Development of indicators for assessing the university development potential in solving management problems

*Tatyana Petrova**, *Tatyana Bobko*, *Galina Kazantseva*, and *Oleg Zatepyakin*

Siberian State Industrial University, 654007, Kirova Str., 42, Novokuznetsk, Russia

Abstract. The research devoted to a comprehensive study of market factors, that affect the improvement of HEIs efficiency and the possibility of solving the problems of universities management, is important for the practical implementation of the fundamental principles of enhancing the Russian universities competitiveness. Such studies are of particular importance in relation to regional universities, which are in difficult conditions: they need to strive for global competitiveness and meet the local territories requirements. The objects of the external environment having connections with universities are identified. Their internal potentials can influence the future university resulting indicators. The originality of this work lies in the proposed system of indicators for solving the problems of university management based on its development potential assessment, taking into account the influence of the external environment potentials of the personnel training market. These indicators have not been sufficiently reflected in the methodology for monitoring the efficiency improvement of universities' activities, developed and implemented by the Ministry of Science and Higher Education of the Russian Federation. The study results can serve as an information and analytical basis for making management decisions in the field of organizing university scientific and educational activities, taking into account its promising development potential.

1 Introduction

The need to solve the problem of balancing the professional training of university graduates in accordance with the needs of employing organizations in the regions where higher education institutions (HEI) are present creates the necessity to combine the efforts of education and science with business [1]. In addition, the universities today are obliged to participate in the competition at the state and international level, and this is the reason why they are forced to strategically accurately predict the trajectory of their movement and develop benchmarks (indicators) that work for the future result.

The expediency of improving the theoretical and methodological support for assessing the HEI development potential, including the development of indicators that take into

*Corresponding author: ptrvt@mail.ru

account the environmental factors used to solve university management problems, determines the relevance of the presented scientific research.

The purpose of the paper is to show the possibility of using indicative management for the strengthening processes of regional HEIs integration with the real economy, represented by territorial organizations and competitiveness enhancement of Russian universities by using the capabilities of external environment objects and solving the university management problems based on its development potential assessment.

The research objectives:

- to investigate the information and analytical links between the HEI potential and the potentials of objects in the external environment on the basis of the methods of system analysis;
- to develop indicators for solving problems of university management based on the potential of its development.

The subject of the research is indicators reflecting information and analytical links and organizational and economic relations that arise between the objects of the regional market of personnel training in the process of HEI scientific and educational activities.

The object of research is the objects of the scientific and educational infrastructure of the regional personnel training system.

Taking into account the poor predictability of many market factors, the forecast for the HEI development is considered as an “assessment of opportunities” based on the analysis of the conditions existing in the external environment of the educational services market.

In the course of the research, the general level and increasing importance of scientific knowledge in the world were taken into account; the advantages of domestic HEIs that occupy the top lines of world and domestic rankings in the field of the quality of specialists training, achievements in fundamental and applied sciences and innovations, the needs of the Russian universities in resources to increase the rating potential and sustainability of development based on the assessment of the potential reserves of the external environment objects in the regional market of educational services.

The essence of the notion “potential” is defined on the basis of the dynamic concept of development potential and is formulated as “a set of variable quantitative and qualitative properties of resources, means, sources and opportunities”.

Determination of the potential is an important component of the research solving problems related to the forecasting the socio-economic development of the object under study.

The following conditions were taken into account when developing the indicators for solving the problems of HEI management based on the assessment of its development potential:

1. Development of indicators for solving the problems of HEI management based on the assessment of its development potential creates the basis for the formation of a methodology for coordinating the results of forecasting, strategic planning and programming of the HEI development with objects of the external environment.

2. The options of socio-economic, scientific, technical and innovative development of the country as a whole and the territory with a particular HEI are analyzed and taken into account in the process of using indicators to solve the problems of HEI management based on the assessment of its development potential[2].

3. The forecasted indicators take into account: the trends in the development of higher education reflected in the Russian state policy in the field of higher education development and the main qualitative changes in higher education in economically developed countries [3].

4. The composition of quantitative and qualitative indicators assessing the future state of the university and forecasting tools are consistent with the forecasting time horizon.

5. A set of indicators, comprehensively characterizing the potentials of objects in the external environment of the territorial personnel training market, is used as the initial information for the of indicators development for solving the problems of HEI management based on the assessment of its development potential.

6. The objective information is withdrawn from the sources of the Federal State Statistics Service (Rosstat) and its territorial divisions and creates the prerequisites for making sound strategic management decisions on the HEI development.

7. The dynamic nature of the assessment of HEI development potential provides in each time period a sufficient horizon to take into account the changes in the objects potentials in the external environment of the personnel training market and substantiate the priority directions for the HEI development.

8. The adaptability of the indicators to changing market conditions is ensured in order to develop reasonable indicators for solving the problems of HEI management on the basis of assessing the its development potential.

2 Materials and methods of research

Domestic studies in the field of the higher education system development are presented in the works of V.A. Sadovnichy, Yu.P. Dubrovchenko, Z.N. Sergeeva, A.A. Firsova and others [4,5,6,7].

International studies are represented by the works of H. De Wit, A. Zomer, P. Benneworth, R. Pinheiro, G.C. Jones and others [8,9,10].

The research of T.V. Fedosova, E.A. Kobets, T.V. Morozova, V.N. Kurbatsky, D.Yu. Busygin and other authors are devoted to the assessment of HEIs potential [11,12,13].

The issues of forming a list of indicators characterizing certain types of universities potentials are reflected in the studies of E. Cherkesova, L.N. Topchienko, D.N. Krymzin, P.G. Ryabchuk and other scientists [14,15,16].

However, they do not pay attention to the issues of the HEI development in relation to the potentials of the objects in the external micro- and macro-environment of the regional personnel training market.

2.1 Empirical base of research

Materials of the Information and Analytical Center of the Ministry of Science and Higher Education of the Russian Federation, Methodology for monitoring the HEIs effectiveness, developed by the Ministry of Science and Higher Education of the Russian Federation, data from the Federal State Statistics Service and its Territorial authority in Kemerovo Region (Kemerovostat), research conducted by the domestic and foreign scientists, our own analytical development.

2.2 Research methods

The analysis of scientific literature and other sources of information, the method of system analysis, the method of formal-logical modeling, the study and generalization of research materials on the topic under study, deduction, comparison.

At present, education in our country is in the sphere of priority interests of the state, which is reflected in the Federal Law "On Education in the Russian Federation" and is emphasized by the implementation of the national project "Education" with many federal

projects in its composition [17,18]. This is due to the fact that the innovative future of Russia and its competitiveness improvement among the world’s leading economic powers depend on the level of development of the educational system.

Thus, changes in the educational system of our country are taking place in the process of international reformation of higher education, and in modern conditions, domestic HEIs are becoming the driving force of social economic growth. The distinctive features of the conditions of their functioning include:

- 1) diversified state support for universities in the form of state orders and grants, allocation of funds for the implementation of development programs, direct budget financing;
- 2) globalization of activities (attraction of foreign students and teachers, cooperation with the world universities in the field of scientific and educational programs, participation in international scientific research, etc.);
- 3) integration of research and educational activities;
- 4) training of potential staff for innovative areas of industry, partnership with regional and multinational companies;
- 5) interdisciplinary nature of educational programs, expressed in the creation of problem centers and laboratories;
- 6) formation of students’ universal complementary competencies (humanitarian, engineering and technological).

Improvement of the HEIs management system should be based on identifying and taking into account the qualitative and quantitative dependencies between performance management and the value of the HEI development potential, which are formed due to the HEI internal potentials and the potentials of the external environment.

The dynamics of social development predetermines the need to assess the future state of an object (HEI) in accordance with the interdependent interaction in the process of training scientific and professional staff with other objects in the educational market system and trends in their transformation. An assessment of the HEI development potential is formed in the form of a forecast of probable results.

The potentials system model of the objects from scientific and educational infrastructure of the regional personnel training system is shown in Figure 1.

Fig. 1. The potentials system model of the objects from scientific and educational infrastructure of the regional personnel training system (Note: compiled by the authors).

The HEI or their totality refers to the socio-economic system. The transformation process in it cannot occur instantly but has a certain duration in time. Therefore, the educational services market can be classified as discrete dynamic systems and the state of its separate object (HEI) can be described by dependence reflecting multi-channel input and multi-channel output (Figure 1):

$$Y(t) = F[X_1(t), X_2(t), X_3(t), Z_1(t), Z_2(t)], \quad (1)$$

and along with this: $Y(t) \rightarrow \max$,

where $Y(t)$ – the resulting state of the HEI at a timepoint t (the result of the activity at a certain point of time). The target state of the HEI is the most efficient;

$X_1(t)$ – the dependence of the HEI state on the parameters of the input values of the subject of control (state) at a timepoint t ;

$X_2(t)$ – the dependence of the HEI state on the parameters of the input values of the consumer market of educational services at a timepoint t ;

$X_3(t)$ – the dependence of the HEI state on the parameters of the input values of the market potential (including the potential of the labor market) at a timepoint t .

$Z_1(t)$ – the dependence of the state of the system object on the parameters of its output values, reflecting the HEI scientific activity at a timepoint t ;

$Z_2(t)$ – dependence of the state of the system object on the parameters of its output values at a timepoint t .

Each of the dependencies given in formula 1 can be formalized and represented by a numerical value, i.e. mathematically described.

Let us analyze the potentials system of the objects of the regional scientific and educational infrastructure in order to study the potentials of the HEI internal and external environment, which affect its resulting state $Y(t)$. The use of the method of system analysis made it possible to investigate the information and analytical links between the HEI potentials and the potentials of the objects in the external environment.

The set of indicators used to assess the potentials of objects in external environmental is formed from two types of indicators: economic and social.

$X_1(t)$ – the dependence of the HEI state on the parameters of the input values of the subject of control (state) at a timepoint t .

The improvement of the organizational foundations of the HEIs functioning presupposes, on the one hand, the expansion of society participation in management, on the other hand, the development of autonomy, but in any case, the mandatory preservation of state influence and state support in various forms.

The public administration potential of a HEI presupposes the degree of organizing and regulatory influence of government bodies on the HEI activities and the process of redistribution of material benefits.

Implementing the policy in the field of education, the State has identified the main priority strategic goals and tactical tasks.

The strategic goals of the State in this area include:

1. Ensuring the availability of good education for all segments of the population.
2. Meeting the current and future needs of the economy and social sphere in professional personnel of the required qualifications.
3. Creation of conditions for enhancing innovation.

The indicators reflecting the dependence of the HEI state on the parameters of input values from the state as a subject of management are presented in Table 1.

Table 1. Indicators forming $X_1(t)$

Factor of external environment	Indicator
<i>Economic factors of the external environment (X^E_1)</i>	
Potential of government control over HEI(potential of government spending on education)	- the rate of growth/decline in the value of government spending on education within the structure of government spending per 1000 students ($X^{E_{1.1}}$)
	- the rate of growth/decline in the share of subsidies received by the HEI within the framework of the state order in the total volume of HEI income per 1000 students ($X^{E_{1.2}}$)
	- the rate of growth/decrease in the share of the volume of funds realized by the HEI within the framework of the implementation of National projects and state target programs per 1000 students ($X^{E_{1.3}}$)
Potential of government control over HEI (the potential of government control over the optimization of the HEI’s expenses)	- the rate of growth/decline in the cost of educational programs ($X^{E_{1.4}}$)
	- the rate of growth/decline in the cost of annual payments for training (or the cost of education for the entire period of training) ($X^{E_{1.5}}$)
<i>Social factors of the external environment (X^S_1)</i>	
Potential of government control over HEI (the potential of government control over the implementation of the quality management system GOST R ISO 9001-2008)	- the rate of growth/decline in the number of accredited educational programs implemented in accordance with the Federal State Educational Standard ($X^{S_{1.1}}$)
	- the rate of growth/decline in the number of licensed educational institutions ($X^{S_{1.2}}$)
Potential of government control over HEI (the potential government control over the development of the educational services market)	- the rate of growth/decline in the share of foreign students who received their high education at a full-time department and/or in a distant mode on the platform “Digital Education platform” ($X^{S_{1.3}}$)
	- the rate of growth/decline in the share of domestic students who received their high education at a full-time department and/or in a distant mode on the platform “Digital Education platform” ($X^{S_{1.4}}$);
Potential of government control over HEI (the potential of government control over the degree of HEI participation in the digital platform “Digital Education” (from 2024 according to the program “Digital Economy of the Russian Federation”))	- the growth rate of the number of training courses developed by universities and placed on the platform “Digital Education” ($X^{S_{1.5}}$)
	- growth rate of the peak load of the “Digital Education” platform ($X^{S_{1.6}}$);
	- the rate of growth in the number of students majoring in IT technologies ($X^{S_{1.7}}$);

$X_2(t)$ – the dependence of the HEI state on the parameters of the input values of the consumer market of educational services at a timepoint t .

The consumer market for educational services is represented by graduates of secondary schools and colleges. Representatives of this market form the resource potential of the HEI external environment.

The economic indicators should take into account: 1) the needs of regional organizations in qualified personnel to ensure their economic growth; 2) the dynamics of population well-being. The main indicators for assessing the dynamics of the regional economic development are: the rate of economic growth, the level of industrial development, labor efficiency.

The social factors reflect the level of education and preferences of the population in obtaining an education of a certain level and profile. They express the volume of social need for higher education and the demand for educational services.

All factors, that form $X_2(t)$ –the dependence of the HEI state on the parameters of the input values of the consumer market of educational services at a timepoint t, can be formalized and described by indicators published in statistical collections of the Federal State Statistics Service and presented in Table 2.

Table 2. Indicators forming $X_2(t)$

Factor of external environment	Indicator
<i>Economic factors of the external environment (X^E_2)</i>	
Resource potential (potential for economic development of the region where the HEI is located)	- GRP growth / decline rate ($X^{E_{2.1}}$)
	- indices of industrial production by type of economic activity ($X^{E_{2.2}}$)
	- темп роста/снижения производительности труда ($X^{E_{2.3}}$); - rate of growth / decline in labor productivity ($X^{E_{2.3}}$);
	- the rate of growth/decline in average monthly wages ($X^{E_{2.4}}$)
Resource potential (solvency potential of the population in the)	- the rate of growth/decline in household expenditures on education services payment (in% to consumer spending) ($X^{E_{2.5}}$)
<i>Social factors of the external environment (X^S_2)</i>	
Resource potential (potential demand for higher education services in the region)	- the rate of growth/decline in education of the population (the proportion of the population with higher education) ($X^{S_{2.1}}$)
	-% of schoolchildren who enter the 10 th grade relative to those who graduate from the 9 th grade ($X^{S_{2.2}}$);
	-% of schoolchildren who choose technical disciplines for passing the exam ($X^{S_{2.3}}$);
	-% of schoolchildren who choose humanitarian disciplines to pass the exam ($X^{S_{2.4}}$);
Resource potential(potential for preparing secondary school graduates for higher education)	-% of 11 th grade graduates who pass the exam in technical disciplines (mathematics, computer science, physics, chemistry) with 100 points ($X^{S_{2.5}}$)
	-% of 11 th grade graduates who pass the USE in the humanities with 100 points ($X^{S_{2.6}}$)
	-% of 11 th grade graduates who pass the exam in technical disciplines (mathematics, computer science, physics, chemistry) with 80-99 points ($X^{S_{2.7}}$)
	-% of 11 th grade graduates who pass the USE in the humanities with 80-99 points ($X^{S_{2.8}}$)
	-% of 11 th grade graduates who win prizes in international or all-Russian Olympiads in technical disciplines (mathematics, computer science, physics, chemistry) ($X^{S_{2.9}}$)
	-% of 11 th grade graduates who win prizes in international or all-Russian Olympiads in humanitarian disciplines ($X^{S_{2.10}}$)
Resource potential(potential for demographic development of the region where the HEI is located)	- the rate of increase/decrease in the population of the region ($X^{S_{2.11}}$)
	- the rate of increase/decrease in the birth rate of the population ($X^{S_{2.12}}$)
	- the share of the population aged 15 and younger ($X^{S_{2.13}}$)
	- the rate of migration increase/decrease of the population ($X^{S_{2.14}}$)

The research conducted in 2017 by the International Laboratory for Evaluation of Practices and Innovations in Education at the National Research University Higher School of Economics, showed that in regions with a higher GRP value the USE results of the

school graduates were on average 3 points higher than in the regions with a lower GRP [19]. This confirms the importance of taking into account the rate of GRP growth/decline for assessing the HEI development potential.

$X_3(t)$ – the dependence of the HEI state on the parameters of the input values of the market potential (including the potential of the labor market) at a timepoint t .

A feature of this relationship is the presence of a time lag between the requirements of the labor market entities (employers) and the ability of HEIs to meet these requirements. Let us assume the minimum HEI response time to an employer's request $n = 4$ years which is the period of earning the Bachelor's degree at the first level of higher education. When the demand structure changes, the value of the parameter will change. For example, if there is a demand for specialists with certain qualification characteristics, the dependence will look like $(t+5)$. With an increase in the demand for managerial personnel, the expectation can increase by two years of Master's degree programme and take the form $(t+6)$.

One of the goals of state support for the development of society and the economy is the development of cooperation between Russian HEIs and industrial enterprises, the development of educational and scientific activities in HEIs, stimulating the use of the potential of Russian universities by industrial enterprises, stimulating innovation and the development of science-intensive production [20].

Requirements of the labor market in general, and employers in particular, to the competencies of HEIs graduates determine the need for a purposeful formation of the potential of public-private partnership by universities. With this approach, the development of the "Concept of Targeted Cooperation" between the HEI and employers and the conclusion of an "Agreement on Strategic Partnership" between the HEI and specialized organizations are of particular importance.

Strengthening of the cooperation between HEIs and employers, first of all, should be aimed at the formation of professional competencies within the profile of future activities of students and obtaining skills and practical experience as a result of participation in real projects of specialized organizations.

The main types of cooperation between the HEI and enterprises – employers might be:

- in the field of support for applicants to universities – creation of technological schools (for example, a school of management, a school of programming, etc.), in which prospective students can receive basic professional knowledge, make a choice of the future profession, develop creative thinking, learn to work in a team, etc.; organization on the HEI basis of pre-university training for passing the USEs and entering the university;
- in the field of education – an increase in the number of training profiles in demand on the labor market; order for targeted training of a specialist and formation of an individual curriculum; development and implementation of educational programs; support of the best students awarding them personal scholarships, the introduction of a student loans system, assistance in the modernization of educational equipment; creation of online technologies for participation in the educational process on the workplaces; provision of teaching materials and benefits for the use of software of enterprises – employers; conducting excursions to production facilities of specialized enterprises, educational, industrial and pre-diploma internship; opening of educational centers "school–university–enterprise", conducting master classes for students in universities by representatives of employers, business games, etc.; preparation of term papers and final qualification works devoted to the solution of urgent problems at organizations;
- in the field of R&D – development of a strategy for using the results of scientific activities and maximizing profits; organization of joint scientific laboratories; participation of specialists from employing organizations in scientific and practical conferences, days of science, joint innovation projects, etc.; holding competitions and specialized seminars aimed at developing the innovative activity of students; financing of scientific events;

- in the field of employment – the formation of a “career portfolio”; labor market monitoring; organization of job fairs and the creation of a sector-specific Internet labor exchange; certification of university graduates at the request of employers; employment of students for jobs during summer vacations, organization of internships; creation of opportunities for students to participate in real projects of specialized organizations, etc.

Within the framework of the study, this type of potential should be considered as a combination of various types of resources, including intellectual, financial, scientific and technical and others, with can help obtain certain results.

Table 3. Indicators forming $X_3(t)$

Factor of external environment	Indicator
<i>Economic factors of the external environment (X^E_3)</i>	
Market potential (potential for motivating students)	- growth/decline rate of average industry wages in the region ($X^{E_{3.1}}$);
Market potential (potential of economic partnership between the HEI and employers in the region)	- the rate of growth/decline in the volume of extra-budgetary funds attracted by HIEs from enterprises in the region for the implementation of innovative projects on the basis of agreements (contracts) ($X^{E_{3.2}}$)
	- the rate of growth/decline in the number of completed (due to extra-budgetary funding) and implemented (commercialized) partner innovation projects ($X^{E_{3.3}}$)
	- the rate of growth/decline in HEI revenues from the implementation (commercialization) of partner innovation projects ($X^{E_{3.4}}$)
<i>Social factors of the external environment (X^S_3)</i>	
Market potential (labor market potential)	- the rate of growth/decline in the labor market demand for young specialists in the region ($X^{S_{3.1}}$);
	- the rate of growth/decline in the number of unemployed with HE ($X^{S_{3.2}}$)
Market potential (potential of social partnership between the HEI and employers in the region)	- the rate of growth/decline in the number of innovation-oriented university personnel undergoing training and improving skills in joint activities with enterprises of ($X^{S_{3.3}}$)
	- the rate of growth/decline in the number of HEI students who do an internship at the workplaces of regional enterprises ($X^{S_{3.4}}$)
	-% of the formed educational programs (majors) at the request of employers in the total volume of HEI educational programs (majors) ($X^{S_{3.5}}$)
	-% of the educational programs developed jointly with employers in the total volume of developed educational programs at the HEI ($X^{S_{3.6}}$)
	-% of the received positive expert opinions on training programs from employers in the total volume of developed training programs at the HEI ($X^{S_{3.7}}$)
	-% of the created competency maps for directions of training and specialties in demand on the regional labor market in the total amount of areas of training and specialties in the HEI ($X^{S_{3.8}}$)
	- the rate of growth/decline in the number of disciplines of the basic part of the educational program, mandatory for study by the bachelor's degree students, and which are based on the project-modular training (taking into account the professional standard) ($X^{S_{3.9}}$)
	- the rate of growth/decline in the number of disciplines of the educational program aimed at mastering competencies by the bachelor's degree students in the field of professional activity, and which are based on the project-modular training (taking into account the professional standard) ($X^{S_{3.10}}$)

Table 3. Continued

Factor of external environment	Indicator
<i>Social factors of the external environment (X^S_3)</i>	
Market potential (potential of social partnership between the HEI and employers in the region)	- the rate of growth/decline in the number of publications indexed in the Scopus database or in the “Network of Science” database (WEB of Science), or patents created by the joint creative work of the HEI scientists and the specialized organization in the total volume of publications (patents) of the HEI ($X^{S_{3.11}}$)
	- the rate of growth/decline in the number of HEI students participating in joint innovation activities with regional enterprises (per 1000 students) ($X^{S_{3.12}}$)
	- growth rate/decline in the number of implemented innovative projects; ($X^{S_{3.13}}$)
	- the rate of growth/decline in the number of students participating in programs, projects and competitions organized by specialized organizations and social partners of the HEI ($X^{S_{3.14}}$)

$Z_1(t)$ – the dependence of the state of the system object on the parameters of its output values, reflecting the HEI scientific activity at a timepoint t .

Indicators of the results of HEIs scientific activities are of great interest both for employing organizations and for society as a whole. The immediate results of the scientific activity of HEI graduates (economic aspect) are easily identified and quantified.

Indicators of the social aspect of the graduates research potential are aimed at increasing the employers satisfaction with the quality of graduates training by the HEI.

Table 4. Indicators forming Z_1

Factor of external environment	Indicator
<i>Economic factors of the external environment (Z^E_1)</i>	
Research potential of HEI graduates (economic aspect)	- the rate of growth/decline in the number of R&D performed by HEIs for the real sector of the economy (financed from the state budget) ($Z^{E_{1.1}}$)
	- the rate of growth/decline in the volume of R&D performed by HEIs for the real sector of the economy (financed by enterprises of the real sector of the economy) ($Z^{E_{1.2}}$)
<i>Social factors of the external environment (Z^S_1);</i>	
Research potential of HEI graduates (social aspect)	- the rate of growth/decline in the number of graduates enrolled in the Master’s degree programs and postgraduate programs ($Z^{S_{1.1}}$)
	- the rate of growth/decline in the number of graduates enrolled in the Master’s degree programs and postgraduate programs ($Z^{S_{1.2}}$);
	- the rate of growth/decline in the number of publications and the citation index of graduates enrolled in the Master’s degree programs and postgraduate programs ($Z^{S_{1.3}}$);

$Z_2(t)$ – dependence of the state of the system object on the parameters of its output values at a timepoint t .

The assessment of the dependence of the HEI state on the potential of graduates is of great importance because it reflects the quality of graduates training and allows the attention of the target audience – a group of potential consumers of educational services to be attracted.

Recently, there has been a lot of criticism from employers directed at the higher education system not meeting the needs of the labor market. This leads to significant qualitative and quantitative discrepancies between the demand for labor of specialists with higher education and their supply. In this regard, it is advisable to measure the labor

potential of a HEI graduate, which is understood as the measure and quality of the graduate aggregate readiness for work [21]. The measure of a graduate readiness for work can be defined as a quantitative value that consists of a set of general professional competencies that are in demand by employers. But as for the quality of a graduate readiness for work, the range of assessment indicators is quite wide.

Table 5. Indicators forming Z (2)

Environmental factor	Indicator
<i>Economic factors of the external environment (Z^E_2)</i>	
Personnel potential of graduates	- the rate of growth/decline in the number of rationalization proposals, patents for inventions, know-how, etc., performed by the teams at enterprises in the real sector of economy with the participation of HEI graduates during their first five years of work ($Z^{E_{2.1}}$)
	- the rate of growth/decline in the amount of funds attracted (saved) by enterprises as a result of the implementation of rationalization proposals, patents for inventions, know-how, etc., performed by the teams at enterprises of the real sector of economy with the participation of HEI graduates during their first five years work ($Z^{E_{2.2}}$)
<i>Social factors of the external environment (Z^S_2)</i>	
Personnel potential of graduates	- the rate of growth/decline in the number of graduates who have mastered some related knowledge, including those who received additional education ($Z^{S_{2.1}}$)
	- the rate of growth/decline in the number of graduates employed in the specialty ($Z^{S_{2.1}}$)
	- the rate of growth/decline in the number of employed graduates who confirm the quality of the mastered general professional competencies with the employer during the first year of work ($Z^{S_{2.3}}$)
	- the rate of growth/decline in the number of graduates employed at enterprises of the real sector of economy after completion of the Master's degree program and postgraduate program ($Z^{S_{2.4}}$)
	- the rate of growth/decline in the number of graduates employed in research/innovation centers at enterprises of the real sector of economy after completion of the Master's degree program and postgraduate program ($Z^{S_{2.5}}$)
	- the rate of growth/decline in the number of graduates who are appointed to senior positions in the first 3-5 years after graduation ($Z^{S_{2.6}}$)

3 Results

1. The potentials system model of objects in the scientific and educational infrastructure of the regional system of personnel training is created on the basis of the potentials interaction of objects from the internal and external environment of this system.
2. The dependence that describes the resulting state of the HEI is proposed, taking into account the potentials of the objects from the external environment of the HEI, and that displays the multichannel input and the multichannel output of the potentials of the objects from the external environment.
3. The assessment indicators of the HEI development potential for solving the problems of HEI management, determining its resulting (prospective) state at a timepoint t, are developed.

4 Conclusions

The results obtained are of practical importance, the application of a model based on the use of indicators will provide an opportunity for HEI administration to solve management problems based on sufficiently complete information about the potentials reserves of objects from the external environmental, which will allow sound decisions to be made in the process of managing the HEI development.

The developed model differs from the existing ones by the possibility of obtaining potentials quantitative values of the external environment objects for assessing the future state of the HEI.

References

1. G.G. Kazantseva, T.V. Petrova et al., *Basic Research*, **7** (2017)
2. T.V. Bobko, T.V. Petrova, *Artif. Societies*, **15** (2020)
3. T.V. Bobko, T.V. Petrova, Yu.V. Dubovik, *Audit and Fin.Anal.*, **2** (2020)
4. V.A. Sadovnichy, *Eurasian University Mission* (2019)
5. Yu.P. Dubrovchenko, Yu.V. Feneva, *Current Issues of Vocational Educ.*, **4** (13) (2018)
6. Z.N. Sergeeva, *Sci. Dialogue*, **6**(54) (2016)
7. A.A. Firsova, R.S. Reicher, *Career Guidance*, **2** (2019)
8. Hans de Wit, *Educational Studies Moscow*, **2** (2019)
9. A. Zomer, P. Benneworth, *The rise of the university's Third Mission* (2011)
10. R. Pinheiro, G.C. Jones, P. Benneworth (eds), *Universities and regional development: a critical assessment of tensions and challenges* (2012-2014)
11. T.V. Fedosova, E.A. Kobets, *IEEE Int. Conf. on Quality Management, Transport and Information Security, Information Technologies IT and QM and IS* (2019)
12. T.V. Fedosova, T.V. Morozova, *IEEE 6th Forum on Strategic Partnership of Universities and Enterprises of Hi-Tech Branches (Sci. Educ. Innov.)* (2017)
13. V.N. Kurbatsky, D.Yu. Busygin, *Accounting and Analysis*, **8**(284) (2020)
14. E.Yu. Cherchesova, L.N. Topchienko, *Bulletin of SRSPU (NPI)*, **1** (2008)
15. D.N. Krymzin, *Economics, Statistics and Informatics. Bulletin of UMO*, **2** (2014)
16. P.G. Ryabchuk, E.V. Gnatyshina et al., *Society and Power*, **4** (2017)
17. Federal law on education in the Russian Federation, 273 (2012)
18. National project "Education", <https://edu.gov.ru/national-project/>
19. A.B. Zakharov, O. V. Lazarev, K.A. Adamovich, *How do USE scores differ by region: student performance and regional inequalities*, <https://ioe.hse.ru>
20. Resolution of the Government of the Russian Federation No. 218 dated 9 April 2010
21. I.Yu. Shakhova, *HR Specialist. Human Resource Management*, **5** (2013)