of the thresholds (values) for performance indicators for each object of research grouped by territories and taking their specific development characteristics into account.

The setting of thresholds is a separate task. The assignment of objects to a particular status is produced by means of the formation and expert analysis of the educational sample of observations. The task of establishing thresholds for the indicators and classification of observations is related; in order to determine the thresholds, it is necessary to know the initial classification of observations at the level of status; in order to classify observations in terms of status, it is necessary to know the threshold indicators. Therefore, the process of establishing threshold values and classification of cases in the training sample is an iterative process that requires the accumulation of databases and knowledge bases for the assessment of each facility (G.A. Kovaleva, A.A. Kuklin, 2003). The starting point for the establishment of threshold levels consists in country-specific social and economic benchmarks, the long-term development programme of the territories, leading indicators from developed and developing countries, the level of international standards and quality of life, etc. (Tatarkin A.I, Myzin A.L., 2013).

It should be noted that the methodology chosen has a number of distinct advantages as follows:

- 1) results obtained by this method show a considerably weaker dependence on the differences in the units of measurement for a large number of diverse indicators that characterise the level and quality of the studied states of the object, compared with methods that require expression of all indicators in the same units;
- 2) this method is capable of identifying “weak areas” in the system of professional education in the region by comparing the actual values of the indicators with their so-called threshold levels corresponding to certain quality levels of the studied object state.

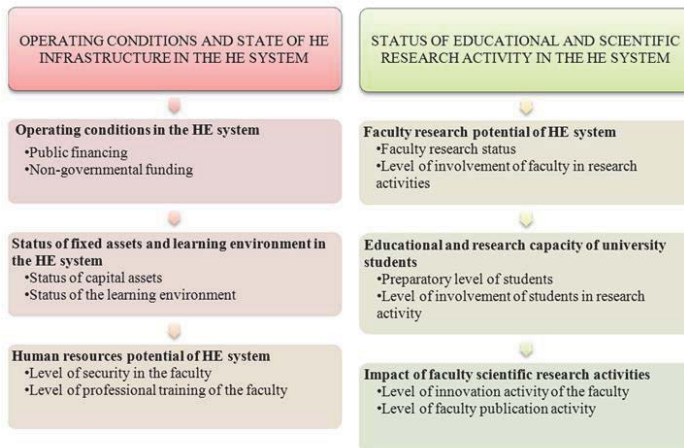
In addition, this approach facilitates solution of the problem of efficient professional education system management in the region and helps identify ways for improving its effectiveness.

Thresholds are formed using different methods – regulatory, targeted and expert evaluations. Their values for certain indicators are adjusted according to the conditions of the education system in the particular territory. In terms of classification criteria, based on which all subjects of the RF are grouped by similar values of thresholds group, the

following were selected:

- the extent of development of the territory and its level of economic development;
- age structure and population density;
- the standard of living in the territory.

The current values of the indicators for each object of study are calculated and the status of each indicator assessed by comparing their current values with the threshold values. On the basis of these assessments, an assessment of the situation was carried out on the indicative module according to individual indicators, followed by a complex assessment of the HE system for each object of study in accordance with its classification. The application of this method permits a diagnostic picture of the general status of HE to be obtained as well as the functioning of the indicator groups and individual performance indicators for each subject of the RF (see Fig. 3).



**Figure 3.** Structure of the diagnosis of the condition of the HE system

The diagnosis of the system of HE is carried out using performance indicators, grouped into two units:

- operating conditions and status of the infrastructure of HE;
- status of educational and research activities in HE.

Each of the indicative units consists of three modules (synthetic indicative parameters) that comprise 25 partial indicators, the calculation of which is based on 40 statistical indicators.

The operating conditions and status of the infrastructure of the HE system units are evaluated under the terms of the financing system of fixed HE assets and the HE learning environment in terms of its human resources. The unit describing the status of educational and research activities in HE is characterised by the status of the research capacity of the professorial-teaching staff (PTS), the educational and research capacity of students and the effectiveness of the research activities of the faculty.

The basis of the methodology for the assessment of the HE status system on the method of indicative analysis was developed in the framework of the Ural economic school headed by Academician A.I. Tatarkin, PhD A.A. Kuklin and doctor of technical sciences, A.L. Myzin, who refer to physical units of various indicators in an indexed (normalised) form of comparison of the values of these indicators and their threshold values according to the rules of the system as a derivation tool (G.A. Kovaleva, A.A. Kuklin, 2003). For an analysis of the HE system of Russian regions (similar to the classification levels of the status of education in the analysis of economic and energy security (Tatarkin A.I. Kuklin A.A., O.A. Romanova, Chukanov V.N. Yakovlev V.I., Kozitsin A.A., 1997), (A. I. Tatarkina, 1998) the following assessment of the level of development for each of the indicators is introduced: high (H), medium (M) and low (L). The medium and low levels are broken into three sublevels respectively. The classification of territory  $j$  (subject of the RF) on the considered indicator  $i$  to a particular level of status is given by the indicator  $X'_{ji}$  and its thresholds.

All indicators expressed in named (natural) units are converted into an index (normalised) form according to the following relations:

$$\left. \begin{aligned} &\text{if } X'_{ji} \geq X_{C1ji}, \text{ then } X^H_{ji} = 0 \\ &\text{if } X'_{ji} < X_{C1ji}, \text{ then } X^H_{ji} = X_{C1ji} - X_{ji} / (X_{C1ji} - X_{H1ji}) \end{aligned} \right\} (1)$$

$$\left. \begin{aligned} &\text{if } X'_{ji} \leq X_{C1ji}, \text{ then } X^H_{ji} = 0 \\ &\text{if } X'_{ji} > X_{C1ji}, \text{ then } X^H_{ji} = X_{ji} - X_{C1ji} / (X_{H1ji} - X_{C1ji}) \end{aligned} \right\} (2)$$

where  $X_{ji}$  is the actual value of performance indicators  $i$  for the territory  $j$ , expressed in named units;

$X^H_{ji}$  is the normalised value indicator  $i$  for the territory  $j$ , expressed in relative units;

$X_{C1ji}$ ,  $X_{H1ji}$  are the indicator thresholds  $i$  for the territory  $j$  and the boundary between the high and middle, middle and low levels, respectively, expressed in named units.

From the ratio of (1), the normalised estimates (NE) are determined in cases where, in the native (named) system of units, a decrease in the value of the indicator leads to the deterioration of the education system ("diminishing" type indicators), and the relation (2), if a deterioration in the status is tending to increase the value indicator ("growing" type). In equations (1) and (2), for the purposes of simplification, the index belonging to the current time period is omitted –  $t$ . Classification rules on status performance indicators based on normalised estimates are presented in Table. 1.

After assessment of the status by private indicator, the status of the modules, units and the education system is determined as a whole. To solve this problem, graded scores are introduced.

**Table 1:** Classification levels of status education system by indicative parameters (IP)

| Name of level status | Abbreviated notation | Values normalised with respect to IP thresholds | Evaluation status score $b_{ji}$ |
|----------------------|----------------------|---|----------------------------------|
| High                 | B                    | $X^H_{ji} = 0$ and $X_{ji} \neq X_{C1}$         | 1                                |
| Average              | C1                   | $0 < X_{ji} < X_{C2}$ or $X_{ji} = X_{C1}$      | 2                                |
|                      | C2                   | $X_{C2} \leq X_{ji} < X_{C3}$                   | 3                                |
|                      | C3                   | $X_{C3} \leq X_{ji} < 1$                        | 4                                |
| Low                  | H1                   | $1 \leq X_{ji} < X_{H2}$                        | 5                                |
|                      | H2                   | $X_{H2} \leq X_{ji} < X_{H3}$                   | 6                                |
|                      | H3                   | $X_{ji} \geq X_{H3}$                            | 7                                |

As shown by the experience of various calculations using the proposed methodology, the most appropriate rule for determining the normalised estimates modules, power and status of the object as a whole is the calculation of the weighted average of the normalised evaluation, in which the weights are the status indicators scores (Table 1).

$$C_{kj} = \left( \sum_{i=1}^{N_{kj}} b_{ji} \cdot X^H_{ji} \right) / \sum_{i=1}^{N_{kj}} b_{ji} \quad (3)$$

where  $C_{kj}$  is the normalised assessment of the status  $k$  of the indicative module for the territory  $j$ , relative unit;

$N_{kj}$  is the number of indicators in the  $k$  indicative module for the territory  $j$ , unit;

$b_{ji}$  is the evaluation of the status score of the indicators.

### 3. Results

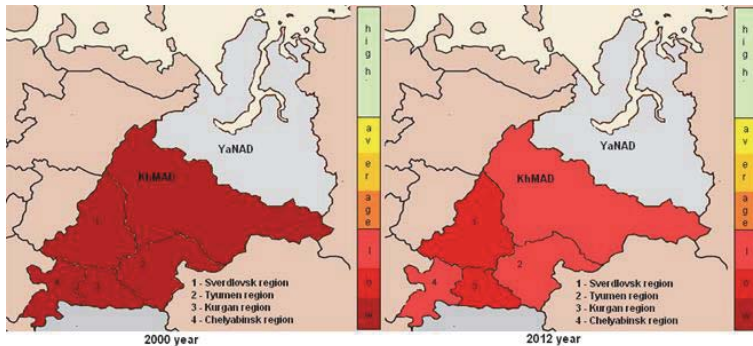
The proposed method for diagnosing the status system of HE of Russian regions has been tested on data from subjects within the UFD for the period 2000-2012. The values of threshold level indicators were regionalised on the basis of the previously described features, according to which three groups of territories were formed. Of the subjects of the UFD, in the first group was classified the Kurgan Region; in the second, the Sverdlovsk, Tyumen (without autonomous districts) and Chelyabinsk Regions; in the third, the Khanty-Mansi and Yamal-Nenets Autonomous Districts.

### 3.1 Operating conditions and status of the HE infrastructure

The status of the education system in this unit was evaluated according to three modules:

- system of HE financing;
- status of foundations and HE learning environments;
- status of human resource capacity of the HE system.

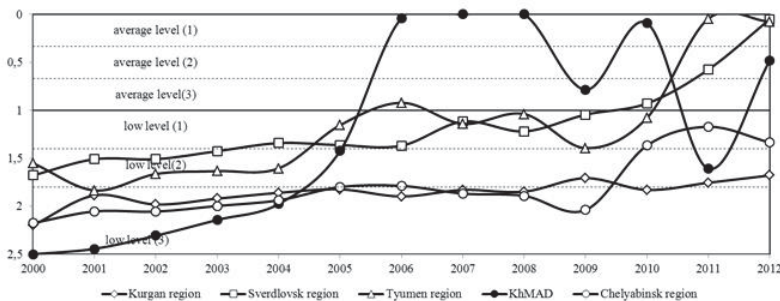
The results of the calculation for the total of the first unit for 2000 and 2012 are presented in Figure 4.



**Figure 4.** Cartographic mapping of the unit entitled “the functional conditions and status of the infrastructure of the HE system”

Based on these results, we can conclude that for the past 13 years the operating conditions and status of the HE infrastructure of the UFD have improved somewhat, although their score remained within the lower level. The most noticeable improvement was noted in the Chelyabinsk region in the south of the Tyumen region and KhMAD: an integrated assessment of the status of HE in this unit is close to the boundary of the average level. For a more detailed analysis of the situation, we consider the status of its constituent modules. Figure 5 shows the results of the evaluation financing of the HE system module.

During the analysed period 2000-2012, the status of the system of HE in subjects of the Urals Federal District shows an overall positive trend. Since 2000, there has been an increase in funding from both the public and non-governmental sectors (compared to 2000, in the enumerated values, funding had increased by 4 times by 2012; compared to 2007, it had doubled)



**Figure 5.** Dynamics of changes in terms of financing of UFD HE entities for the period 2000-2012

However, the number of faculty members and university staff in the sphere of research and development has not changed much (compared to 2000 the number of faculty staff had increased by 1.14 times by 2012 and number of researchers by 1.22 times; compared with 2007, a decline was observed in faculty staff (0.94 times) while the number of researchers remained virtually unchanged (1.03). Based on the analysed data, it can be concluded that funding per

faculty and researchers had increased. Table 2 shows the dynamics of the indicators.

**Table 2:** The dynamics of indices by module of HE system financing in comparison with the change in the number of teachers and researchers, times

| Subject of the UFD | Public financing |              | Non-governmental funding |              | Faculty      |              | Research workers |              |
|--------------------|------------------|--------------|--------------------------|--------------|--------------|--------------|------------------|--------------|
|                    | 2000 to 2012     | 2007 to 2012 | 2000 to 2012             | 2007 to 2012 | 2000 to 2012 | 2007 to 2012 | 2000 to 2012     | 2007 to 2012 |
| Ural District      | 4.4              | 1.5          | 3.8                      | 1.3          | 1.14         | 0.94         | 1.22             | 1.03         |
| Kurgan region      | 11.3             | 1.5          | 0.7                      | 0.4          | 0.76         | 0.83         | 0.54             | 1.17         |
| Sverdlovsk region  | 3.5              | 1.8          | 3.3                      | 1.6          | 1.14         | 0.94         | 0.88             | 0.89         |
| Tyumen region      | 4.3              | 1.9          | 5.4                      | 1.0          | 1.19         | 0.99         | 2.02             | 1.33         |
| KhMAD              | 16.8             | 0.2          | 26.2                     | 0.6          | 0.89         | 0.72         | -                | 2.75         |
| Chelyabinsk region | 6.7              | 1.5          | 2.7                      | 1.6          | 1.22         | 0.94         | 0.87             | 0.58         |

In 2000, all UFD subjects received low scores by status of foundations and educational conditions; in 2012, low scores were received by the Sverdlovsk and Kurgan regions; however, Chelyabinsk, Tyumen and KhMAD received high scores in the status of funding of HE institutions. In all regions of the UFD, an increase in the specific value of fixed assets, machinery and equipment per worker in HE institutions was observed. Table 3 shows the changes in the indices in 2012 compared to 2000, 2004 and 2008.

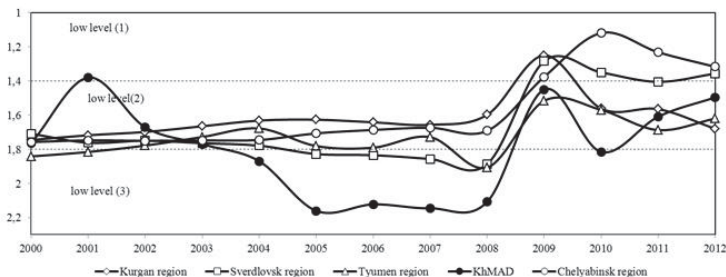
**Table 3:** Dynamics module indicators “of the Fund and the learning environment,” times

| Subject of the UFD | The cost of fixed assets, machinery and equipment |              |              | The number of university staff |              |              | Change in the value of the fixed assets, machinery and equipment per worker |              |              |
|--------------------|---|--------------|--------------|--------------------------------|--------------|--------------|---|--------------|--------------|
|                    | 2000 to 2012                                      | 2004 to 2012 | 2008 to 2012 | 2000 to 2012                   | 2004 to 2012 | 2008 to 2012 | 2000 to 2012  | 2004 to 2012 | 2008 to 2012 |
| Ural District      | 2.85  | 1.26         | 0.98         | 1.38                           | 1.21         | 1.02         | 2.29  | 1.14         | 1.01         |
| Kurgan region      | 1.34  | 0.89         | 0.88         | 0.86                           | 1.02         | 0.94         | 1.70  | 0.93         | 0.96         |
| Sverdlovsk region  | 1.92  | 1.05         | 0.83         | 1.31                           | 1.10         | 0.91         | 1.60  | 1.03         | 0.92         |
| Tyumen region      | 3.25  | 1.55         | 1.03         | 1.72                           | 1.61         | 1.13         | 2.13  | 1.05         | 0.98         |
| KhMAD              | 20.93   | 1.17         | 0.99         | 1.67                           | 0.79         | 0.70         | 13.55   | 1.60         | 1.41         |
| Chelyabinsk region | 3.04  | 1.37         | 1.10         | 1.40                           | 1.25         | 1.17         | 2.48  | 1.24         | 1.03         |

Module Indicators of HE human resource capacity indicators permit an evaluation of the security of the system of HE faculty members, researchers, and a determination of their level of qualification under the criterion of the presence of academic degrees. This module includes two synthetic indicators:

- at the level of security of the faculty system of HE, which is calculated on the basis of two partial indicators: the proportion of faculty members and researchers in the aggregate of employees of universities; the number of students per teacher in HE institutions;
- the level of the professional formation of the system of HE, which is calculated on the basis of two partial indicators: in the practical quantity of employees with academic degrees at the level of doctor and candidate of sciences.

Figure 6 shows the results of the calculation of this module.



**Figure 6.** Dynamics of changes in the status of human resources of the HE system in UFD subjects for the period 2000-2012



The results indicate a positive dynamics of the status of human resource capacity of HE in the UFD. For example, in 2000 all subjects UFD got low marks in the whole of this unit; however, by 2012 the status of human resource capacity of the system of HE in the analysed regions had improved, and the tendency towards the transition of assessments of the Chelyabinsk and Sverdlovsk regions in the mid-level area, was bringing them closer to the evaluation of the human resources potential of the KhMAD (NO = 1,496). In the Kurgan region and in the south of the Tyumen region only a slight improvement in human resource capacity of the system of HE can be noted.

Table 4 shows the changes in indicators of human resource capacity of the module system of HE.

**Table 4:** Dynamics of indicators of the "Personnel potential of HE" module, times

| Subject of the UFD | Proportion of teaching staff and scientific researchers to aggregate number of university staff |              |              | Number of students per teacher |              |              | Number of employees who have a PhD or candidate degree |              |              |
|--------------------|---|--------------|--------------|--------------------------------|--------------|--------------|--|--------------|--------------|
|                    | 2000 to 2012  | 2004 to 2012 | 2008 to 2012 | 2000 to 2012                   | 2004 to 2012 | 2008 to 2012 | 2000 to 2012   | 2004 to 2012 | 2008 to 2012 |
| Ural District      | 0.84  | 0.83         | 0.92         | 1.07                           | 0.92         | 0.94         | 1.9  | 1.9          | 1.9          |
| Kurgan region      | 0.88  | 0.78         | 0.79         | 1.53                           | 1.21         | 0.97         | 2.3  | 2.1          | 1.8          |
| Sverdlovsk region  | 0.87  | 0.91         | 1.01         | 0.88                           | 0.83         | 0.86         | 1.8  | 2.0          | 2.1          |
| Tyumen region      | 0.75  | 0.67         | 0.95         | 1.14                           | 0.88         | 0.98         | 1.9  | 1.5          | 1.8          |
| KhMAD              | 0.71  | 0.92         | 1.24         | 1.35                           | 0.79         | 1.05         | 1.9  | 1.6          | 2.2          |
| Chelyabinsk region | 0.87  | 0.82         | 0.80         | 1.17                           | 1.04         | 0.99         | 2.2  | 2.0          | 1.8          |

On average in the UFD, the proportion of faculty and research workers in the total number of employees of universities consisted 45% in 2000 (KhMAD - 49%); in 2012, there has been a gradual decline in the proportion of academics and researchers, the average for the UFD – up to 38%. In the Tyumen region and KhMAD the proportion of academics and researchers compared to the total number of employees of universities in 2012 was 35%; in the Chelyabinsk and Sverdlovsk regions the proportion was 39%, while in the Kurgan region it was 41%.

The dynamic of the number of students per teacher for the period 2000-2012 in the subjects of the Urals Federal District has a different trend. Only a small positive trend was observed in the Sverdlovsk region (a reduction in the ratio of students to teacher from 19 people in 2000 to 17 in 2012). The remaining regions are characterised by negative dynamics: in Kurgan and Tyumen regions and KhMAD the number of students per teacher had reached 24 people by 2012.

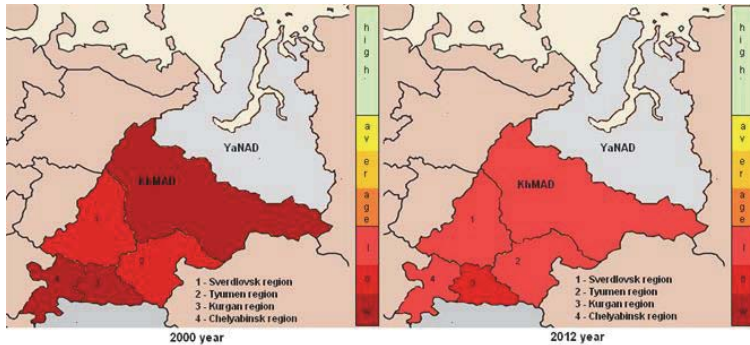
The indicator of the number of employees with academic degrees for the analysed period shows a positive trend: by 2012, it had doubled compared with 2000, with the largest increase being observed in 2009 in all regions. On average in the UFD in 2000 for 100 university staff, 25 people had advanced degrees, with the highest number in the Sverdlovsk region (27 people) and the smallest in the Tyumen region and KhMAD (21 people). By 2009, an average of UFD specific number of workers with advanced degrees to 100 university staff had reached 50 people (in the Sverdlovsk region it was 63 while in the Tyumen region it was 43). After 2009, a significant change is observed in this indicator.

Status of educational and scientific research activity in the HE system The status of the education system in this unit is evaluated according to three modules:

- status of the research capacity of the teaching staff;
- status of the educational and research capacity of students;
- the impact of research activities of the HE system.

Based on the analysis of the results of this unit, conclusions can be drawn concerning the effectiveness of the HE system.

The overall situation for this unit in 2000 and 2012 is shown in Figure 7.



**Figure 7.** Cartographic mapping of the block entitled “the functional conditions and status of the infrastructure of the HE system”

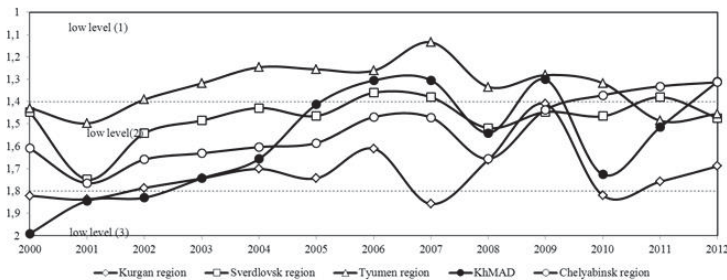
The results show that over the past 13 years the state of the educational and research activities in the regions of the UFD has improved somewhat, although these estimates were in the range of low values (less than the entire situation has changed in the Kurgan region).

For a more detailed analysis, let us analyse its components.

The module of the research potential of the faculty of the system of the composition of the HE is characterised by two synthetic indicators:

- research status of scientific, technical staff and faculty of the HE system, which is estimated by the criterion of the presence or absence of academic degrees;
- the level of involvement of scientific, technical staff and faculty in research and development, which is estimated in terms of specific R&D expenditures per employee in research work and the indicator number of the protection of employees of the university.

Figure 8 shows the results of evaluation of the module of the research capacity of the HE teaching staff.



**Figure 8.** Dynamics of changes in the status of scientific research potential of the faculties in the composition of the HE system in the UFD for the period 2000-2012

In general, the assessment of the research capacity of the teaching staff in HE in the UFD lies at a low level; however, from the schedule it can be seen that during the analysed period of the subjects an improvement may be noted (Kurgan and Chelyabinsk regions, KhMAD). Compared to 2000 estimates, the faculty research capacity remained at the same level in the Sverdlovsk and Tyumen regions in 2012 (deteriorated only slightly).

The peak values of the graphs in Figure 8 correspond to changes in the number of teaching staff and researchers with advanced degrees and the number of employees maintained by the university, as well as a change in the level of R&D funding.

Table 5 shows the dynamics of particular indicators included in this module.

**Table 5:** Dynamics of indicators of the “Research potential of the HE faculty system” module, times

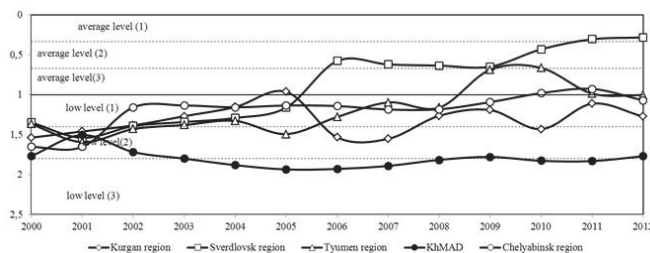
| Subject of the UFD | Number of researchers with a PhD level qualification |              |              | Number of researchers having a PhD-level qualification |              |              | R&D expenditure per person employed in research work |              |              |
|--------------------|--|--------------|--------------|--|--------------|--------------|--|--------------|--------------|
|                    | 2000 to 2012   | 2004 to 2012 | 2008 to 2012 | 2000 to 2012   | 2004 to 2012 | 2008 to 2012 | 2000 to 2012   | 2004 to 2012 | 2008 to 2012 |
| Ural District      | 1.04   | 1.14         | 1.07         | 1.08   | 1.16         | 1.06         | 3.47   | 2.10         | 1.69         |
| Kurgan region      | 1.06   | 0.91         | 0.61         | 1.24   | 1.28         | 1.18         | 11.35  | 1.89         | 1.70         |
| Sverdlovsk region  | 0.91   | 1.04         | 1.01         | 0.95   | 1.10         | 1.03         | 3.04   | 2.25         | 2.08         |
| Tyumen region      | 1.08   | 0.98         | 0.94         | 1.20   | 1.25         | 1.07         | 3.83   | 1.94         | 1.29         |
| KhMAD              | 2.15   | 1.85         | 1.04         | 1.05   | 0.94         | 0.94         | 15.66  | 2.41         | 0.57         |
| Chelyabinsk region | 1.18   | 1.42         | 1.33         | 1.20   | 1.20         | 1.09         | 2.93   | 1.79         | 1.77         |

The indicator of researchers with a doctorate degree or candidate of science changed slightly during the analysed period. In the Kurgan and Tyumen regions, a decrease was observed in the number of scientists with a PhD, and, in KhMAD – candidates. Indicator specific R&D expenditure has trends that vary by subject of the UFD; for each region, maximum and minimum values are recorded in different years. For example, in KhMAD the maximum value of the indicator was achieved in 2007 (400 thousand rubles per person in 2009 prices), compared to the minimum in 2000 (7.2 thousand rubles per person). In the Sverdlovsk region significant R&D funding gap values were observed (maximum value in 2012 144 thousand rubles per person; the minimum in 2000 was 47 thousand rubles per person in 2009 prices). As for the other subjects, the indicator changes show a positive trend with a more or less steady pace.

The module of the educational and research capacity of students allows an evaluation of the level of involvement of students in research activities and their academic performance. The module is calculated on the basis of the two synthetic indicators:

- the level of training students, which includes two private indicators: the number of students receiving scholarships, the winners of competitions (tenders) and the number of full-time students;
- the level of involvement of students in research activities, which includes two private indicators: number of scientific publications and presentations at scientific conferences with the participation of students and number of documents of title to intellectual property of students.

From the graphs presented in Figure 9, the educational and research capacity of students in HE has improved in all regions of the Urals Federal District with the exception of the KhMAD. In 2000, the assessment of all subjects was in the low level; by 2012, Sverdlovsk and Tyumen regions were already exhibiting average scores of the educational and research capacity of university students (see Figure 9).



**Figure 9.** Dynamics of changes in the formation and research potential of the faculties in the composition of the HE system in the UFD for the period 2000-2012

Table 6 shows the dynamics of particular indicators included in this module.

Compared to 2000, positive dynamics are shown in 2012 for all analysed parameters: the involvement of students in research activities increases.

The module of efficiency of research activities of HE allows the evaluation of publications and innovative activity systems of workers in the HE system. This unit includes two synthetic indicators:

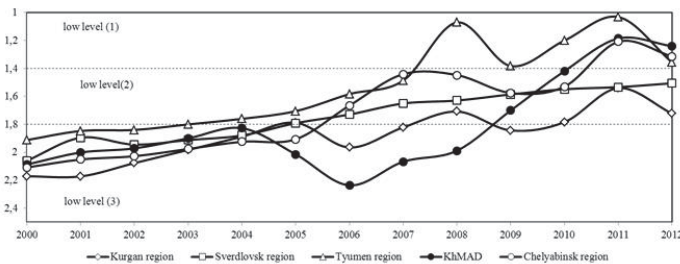
- level of innovation activity of scientific, technical staff and faculty, which is estimated by the number of

- supported patents and registered computer programs per researcher and faculty;
- level of publication activity of the faculty, which was estimated to 2011 inclusive in three partial indicators (number of academic publications, scientific articles, monographs), and from 2012 to four private indicators (number of academic publications, monographs and articles indexed in the Web of Science, Scopus and RISC databases).

**Table 6:** Modulo changes in the educational and research capacity of students, times

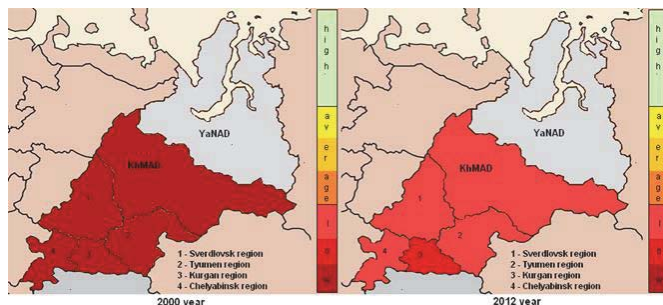
| Subject of the UFD | Quantity of students receiving a stipend, the number of students receiving scholarships, winners of competitions (tenders) |              |              | Number of scientific publications and presentations at scientific conferences with the participation of students |              |              | Number of documents of title to intellectual property of students |              |              |
|--------------------|--|--------------|--------------|--|--------------|--------------|---|--------------|--------------|
|                    | 2000 to 2012   | 2004 to 2012 | 2008 to 2012 | 2000 to 2012   | 2004 to 2012 | 2008 to 2012 | 2000 to 2012  | 2004 to 2012 | 2008 to 2012 |
| Ural District      | 5.9  | 3.1          | 1.3          | 1.5  | 1.4          | 1.2          | 3.3   | 1.6          | 1.3          |
| Kurgan region      | 14.7   | 7.8          | 1.2          | 1.3  | 1.1          | 1.2          | -   | -            | -            |
| Sverdlovsk region  | 6.0  | 3.9          | 1.3          | 1.8  | 1.7          | 1.1          | 4.0   | 4.6          | 2.0          |
| Tyumen region      | 6.6  | 2.0          | 1.3          | 1.4  | 2.0          | 1.3          | 1.3   | 0.9          | 0,5          |
| KhMAD              | 0.8  | 1.0          | 1.2          | 1.0  | 1.9          | 1.1          | -   | -            | -            |
| Chelyabinsk region | 5.4  | 2.1          | 1.1          | 1.2  | 0.9          | 1.0          | -   | -            | -            |

Figure 10 shows the results of the calculation of this module. In general, the dynamics shaping module is characterised by positive indicators: in 2000, the assessment of all subjects was in the worst part of a low level, whereas by 2012 it is possible to say that there is a tendency towards progress in the average rating.



**Figure 10.** Dynamics of changes in the impact of the research potential of the activities of the HE system in the UFD for the period 2000-2012

For all indicators, there is an increase in the publication and innovation activities of researchers and faculty. Figure 11 shows a mapping of the HE system status as a whole in 2000 and 2012.



**Figure 11.** Cartographic mapping of the state system of HE subjects of the UFD.

During the analysed period as a whole, a positive dynamics of development of HE in all regions of the UFD is indicated; this is illustrated by the approach of an integrated assessment of the state system of HE in the UFD from low to medium level of development, with the exception of the Kurgan region, where dynamics of improving estimates were less pronounced (normalised assessment of the HE system of Kurgan region decreased from 1,878 in 2000 to 1,659 in 2012). Based on this analysis, we can conclude that, despite the positive dynamics in the development of the HE system of the UFD for the period 2000-2012, increasing its effectiveness requires considerable effort, as evidenced by a low value of integrated assessments of the state of IN in the subjects of the UFD.

#### **4. Conclusion**

The results of the method according to the calculations show that the operating conditions and the state of the infrastructure of HE of the UFD as a whole for the period 2000-2012 improved; however, in the general assessment, the level of development of the HE system the county did not rise above the low level. With regard to the subjects that form the UFD, the assessment of the state of HE in all UFD regions except Kurgan and Sverdlovsk was close to the average level. A similar picture for the whole UFD was observed to improve during the study period for the educational and research activities in HE districts; in this unit, the lowest level of assessment remained the Kurgan region.

The leaders in the growth of financial security for the period from 2000 to 2012 were the KhMAD and Tyumen regions, with a faster pace of growth in funding from non-governmental sources. Increased funding is reflected in the provision of equipment, increasing the number of employees of HE in these federal subjects. At the same time the leader in the growth of the number of employees with master's and doctoral degrees became the Kurgan region (the last place in the rise of finance). The first place in the number of scientific publications, presentations at scientific conferences, as well as on the number of documents of title to intellectual property, was taken by students in the Sverdlovsk region. From this we can deduce that since the turn of the century there has been some improvement in the system of HE as a whole within the UFD as well as a marked improvement in the Sverdlovsk, Tyumen (southern region) and Chelyabinsk regions and in the KhMAD.

In this connection, the overall increase in the level of development of the HE system in the Sverdlovsk region was achieved by means of an improvement in the state of educational and research activity against the background of slightly changed conditions of its functioning and the state of the infrastructure. Conversely, in the KhMAD, despite the marked improvement in operating conditions and the state of the HE infrastructure system, a significant improvement in educational and research activity did not take place. The analysis conducted over a time period of 12 years has shown that, unfortunately, a direct correlation between the growth of investments and an increase in quality is not observed. The growth rate of financing of regional HE was in some cases several times higher in one region than another, increasing the visibility of the results. It is clear that the leaders in terms of financing and the leaders in terms of improving the quality of education are two different things. This demonstrates the need to reform the regulation of HE, particularly with regard to prioritising its development and improving the financial and economic mechanisms required to achieve this. Testing of the proposed methodological tools for data on all subjects of the RF opens wide possibilities of its use for large-scale monitoring of the state system of HE across the country.

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