Impact of human capital on sustainable development of Russia in digitalization environment

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Abstract. Studies of human capital at the present stage of human development are extremely relevant, since at present human capital is steadily transforming from a factor of economic development into a target for its sustainable development. The paper proposes the basic tool i.e. a new mathematical model for assessing the impact of human capital on social well-being and development of Russian society. It uses the interdependencies among the criteria of human capital and general development. The tool proposed in paper will be powerful for improving and increasing the quality of human capital, improving the social welfare of society, bringing the most effective innovative solutions to the economy. The Human Capital can be assessed in particular by publications, proceedings, and other types of knowledge representation on the websites. And also all this materials can be automatically placed in other databases, including in Elibrary which can also be a parameter of a model. The assessments of the impact of human capital on social well-being and the development of regions and countries can be obtained automatically on-line.

1 Introduction

Studies of human capital at the present stage of human development are extremely relevant, since at present human capital is steadily transforming from a factor of economic development into a target for its development. Therefore, there is a reassessment of its role in the development of society, the importance of various types of capital in the economy. The problem of improving the quality of human capital is crucial in our country. However, despite the relevance of this problem, the increasing number of publications on this topic, the methodological issues of assessing the impact of human capital on social well-being and social development are still not well developed: the existing approaches to valuation are non-

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perfect, they are difficult to put into practice, especially in light of the country's ongoing digitalization.

Since in this process physical capital, identified with labor, which is part of the productive forces of society, yields leadership to intangible productive forces, human capital, it is necessary to consider concepts such as social well-being and social development for an objective assessment of human capital from a system perspective.

Following [1], society is understood as a stable system of relationships formed within a long historical period of time within the human community with established mechanisms and means of production, distribution, consumption of all goods (material and spiritual) within the framework of existing political, moral, spiritual, social institutions.

Social well-being is an integral criterion that determines the fundamental factors of the quality of life of people: material status, health, the safe existence of both the individual and the safety of public life in general. This criterion in everyday life reflects the effectiveness of public administration [1].

In [2], social well-being refers, in particular, to the following factors: average monthly cash income per capita, the share of the population's expenses on food, its purchasing power, the share of the poor in the total population, the share of expenses on culture and recreation in the structure of all expenses, Gini coefficient (reflects inequality of incomes of the population), questionnaire assessment of the material situation of the population, average age of life, registered number (per 1000 people) of the diagnosis established for the first time in life, mortality per 100,000 people in road accidents, the number of suicides, mortality per 100,000 people from poisoning alcohol, the number of patients with alcoholism, the number of drug addicts per 100,000 people, a questionnaire on the state of health care, the number of homicides per 100,000 people, the number of recorded crimes, the number of victims of criminal acts per 1000 people, a questionnaire on the level of crime, a questionnaire on the level of confessional and national conflicts, the birth rate of the population (per 1000 people), the level of regional migration, the number of children without parents, etc.

Based on these indicators, a rating of regions for social welfare is built. Of course, the choice of indicators may vary based on an assessment of their importance for the purposes of the studies in question.

K. Marx showed how the economy is primary connected to social relations. But modern scientists recognize that all the constituent institutions of public life (economic, social, political, spiritual) are closely linked and influence each other, being, in most cases, not one of them dominating. In the modern world, human behavior depends on the state of all four areas, as it enters into relationships on a daily basis, both political, and economic, social, cultural.

Then, based on a systematic approach to the development of society and for a correct understanding of the main trends and significant changes in modern society under the influence of digitalization, human capital (HK) in modern science means the stock of knowledge, health, skills, experience, culture that are used an individual to generate income [3].

In the works of T. Schulz and G. Becker, "human capital includes acquired knowledge, motivation, skills, abilities and energy that a person is endowed with and which can be used by him for a certain period of time for the purpose of producing goods or services" [4]. A number of scientists describe the HK through indicators such as: the cost of migrating workers from places with relatively low wages to places with higher wages, which is a consequence of labor productivity, and other sources of household income [4], quality of life [5, 6], or as the ability to innovate [7], the birth and upbringing of children.

But mainly the following components of human capital are used: education, health, culture.

Investing in education leads to an increase in highly qualified specialists, which results in an increase in labor productivity, product quality and output.

Investing in the field of health leads to an increase in the working time of people, in particular due to the reduction of diseases.

Investing in culture ultimately leads, through strengthening moral standards, to raising the level of public and social security, to developing the creative potential of the individual.

Depending on the level of investment in a particular indicator of human capital, its value increases by a certain age (usually the end of the second decade of work experience), after which it begins to decline.

According to the Higher School of Economics in Russia, in the coming years, the most active part of the population that can act as a driver of economic growth will be a group of about 40% of the population, characterized by a high-level education with a developed consumption model and focused on self-development. They are able to allocate 2/3 of the funds for culture, housing, quality education and healthcare, as well as reserves for future investments.

2 Materials and methods

2.1 Problems of mathematical modeling for assessing the impact of human capital on social well-being and development of Russian society

As follows from the definition of human capital, society and social well-being, their relationship can be defined as follows (Fig. 1).

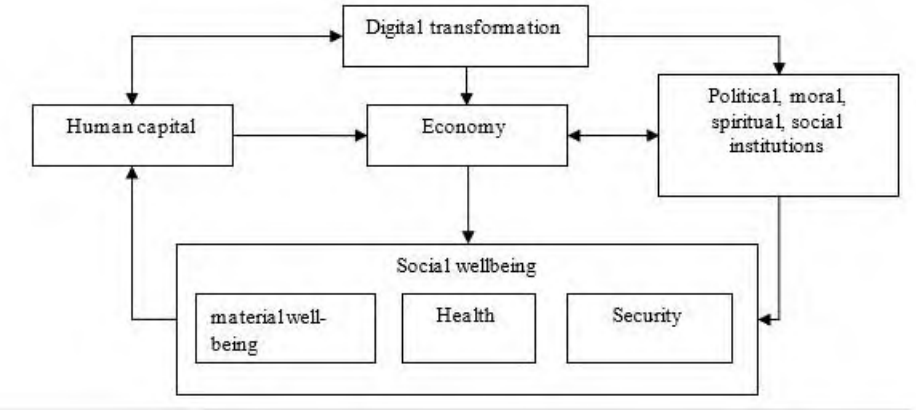

Fig. 1. Mutual influence of human capital, society, social well-being and digital transformation.

As noted above, it is the effective use and development of human capital, the ability to create and master the latest technologies that become not only critical conditions for the sustainable development of the economy, but also the main factors in the growth of well-being of countries and regions. With the balanced development of political, moral, spiritual, social institutions, there is an increase in social well-being, which directly affects the improvement of human capital. The digital transformation of society and the economy and human capital itself further strengthens this relationship.

Such a science, as the theory of systems, is precisely engaged in research of such education, which has a great variety, described by a variety of indicators that characterize, as a rule, a system in dynamics. Moreover, changes in indicators are often interconnected and

interdependent. From the point of view of the theory of systems for their control, the most important task is to study the nature of the relationship between indicators (features). The most developed in this regard are statistical methods. Most studies of objectively existing relationships in socio-economic systems are carried out by these methods. In the process of statistical analysis of dependencies, cause-effect relationships between phenomena are found, which make it possible to identify factors that show the main influence on the change of phenomena and processes allocated to the object of study (productive signs). Factors (x) are called signs that cause changes in other productive signs (y). Mathematically, this can be expressed as $y = f(x)$.

However, statistical methods impose certain restrictions on the characteristics that must be taken into account in research, based on an understanding of the nature of the relationship between productive characteristics and factors. The signs that must be included in the analysis must meet the following conditions: they must be quantifiable; there should be no intercorrelation of signs, otherwise, a functional relationship.

The presence of a functional relationship, expressed mathematically, for example, between productive attributes and factors in the form $y = (x)$ and $x = (y)$, often leads to the system being unconditioned, resulting in unreliability and fuzzy estimates [8].

Since in real conditions when solving applied problems the considered features are usually always interconnected, statisticians have developed a set of rules for the competent and correct conduct of such studies [9]. This is where the difficulty arises of developing methodological approaches to assessing the impact of human capital on social well-being and the development of society. Many studies on the development of mathematical models for assessing the impact of human capital on social well-being using econometric methods simply establish a correlation between these indicators. With those selected constituent factors, the influence of social well-being on human capital would be noticed. And what affects what, as already indicated, requires careful justification. Therefore, many works are devoted to assessing the influence of only certain factors on some obvious resulting indicator. Although the latter is often quite multidimensional, for example, the same human capital. To reduce the multidimensional resulting indicator to a scalar quantity, the so-called convolution procedure is usually used. However, problems arise here. The convolution of the indicators included in the resultant is used in case of comparability of the values of all of them, otherwise expressed in one unit of measure, otherwise, a normalization procedure is carried out, for example, the logarithm of some criteria of such a convolution. Thus, a general description of the relationships of the system depicted in Fig. 1, we will not wait soon.

2.2 The transformation of human capital in the digital economy

Many countries of the world are concerned about the issues of increasing labor productivity due to the efficient use of human capital in the context of the digital transformation of the economy and society, since the race for leadership in such a transformation does not forgive delays. Many people understand that the digitalization of production and business through the introduction of ICT will lead to the transformation of management systems along with the transformation of the HK. But what is the ratio of these investments to bring national economies to the path of accelerated growth in a rapidly changing world with the greatest efficiency? This requires appropriate assessments of the impact of investments in ICT, organizational and human capital. At the same time, each of these capitals consists of a set of own factors, which should also be evaluated.

For example, the most famous method for assessing the level of HK is the human development index, which appeared back in 1990. It was used in a section of one of the UN programs to compare between countries the levels of well-being, education and age

characteristics of the population, as the main indicators of the state of human potential in them. The developed indicators of human potential are generally accepted and available in the statistics of almost every state or territory. There is currently no universally accepted unified quantitative methodology for assessing the value of human capital within each state, region, industry, especially organization, individual.

Since the problems of assessing the effectiveness of the use of human capital in its new interpretation appeared with the development of information technologies, which are also considered as a significant level for increasing productivity, we first began to study the return on investment in ICT. This problem remains relevant over the past few years.

The first studies conducted by Nobel laureate R. Solow were unable to identify econometric methods for the direct relationship between investment in ICT and efficiency (the well-known "IT productivity paradox".

Further thorough econometric studies carried out in 2003. by the Economist Intelligence Unit, led to a number of significant conclusions regarding the impact of ICT on both labor productivity and economic growth [10].

1. ICTs lead to economic growth, but only when a certain threshold of the state of the entire ICT infrastructure is reached. It follows that the level of implementation and technologies for the use of ICTs must exceed a certain critical value, above which ICTs will begin to show a significant positive impact on the economic development of the country.

2. There was a significant time lag between the start of investing in ICT and the manifestation of the positive impact of these technologies on the economy and productivity. Therefore, one cannot count on a quick and substantial return on investment in this area. To obtain a significant effect, it is necessary to carefully implement their systemic implementation, taking into account attraction with appropriate investment in related intangible assets, affecting the effect of ICT implementation.

3. As a result, if the level of ICT development is below the threshold value, the economic result from the introduction of ICT may not appear at all, or it may turn out to be negative at all.

To confirm these conclusions in this direction, Timothy Bresnaan and Shane Greenstein conducted serious research in the framework of the theory of complementarity [10], the founders of which were Milgor and Roberts [10]. Their work confirmed the complex nature of ICT implementation, so it was concluded that investments in ICT are more effective when there is a corresponding, moreover, significant level of investment in still other complementary assets - human and organizational capital. Thus, investments in all three capitals are interconnected and interconnected in certain proportions and with a certain degree of variability. Some assets, changing at a faster rate than others, play the role of a transformation engine: its speed, in accordance with the chain of relationships, causes certain changes in other complementary assets. Then, in any organization, there are more volatile assets that have a restraining effect on other assets that do not match its rate of change. Indicative in this regard is the history of the development of production in the world for a long time, in which there are three main periods [10].

4. Before the advent of industrial production, business performance was determined mainly by the personal skills of workers and informal human relations in the internal structure of the enterprise. This is the period of the most volatile assets of human capital in the composition of complementary assets. Its dynamics to a greater extent determined the level of development of all enterprises.

5. With the advent of industrial production in the 18th century, the replacement of more mobile assets of human capital with organizational capital as part of complementary assets gradually begins. The transition to large-scale serial production led to the emergence of new forms of management of it. Therefore, the high rate of variability of organizational capital

led to the widespread adoption of serial conveyor production at the beginning of the 20th century. This was the period of the most volatile assets of organizational capital as part of complementary assets. The impact of computer capital during this period was low.

6. Computerization and automation of production marked the beginning of the active growth of computer capital as part of complementary assets. This began the period of the most volatile assets of computer capital. There was even a term the digital economy.

Eric Brinjolfson, Lorin Hitt, and Shinkyu Young [11] did another significant study confirming the existence of complementary connections between ICT, human and organizational capital. They found numerical correlations of combinations of ICT and organizational capital when their joint development creates greater value than each of them individually. At the moment, investments in computer capital significantly affect the value of the company, so its market value rises by about 12 times with a single investment in ICT, and a little more than once with a single investment in other tangible assets. Thus, for the digital transformation of companies, a comprehensive investment is necessary, first in improving management, in the quality of human capital, and then in introducing digital technologies. A different path will lead to managerial backwardness. This conclusion is especially relevant for the agro-industrial complex due to the significant gap between these areas.

At the international Likhachev scientific readings, the report [12] shows studies by Capgemini Consulting and MIT Sloan School of Management, confirming the above results. Thus, it has been demonstrated that the economic efficiency of enterprises depends to a large extent on the sharing of complementary assets. If an enterprise improves human capital in its management system by traditional methods without the use of digital technologies, then this leads to an increase in its profit by 9%, and if at the same time as digital technologies by 26%.

When an enterprise tries to introduce digital technologies without improving its human capital, on the contrary, a profit decline of 11% is observed. At the same time, it is generally unacceptable to ignore the digital transformation of human capital, since this leads to a decrease in the company's profit by 24% compared to competitors carrying out such a transformation [12].

In [13], the first attempt to repeat the empirical study conducted by the Economist Intelligence Unit to establish a relationship between investments in ICT and their effectiveness, as applied to Russia as far back as 2010 - 2012, was carried out by a group of mathematicians led by the Moscow Institute of Physics and Technology.

What was also used the Cobb-Douglas function:

$$Y = aK^{\propto}L^{\beta}C^{\gamma} \quad (1)$$

wherein Y – organization income

K – fixed capital of the organization minus computer (ICT),

L – indicator of labor contribution in the form of the amount of wages and administrative costs,

C – ICT capital of an organization, including hardware and software,

a, α, β, γ – standard coefficients Cobb-Douglas function.

For calculations, a sample of 170 Russian enterprises was used. In order to eliminate the factor of heterogeneity in the size of enterprises, they were divided into corresponding classes by size and calculations were performed in each class. The calculations confirmed the positive impact of computer capital on output.

The use of the Cobb-Douglas production function was complicated by a number of circumstances inherent in the general application of mathematical modeling methods in

Russia, namely, the lack of a reliable, representative information base. For example, it was not possible to find data on the application of any organizational practices in enterprises that actively use IT. Note that the lack of a reliable, representative information base for solving many management tasks in most industries will be an obstacle to the implementation of many government programs, including the digital economy program, artificial intelligence, etc. Because of this, the market for analytical research software will not be developed in the country that is, there are no widespread linear programming packages, statistics, expert systems, optimization packages on-line on the Internet. The analysis showed that the providers in the arsenal have only a DBMS, and there are no such packages.

The experience of mathematical modeling to assess the impact of human capital on social well-being

As already noted in the discussion of the problems of mathematical modeling for assessing the impact of human capital on the social well-being and development of Russian society in Section 1, when developing the corresponding models, only individual indicators are chosen as both a result and a factor attribute, usually economic ones are taken. Let's consider some models.

So, following the above studies in [14], econometric modeling has already given a quantitative assessment of the impact of human capital on social well-being, based on Fig. 1, through economic indicators on the example of 78 regions of Russia according to the Federal State Statistics Service for 2007–2014. based on the Mankiw-Romer-Wale model, which is a modification of the Cobb-Douglas function.

Assessment of the impact of human capital on the economy of the Russian regions was carried out using various components (forms) of the HC: by the share of university graduates per one thousand able-bodied population; by the share of personnel in research and development to the total number of working-age population; on the costs of research and technological innovation, referred to the number involved in these works; by the amount of investments in education, culture, healthcare, the value of which includes government spending on activities in social and cultural life and the cost of forming a private business.

The calculations also confirmed the positive impact of human capital on economic growth. The criterion for economic growth was selected gross regional product (GRP), calculated for one working in monetary terms, taking into account the discounting of consumer price indices (CPI).

According to the first criterion, the following data were obtained: the contribution of the HC to the economy in 2007. amounted to 7.82%, in 2008-2012. there was an increase from 4.94% to 10.03%, for two years of 2014. there was a decline to 2.03%.

According to the second criterion, the contribution of the HC made up on average 4.97% of the average per capita GRP over the entire period 2007–2014.

According to the third criterion, the contribution of the HC was only 1.62%.

The most interesting calculations are based on the fourth criterion, since it affects all forms of human capital, although not all indicators of forms used in science are true. Therefore, the calculation results showed that the contribution of human capital was significant, about 20%.

The general results of calculations according to four criteria are as follows: HC contributes to the growth of the regional economy in the range from 1.8% to 27%, depending on the form of HC, while physical capital makes an invariably large contribution: from 24% to 40%.

In [15], as well as in the previous work, on the basis of mathematical modeling, the influence of the HC on the GRP index per capita of the able-bodied population of the regions is considered. Similar to the model considered in Section 2, in order to eliminate the factor of heterogeneity in the size of the regions, they were divided by the k-means method into the

corresponding classes in decreasing order of GRP per capita of the able-bodied population of the regions (very high, high, above average, average), in each class calculations were carried out for 2003, 2006, 2009 and 2012. At the same time, it was hypothesized that the main form of accumulation of HC is the share of university graduates in the number of people employed in the economy. Therefore, of the three forms of HC, two represented education and only one share of wages out of the total amount spent on the increase in HC.

Depending on the class, the most appropriate regression models were built. So, for the first class, the model is as follows:

$$\ln y=2,62+0,63 \ln k+\varepsilon \tag{2}$$

Herein after:
y – GRP per one employee,
k –capital-labor ratio,
n – number of employees with higher education,
v –concolidated budget spending on education,
z – salary (average monthly);
i – region number,
t – year number.
The second class model looks as follows:

$$\ln y_i = 3,03+0,49 \ln k_i + \varepsilon_i \tag{3}$$

For the third class:

$$\ln y_{it} = -4,3+0,37 \ln v_{it} + 0,68 \ln z_{it} + \lambda_i + \gamma_t + \varepsilon_{it}, \tag{4}$$

where λ_i– region effect, γ_t– year effect, all ε are remainders.
And for the fourth:

$$\ln y_i = 2,05+0,43 \ln k_i + 0,09 \ln n_i + \varepsilon_i \tag{5}$$

From the calculation results, it was concluded that in the first and second classes of regions, where there is a rather high level of GRP per capita of the able-bodied population, the HC is insignificant compared to physical capital. In the third grade with great scientific and technical potential and a GRP per capita of the able-bodied population above the national average, human capital began to play the main role. Thus, a 1% increase in spending on education is reflected in the growth of GRP by 0.37%, and wages by 0.68%. In the fourth grade, both physical and human factors affect the growth of the corresponding GRP, although the latter on a much smaller scale. An increase in capital-labor ratio by 1% leads to an increase in GRP by 0.43%, and an increase in the number of workers with higher education by 0.09%.

2.3 The leading role of education in the development of human capital

When analyzing publications on the development of human capital, mathematical modeling of its impact on public life, you constantly come across the importance of the education system for the formation and evaluation of human capital.

The importance of education in our time in the world can hardly be overestimated. A report on the topic "Education for the benefit of people and the planet: building a sustainable future for all", released by UNESCO [16], assesses the growing role of education in today's digital society. It is indicated that by 2020. there will be a shortage of about 40 million people with higher education. The growing importance of education is once again convinced by the example of the My World studies conducted by the UN [16]. For this study, a survey of over 7 million was carried out on the importance of achieving its development goals. In the answers, the main priorities were: "good education", "best medical care". The first priority was indicated among the most important factors, regardless of age categories and gender, financial situation and the declared education of the participants.

The status of education by country is also given great attention by UNESCO, which maintains a worldwide database on the status of education worldwide. This database makes it possible to analyze the significance of many different factors on the possibility of obtaining education, in particular, on the basis of the educational development index [16], according to which Russia in 2015 among 118 countries it ranked 31st.

In section 2, the problems of investment in education and their effectiveness in the transition to a digital economy have already been considered. In particular, in [12] it was shown that with investments in human capital without the introduction of digital technologies, profit increases by 9%, when used together with them - by 26%. With the introduction of digital technology without investing in human capital, on the contrary, there is a decrease in profits by 11%.

Therefore, education is one of the most important components of the social sphere of the state, which ensures that an individual obtains systematic knowledge, skills and abilities for applying them in their professional activities. Additional education and training in the workplace increases the level of knowledge of the employee, thereby increasing both the volume and quality of the human resource. The quality of education increases the efficiency of labor due to two factors: either by increasing labor productivity, or by changing jobs to more skilled ones. Studies at the University of Pennsylvania partially confirmed the findings of [12] set out in section 2 on the positive effects of education on labor productivity. An increase in the level of education by 10% leads to an increase in the latter by 8.6%, and with investments in the same volume in fixed assets - by only 3.4%. Thus, the return on investment in the Cheka is 2.5 times higher than the return on investment in new equipment [17].

Currently, to analyze the impact of education on public life, much attention is paid to the problems of training in the field of information and communication technologies (ICT), in particular, such groups of indicators are studied [18]: access to ICT and the level of skills to work with these technologies; the use of computer technology, Internet technologies, related cloud technologies; development of state electronic services and access to them, the state of electronic services in healthcare, justice, business, science.

As a result of the efforts of various countries, mankind spontaneously approaches a kind of global informational educational Internet space, on the level of development of which Russian education also depends. Modern digital technologies, potentially with a systematic approach, provide an opportunity to rebuild our present on the basis of the formation of completely new communications in society, in particular in education, which should lead to a restructuring of the entire economy and society. Therefore, the main task today is to carry out such a digital transformation of society on a scientifically-based, integrated approach, so as not to slide into the digitalization of existing economic relations, bearing in mind the words of W. Churchill "Generals always start a war by the old methods."

The modern development of mankind does not forgive the delays in the pace of digital transformation necessary to bring the economies of countries to the path of accelerated growth in a rapidly changing world.

3 Results

3.1 A mathematical model for assessing the impact of human capital on social well-being and development of Russian society in the context of the digital transformation of education

As follows from the above material, social, political, economic and other advantages are given to those countries and organizations that have not only access to information, but also effective, promising technologies for their processing and use. The quality of the HC and the effectiveness of its use in social development depend on this.

For Russia, at this stage of digital transformation, a chaotic, uncontrolled development of informatization and Internet technologies is inherent in which each organization, including universities, create their own websites based on many subjective and objective factors without taking into account their integration, the interests of a wide range of potential users. This trend leads to a significant cost overrun, a decrease in the quality of education. The digital transformation of the economy requires, firstly, the integration of information systems (IP), related information resources (IR) and tools for their design and development, and secondly, a clearly more precise orientation of educational services to the dynamically segmented needs of society and the global market. This integration is carried out by developing standards for the integration of information technology, applications (management functions), as well as through a systematic approach to the design, development and implementation of IP.

The digitalization of education, as well as the entire economic life of the country, as mentioned earlier, needs a deep theoretical understanding of the use of these technologies, a generalization of the results of the passed stage of informatization in order to develop, based on the opened up ICT capabilities, fundamentally new methods of digital transformation of the educational process.

One of the promising areas of digitalization of universities, research institutes is the formation of a unified educational and scientific information space in the form of integration of scientific and educational resources on the Internet (EIIPNOR), which will play a threefold role: support for research, increase the level of education (sometimes retraining) for all segments of the population , an effective system for transferring scientific and educational knowledge to the economy due to unlimited access to this knowledge not only to traditional users in the person of scientists, students and teachers, but also to future applicants and employers, government agencies, producers, business, management, and other categories of the population. Such a space should remove the contradictions between the volumes of accumulated information, knowledge and their effective use, as well as a tool to improve the quality of the HC, its assessment, and the impact on social welfare in the country. Moreover, the education system must be flexible and take into account the long-term needs of the real economy.

In [19], the concept of a unified informational Internet space of scientific and educational resources is presented, the corresponding toolkit for assessing the effectiveness of the use of these resources (INOR) is developed, which is also applicable for assessing human capital. At the same time, the requirements of the Ministry of Education and Science, Rosobrnadzor to the content of the sites of educational institutions in order to evaluate their activities in the form of self-examination reports were taken into account.

However, these requirements do not take into account either the state, effective, promising technologies for processing and using scientific and educational resources, nor their need for economics, nor assessing their impact on the quality of training of highly

qualified specialists and scientists (human capital) in educational institutions, nor evaluating educational institutions methods of sitemetry, reflecting their image and reputation, as well as current trends in the provision of information services on the Internet in the form of electronic labor exchanges (ESTs) and trading platforms (ETPs). Therefore, these data had to be included in the tool for assessing the effectiveness of the use of INOR. An analysis of the sites of production and consulting organizations made it possible to determine the types of INOR that are most in demand in the economy and are available on the websites of research institutes and universities: development, publications, consulting services, regulatory and legal information, distance learning tools, software products, databases. [20].

The influence of the most significant indicators of the activities of universities on the effectiveness of achieving the goals of universities: the training of qualified specialists and scientists, the production of scientific products that also significantly affect human capital in the economy, is conveniently reflected through the process approach (Fig. 2).

Entrance process - these are applicants. The way out is qualification specialists and scientists (human capital), results of scientific activity. Resources are the tools needed to convert input to output. Usually they are teachers and employees of educational institutions, employees of regulatory and regulatory bodies, fixed assets, etc., helping to carry out the process or be used in the process.

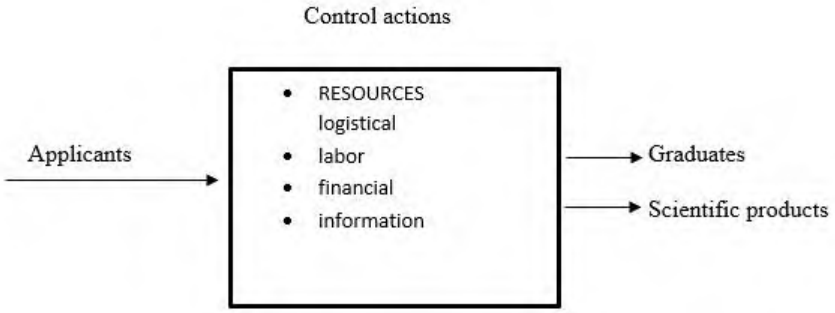

Fig. 2. Process approach to the activities of the university.

Under the management is understood the system of influence on the process with the aim of the effectiveness, in one way or another, of achieving the set goals. Management is mainly informational and regulatory in nature: documents containing certain requirements, laws, standards, methodologies, instructions, plans, executive orders, etc.

Moreover, the effectiveness of using INOR, which can be used to assess human capital from the point of view of operations research methods [20], is understood as the effectiveness in achieving the following goals:

- the level of accessibility of information for a wide audience of users;
- a variety of types of presentation of information;
- quality, completeness, efficiency, reliability and reliability of the stored information;
- simplicity, comfort of obtaining the required information;
- optimization of design, development and maintenance of information systems.

As can be seen, to assess the effectiveness of using INOR, significant indicators were taken into account that affect the HC, for example, in the form of distance learning (DO), which is currently given increased attention to improve the quality of the HC and what is needed, in addition to students and teachers, as is now understood, future applicants and employers, government agencies, producers, scientists, managers, and the public. In tab. 1 presents such an extended list of distance learning in electronic form.

Table 1. Types of distance learning in electronic representation.

Code	Distance learning
1	Electronic textbooks on branches of knowledge
2	Audio recording of lectures of the best teachers
3	Video lectures of the best teachers
4	Electronic manuals, recommendations for producers
5	Audio and video conferencing in accordance with the classifiers
6	Teacher Counseling Support
7	Video seminars
8	Multimedia forms of practical training in science, business, education
9	Computer programs controlling and evaluating knowledge and skills
10	Task collections and application package examples
11	Database Application Examples

Since the assessment of the impact of human capital on social well-being and the development of society, taking into account all factors affecting the Cheka, in addition to the problems reflected above, is associated with the presence of a reliable, representative information base, a culture and collection mechanisms of which in our country do not exist, and in others the countries do not always have the necessary information, and sometimes the collection procedure is extremely difficult, in modern theories, as a rule, emphasis is placed on the study of individual sub-parts of human capital: from knowledge, skills and abilities to the spiritual component, sometimes based on indirect data. On the other hand, the leading role in the development of human capital belongs to education, especially in connection with the digitalization of society. Therefore, most of the work is dedicated to this topic. In the presented mathematical model for assessing the impact of human capital on the social well-being and development of Russian society, we will also adhere to this trend.

Description of the model:

i — code of the INOR integration level, $i \in I$;

l — code of the INOR keeping form, $l \in L$;

n —INOR code, $n \in N$;

m — education organization number, $m \in M$;

h — code of secondary IR representation, $h \in H$;

t — moments of computations;

P_j^{tm} — partial criterium of evaluation of the efficiency of using of IR of m-th High School by j-th indicator at moment t, $j \in J$;

P^{tm} — criterium of evaluation of the efficiency of using of IR of m-th High School in moment t;

α_i^1 — weighted coefficient of INOR integration level;

α_l^2 — weighted coefficient of l -th INOR keeping form;

α_n^3 — weighted coefficient n– th INOR representation;

β_j — weighted coefficient of evaluation criterium of the INOR use efficiency by j-th indicator;

$v_{i\,ln\,0}^{tm}$ — quantity of INOR of i-th integration level, l-th keeping form, n–th representation on level of m-th high school in moment t;

$vf_{i\,ln\,f}^{tm}$ — quantity of INOR of i-th integration level, l-th keeping form, n–th representation on level f- th faculty of m-th high school in moment t;

$vk_{i\,ln\,k}^{tm}$ — quantity of INOR of i-th integration level, l-th keeping form, n-th representation on level k-th department of m-th high school in moment t;

λ_{iln}^{tm} — estimate of INOR of i-th integration level, l-th keeping form, n–th representation on level m-th high school in moment t;

λ_{iln}^{tm}= $(v_{i\,ln\,0}^{tm}+\sum_f vf_{i\,ln\,f}^{tm}+\sum_k vk_{i\,ln\,k}^{tm})/\max_m (v_{i\,ln\,0}^{tm}+\sum_f vf_{i\,ln\,f}^{tm}+\sum_k vk_{i\,ln\,k}^{tm})$;

d_{rm}^{t2} — number of r-th estimate indicator of site by sitemetric methods in m-th high school in moment t, $r \in R$;

q_{rm}^{t2} — number of r- th criterium of site evaluation by sitemetric methods in m- th high school in moment t;

ω_r^2 — weighted coefficient r-th indicator of evaluation criterium of a site by sitemetric methods;

$q_{rm}^{t2} = d_{rm}^{t2}/\max_m d_{rm}^{t2}$;

d_{sm}^{t3} — value if s- th indicator of evaluation criterium of a site by ETP condtionos [21] in m- th high school in moment t;

ω_s^3 — weighted coefficient s-th indicator of evaluation criterium of a site by ETP condtionos;

d_{gm}^{t4} — value of g-th indicator of evaluation criterium of a site by EBT condtionos [21] в m-th high school in the moment t;

ω_g^4 — weighted coefficient g- th of evaluation criterium of a site by EBT condtionos, $g \in G$;

d_{hm}^{t5} —h-th indicator of estimation of the efficiency of use of secondary IR in m- th high school in moment t, $k \in K$;

q_{hm}^{t5} —h-th indicator of evaluation criterium of the efficiency of use of secondary IR in m- th high school in moment t;

ω_{hm}^5 — weighted coefficient h-th indicator of evaluation criterium of the efficiency of use of secondary INOR in m- th high school, $k \in K$;

$q_{hm}^{t5} = d_{hm}^{t5} / \max_m d_{hm}^{t5}$;

Then: $P^{tm} = \sum_j \beta_j \cdot P_j^{tm}$, where $P_1^{tm} = \sum_{i,l,n}^{\sum} \lambda_{iln}^{tm_i^{1\,2\,3}\,l\,n}$, $P_2^{tm} = \sum_k \omega_k^2 q_{km}^{t2}$,
$P_3^{tm} = \sum_s \omega_s^3 d_{gm}^{t3}$, $P_4^{tm} = \sum_g \omega_g^4 d_{gm}^{t4}$, $P_5^{tm} = \sum_h \omega_h^5 q_{hm}^{t5}$.

In the notion above P^{tm} can be defined as HC, done by m-the educational ogranizatiob.

At first we look at the problem on regional level. Let us take regional ratings R_k^{tm}. And then m also defines the region. We can range P^{tm}, and will obtain high school rations by HC estimation P^{0tm}.

Let R^{tm}= $(\sum_{k=1}^K \eta_k R_k^{tm})/K$be generalized rating, where $\eta_k$are positive numbers, reflecting the weights of and $\sum_{k=1}^K \eta_k$= 1. They are taken according to the region potentials.

Then R_k^{tm} - are parts of social welfare, with two categories:

1) the first group of criteria during normalization is ranked by the degree of increase in the indicator (i.e., the best values of the component of social well-being have lower values, for example, the region with a lower Ginny coefficient is the most socially safe, because there is less income difference between the population and etc.):

- Ginny coefficient (income distribution level);
- poverty level;
- unemployment rate;
- mortality rate, etc.

2) the second group of criteria during normalization is ranked by the degree of decrease of the indicator (i.e., the best values of the component of social well-being have higher values, for example, a region with a higher level of employment is the most socially safe, etc.):

- level of employment
- birth rate;
- the proportion of the population with higher education;
- life expectancy, etc.

The influence estimation of HC on social welfart will depend of the relations between P^{0tm} and R^{tm}. If $P^{0tm} < R^{tm}$ then HC is not developed. If $P^{0tm} > R^{tm}$ then, HC in region is underused

Taking $\Delta^{tm} = P^{tm} - P^{t-t_1,m}$, where t-$t_1$– is time lag, we may estimate degree of change for the better / worse quality of the HC.

An assessment of the impact of human capital on social well-being and social development in Russia can be obtained by summing up the relevant regional estimates with some weights. For this, appropriate methods can be used [20], used to find statistical dependencies of university ratings reflecting the assessment of the quality of human capital, and five regional ratings reflecting the socio-economic situation of the regions.

Why two well-known methods are used. One of them establishes pairwise relationships between ratings based on the so-called Spearman correlation coefficients [22], calculated as follows:

$\rho = 1 - \frac{6 \cdot \sum d^2}{n(n^2-1)}$, with d, defined by the difference of two ranks, and n is the number of the pair of ranks.

In tab. 2 shows the data obtained pairwise Spearman correlation coefficients of regional ratings.

Table 2. Pairwise Spearman correlation coefficients.

Ratings	1	2	3	4	5	6
1	-	<0.001	0.17	0.17	0.25	-0.005
2	-	-	0.35*	0.18	0.19	0.44**
3	-	-	-	0.22	0.36*	0.35*
4	-	-	-	-	0.15	0.17
5	-	-	-	-	-	0.02
6	-	-	-	-	-	-

The usual interpretation of Spearman's correlation coefficients is as follows: up to 0.3– weak connection tightness; in the range from 0.3 to 0.7 - moderate tightness of communication; more than 0.7 - high communication tightness.

Another method relates to the calculation of the so-called Kendall concordance coefficient. This method determines the degree of proximity of the ranks.

In the considered example [NOR], the obtained value of the Kendall concordance coefficient $W = 0.32$ indicates the presence of a weak degree of consistency in ratings, which once again confirms the lack of attention to education and digital technologies in the industry in our country.

4 Conclusion

Thus, the transition to the EIIPNOR platform of the country with unified digital standards is one of the urgent tasks in the transition to the digital economy and will significantly (tenfold) reduce the cost of developing, implementing and maintaining IP in science and education. The result deals with problems similar to descrbed in [23-25].

The proposed CPU will be a powerful tool for improving and increasing the quality of human capital, improving the social welfare of society, bringing the most effective innovative solutions to the economy, and when entering publications, developments, and other types of knowledge representation on the websites of universities, they can be automatically placed in other databases, including in Elibrary. This work would be greatly simplified if all these organizations switched to the standard site form. At the same time, assessments of the impact of human capital on social well-being and the development of regions and countries could be obtained automatically on-line.

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