PERSPECTIVE DEVELOPMENT OF INTELLECTUAL POTENTIAL OF SOCIETY

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Abstrakt: (100 – 150 slov)
Je dobře známou skutečností, že za účelem konkurence na trhu, je nutné, aby výrobky byly kvalitnější, a zároveň, aby dosahovaly nižších výrobních nákladů. Efektivní využití intelektuálního potenciálu může napomoci dosáhnout plnění těchto podmínek, a tím přispívat k růstu ekonomiky, jeho uplatnění ve skupině evropských lídrů v oblastech socio-ekonomického rozvoje. To je možné díky implementaci intelektuálního vkladu pro dosažení výše uvedeného cíle. Náklady na školení a další vzdělávání odborníků a vládní podpora rozvoje intelektuálního potenciálu otevírá vyhlídky na zavádění nových technologií, zvýšení hrubého domácího produktu, zlepšení životních podmínek a duševního komfortu občanů. Příspěvek se zaměřuje na posouzení intelektu společnosti v regionu, navrhuje univerzální metodu, pomocí níž můžeme odhadovat intelektuální potenciál.

Abstract:
It is a well-known fact that in order to compete in the market, it is necessary to have the highest quality products and at the same time, have lower production costs. The effective use of intellectual potential could ensure the fulfilment of these conditions and thus contribute to the growth of the economy, its entry into the group of European leaders in the socio-economic development. It is possible due to the implementation of intellectual investment to achieve the above objectives. The costs for training and continuing education of professionals and government support on the development of intellectual potential opens up the prospects for the introduction of new technologies, the increase of the Gross Domestic Product, the improvement of the welfare and spiritual comfort of citizens. The paper focuses on the assessment of the intellectual society of a region, proposing a universal method by which we can estimate intellectual potential.

Introduction

In particular, the intellectual potential of a region are the potential opportunities of economic units to create, store and effectively use intellectual resources for the effective socio-economic development of the country. In order to ensure the continuity of the process of reproducing the intellectual potential of society a timely evaluation is needed, which becomes possible only if there are reasonable methodological approaches to the management of intellectual potential. Thus, there is an actual technique which allows assessing the available intellectual potential of society, taking into account the influence of all the factors and conditions that determine the process of growth and intellectual potential of society at different levels of the hierarchical structure of the state, and conduct monitoring.

The analysis of approaches to establishing the structural components category of "intellectual capital" indicates that a set of components is different for all authors, but in general they define the same elements [7]. Thus, the majority of authors establish the following structural components of intellectual capital as defining: human capital (knowledge, experience, ability to innovate, etc.); structural (or process) capital, which includes the results of the use of human intelligence embodied in patents, know-how, copyright; client (or consumer) capital, which is the result of the effective use of human intellectual work and is expressed as the business reputation of enterprise, goodwill and so on.

The formulation of the assessment methodology of intellectual potential is based on the existing methodology, the authors which are such Ukrainian scientists: Bogachev S.V., Veretennikova O.V. Krykun N.A. [1]. This methodology has served as an example of the formation of the quantitative factors, and also became the basis for the formulation of stages for evaluating the intellectual potential of society.

1. Statement of problem – methodology of intellectual potential

The following algorithm can be the basis for the developed methodology: Stage 1: The formation of indicators summation that enables evaluating the intellectual potential of society (Table 1-4)

Table 1: *Formation of physical indicators*

Physical indicators	
The coefficient of an economically active population (Cec.act.)	$C_{ec.act.} = \frac{N_a}{\mathrm{N}}$ (1.1) Na - the economically active population, a thousand people; N - the total number of resident population, a thousand people;
The coefficient of scientific and technical activities (Cscient.techn.act.)	$C_{scient.act.} = \frac{N_{res.}}{\mathrm{N}}$ (1.2) Nres.- the number of residents from the scientific and technical professions, a thousand people;
The coefficient of the working population (Clab)	$C_{labour} = \frac{N_{wp}}{\mathrm{N}}$ (1.3) Nwp - working age population, a thousand people.
The employment rate (Empl. rate)	$C_{occup.} = \frac{N_{occup.}}{N_{ec.act.}}$ (1.4)

	Noccup. - the number of people employed in the national economy, a thousand people Nec.act. - the number of the economically active population
The unemployment rate (Cunempl. rate)	$C_{unempl} = \frac{N_{unempl.}}{N_{ec.act.}}$ (1.5) Nunempl. - the number of the unemployed population, a thousand people. Nec.act. - the number of the economically active population.

Source: [1]

Table 2: *Formation of educational indicators*

Educational factors	
The coefficient of the base level of education (Cb)	$C_b = \frac{N_b}{\mathrm{N}}$ (1.6) Nb - number of people with basic education, employed in the economy, people.
The coefficient of average education level of the population (Cav.)	$C_{av.} = \frac{N_{av.}}{\mathrm{N}}$ (1.7) Nav. - population with secondary education, employed in the economy, people.
The coefficient of the secondary specialized education level of the population (Cav.spec.ed.level)	$C_{av.spec.ed.level} = \frac{N_{av.spec.ed.level}}{\mathrm{N}}$ (1.8) Nav.spec.ed.level - population with specialized secondary education, employment in the economy, people.
The coefficient of a higher level of education (Chigh)	$C_{high} = \frac{N_{high}}{\mathrm{N}}$ (1.9) Nhigh - population with higher special education, employed in the economy, people.
The coefficient of supporting the education with staff (Ced.)	$C_{ed.} = \frac{N_{ed.}}{N_{tot.}}$ (1.10) Ned. - number of employees in the field of education, persons; Ntot. - the total number of the employed population

Source: [1]

Table 3: *Formation of financial indicators*

Financial indicators	
The coefficient of research funding (C.res.fund.)	$C_{res.fund.} = \frac{P_{st.budg.}}{\mathrm{Ptot.}}$ (1.11) Pst.budg. - the sum of spending on scientific research from the state budget, a thousand UAH; Ptot. - the total amount of expenses, a thousand UAH;

The coefficient of the regional research funding (Creg.fun.)	$C_{reg.fun.} = \frac{P_{reg.}}{P_{tot.}}$ (1.12) Preg. – the sum of spending on scientific research in the region; Ptot. - total costs;
The coefficient of labor payment in scientific and technical activities (Cpaym.)	$C_{paym.} = \frac{P_{scient.}}{P_{tot.}}$ (1.13) Pscient. - the sum of the average monthly wage of workers in the professional, scientific and technical spheres of activity; Ptot. - the sum of the average monthly wage in all sectors of the economy;
The coefficient of labor payment in educational activities (Cpaym.educ.)	$C_{paym.educ.} = \frac{P_{educ.}}{P_{tot.}}$ (1.14) Peduc. - the amount of average wages of workers in education; Ptot. - the sum of the average monthly wage in all sectors of the economy;

Source: [1]

Table 4: *Formation of research and innovation indicators*

Research and innovation factors	
The coefficient of supporting with scientific staff (Cscient.pers.)	$C_{scient.pers.} = \frac{N_{scient.}}{N_{tot.}}$ (1.15) Nscient. - number of employees of scientific and technical organizations, people; Ntot. - the total number of employed population, people
The coefficient of supporting with employees who perform research (C.sup.empl.)	$C_{sup.empl.} = \frac{N_{scient.}}{\mathrm{N}}$ (1.16) Nscient. - number of researchers, a thousand; N - the total number of the resident population, a thousand;
The coefficient of employment in research and development (Cscient. research.)	$C_{scient.research.} = \frac{N_{empl.}}{N}$ (1.17) Nempl. - the number of employees occupied in the sphere of research and development, a thousand people; N - the total number of the resident population, a thousand people;

Source: [1]

The assessment of the qualitative conditions of reproducing the intellectual potential of society plays an important role in the formation of the main directions of the state, regional or local policy, to manage reproduction and the use of intellectual potential. The qualitative factors of reproducing the intellectual potential of society can be divided into the same groups that have been proposed for measuring the quantitative manifestation, namely: physical, educational, financial, scientific and technological (Table 5).

Table 5: *Qualitative indicators of reproducing the intellectual potential of society*

Group	Indicators
Physical	the presence of a stable rate for mechanical growth of the population
	the presence of stable rate for natural population growth
Educational	the possibility of the effective functioning of the educational system, specialist training and retraining
	youth focus on the acquiring of knowledge and the generation of intellectual products
	willingness of residents from a certain area for education and self-education
Financial	investments in product development, the level of personnel qualification, innovative capacity
	state funding of research activities
Research and innovation	the activity of scientific and technological processes
	the activity of scientific institutions in the establishment of intellectual resources
	the opportunity of bringing to the implementation of research and development the work of scientists from other countries
	inventive activity
	innovative activity of business entities
	the possibility of implementing an innovative model of territorial development
	certain directions of the innovative development in a specific territory

Source: [1]

Stage 2: The assessment of the importance of high-quality conditions of reproducing the intellectual potential of society. The assessment of the importance of qualitative conditions should be carried out by an expert group on a 10-point scale with the help of a questionnaire in which each of the experts evaluate the importance of each indicator. Experts are the professionals involved in the management of the scientific and technological, innovative and educational development of the country, regions and cities.

Thus, the assessment of 10 points is put by the experts in cases when they consider a qualitative indicator to have a very high impact on the development of the intellectual potential of society; 9 - quality condition has a high impact; 8 - a significant impact; 7- sufficient influence; 6 - impact is above average; 5 points - average impact; 4 - moderate impact; 3 points - negligible impact; 2 points - low impact; 1 point - very low impact; 0 points - there is no impact.

The obtained values should be processed for final evaluation [5]. The generalized evaluation for each generalized qualitative indicators, i.e. groups of indicators can be calculated as the arithmetic average (1.20):

$$\bar{x} = \frac{\sum_{j=1}^{m} x_j}{m}, \qquad (1.18)$$

x_j- assessment of the jth expert; j=1,…m; m - the number of experts

The processing of expert evaluations makes it possible to rank the groups of qualitative conditions.

Stage 3: Ranking the groups of qualitative conditions on the basis of obtaining in the previous step the estimation of the values of reproducing the intellectual potential of society according to their significance. [4] Ranking allows selecting from a set of the most important groups of indicators. The highest rank is obtained by the group of qualitative conditions, the arithmetic average evaluation which will be high. The groups of qualitative conditions should be placed in descending order for the rule's execution:

$$r_1 \geq r_2 \geq \ldots \geq r_n, \tag{1.19}$$

r_n - a group of qualitative conditions of reproducing the intellectual potential of society.

Stage 4: Calculation of the importance of groups of qualitative conditions formed under the influence of the reproduction factors of the intellectual potential of society. The significance of groups for qualitative conditions is not the same, so it is necessary to determine the significance of these groups. In cases when the groups are arranged in descending order, it is possible to calculate their significance for the development of intellectual potential of society by the method of Fishburne [2].

The peculiarity of Fishburne's method lies in the process of calculating the significance of the groups of qualitative conditions that does not need more information than r1> r2> ...> r_n, the level of importance for each of the groups. In accordance with the rule of point estimation of the i-th index R, according to Fishburne's method the weight of the group of indicators is calculated by the following formula:

$$r_i = \frac{2(N - i + 1)}{(N + 1) \cdot N}, \tag{1.20}$$

where r_i - weight of the indicator group ; i - index; N - number of groups.
If all parameters are of equal importance, then $r_i = 1 / N$.

Since the formation of qualitative conditions of reproducing the intellectual potential of society depends on the totality of the groups of factors, quantitative evaluation is possible, and vice versa, the importance of groups for qualitative conditions and groups of quantitative measure can be considered as identical.

Stage 5. Calculating the terms of the quantitative indicators' development of the intellectual potential of society with the use of statistical information.

Stage 6. Determining the reliable indicators by discarding the unreliable with the initial population. In order to determine the reliability of the selected set of indicators the following model proposed by Lee Cronbach is used and it is based on the average correlation between the indicators.

$$\alpha = \frac{k}{k-1} \cdot \left(1 - \frac{\sum_{i=1}^{k} \sigma_i^2}{\sigma^2} \right), \tag{1.21}$$

k – the number of indicators;

σ_i^2 – intragroup dispersion;

σ^2 – total dispersion.

The meaning of Cronbach's alpha is in the range from 0 to 1. The closer it is to 1, the higher the level of reliability concerning the original correlation matrix. Experts consider the coefficient> 0.7 to be acceptable [5]. Thus, as a result of the selection of indicators according to the values of the reliability coefficient of Cronbach's alpha there are still a small number of indicators considered to be most reliable for calculating the integral index.

Stage 7. Development of the indistinct classification values for quantitative indicators. In the case of need for comparing the current value of the quantitative indicator with its qualitative characteristics (to determine its compliance with one of the levels: very low, low, medium, high, very high) the theory of fuzzy numbers is used. Using this theory it is possible to establish the connection of the quantitative indicator value with its high-quality linguistic description, given by the so-called membership functions index fuzzy set [5].

In order to determine the linguistic variable exponent Xj (quantitative indicator) its term-set of values (the set of linguistic values) is to be established: very low (VL) - Bi1, low (L) - Bi2, medium (M) - Bi3, high (H) - Bi4 very high (VH) - Bi5. Each of these values is assigned on the basis of expert estimates - the average value, which can be used for modeling fuzzy classification trapezoidal numbers. As a result, the analysis builds a certain fuzzy classification of the current values of parameters Xj (Table 6).

Table 6: *Fuzzy classification of the current parameter values*

Index	B_{i1} (VL)	B_{i2} (L)	B_{i3} (M)	B_{i4} (H)	B_{i5} (VH)
X_1	$x_1<b_{11}$	$b_{11}<x_1<b_{12}$	$b_{12}<x_1<b_{13}$	$b_{13}<x_1<b_{14}$	$b_{14}<x_1$
….	…	…	…	…	…
X_j	$x_i<b_{i1}$	$b_{i1}<x_i<b_{i2}$	$b_{i2}<x_i<b_{i3}$	$b_{i3}<x_i<b_{i4}$	$b_{i4}<x_i$
…	…	…	…	…	…
X_N	$x_N<b_{N1}$	$b_{N1}<x_N<b_{N2}$	$b_{N2}<x_N<b_{N3}$	$b_{N3}<x_N<b_{N4}$	$b_{N4}<x_N$

Source: [1]

Stage 8: Obtaining linguistic values of quantitative indicators. The rank is calculated as follows:

- if the value of the index falls exactly at a given interval in the previous stage (very low, low, medium, high, very high), the rank is equal to 1 for a given level of the indicator and 0 for all others;

- if the value of the index lies in the area of fuzziness (low - very low, medium - low, high - medium, very high - high) then for two adjacent classes there are formed ranks, the amount of which is equal to one. In this case, the calculation of ranks takes place according to the rule of calculating: the ordinates of the rib trapezoidal membership function for a given abscissa point on the lower trapezoid basis [3].

Stage 9: The calculation of the integral index of the intellectual potential of society. 9.1. The definition of the linguistic variable "Level of reproduction for the intellectual potential of society" with the term set of values "Very Low (VL), Low (L), medium (M), High (H), very high (VH)." 9.2. The definition of medium term set - a real variable A in the range from 0 to 1 for the constructive description imposed by linguistic variable "The level of reproduction for the intellectual potential of society".

The calculation of the integral index of the replacement level for intellectual potential of society must be implemented in such a way [2]:

$$IPR = \sum_{i=1}^{N} p_i z_i, \tag{1.22}$$

where N - total number of indicators by means of which one makes a quantitative estimate;

i - the index of a particular indicator for the total number N;

p_i - the significance of the indicator;

z_i - average level for the each of the indicators.

$$z_i = \sum_{j=1}^{M} a_j \gamma_{ij} \ , \tag{1.23}$$

where M - the total number of levels in a subset of Bin;

j - the indicator level index for the total number of M levels;

αj – abscissa for the maximum of membership functions of the linguistic variable;

γij –the rank of *i* indicator for the *j* level.

Stage 10. Ranking of the integral indicator of the reproduction level for the intellectual potential of society with the replacement levels' allocation. The usage for the calculation of the integral index of weight and the average level of indicators, which are included in it, determines that the value of the integral index ranges from 0 to 1. The distribution of the integral values of the replacement level for the intellectual potential of society can be uniform (for example, for the regions - from the minimum importance in regions with the low reproduction of the intellectual potential to the maximum value in the regions with a very low output level), in such a situation, appropriate is the construction of groups with equal intervals. The size of the equal interval is set by the formula:

$$i = \frac{(X_{\max} - X_{\min})}{n}, \tag{1.24}$$

where Xmax, Xmin - the largest and smallest value of the characteristic in the aggregate;

n - number of groups;

Xmax - Xmin - range of variation.

The determination of the reproduction level for the intellectual potential of society is described with the help of Table 7.

Table 7: *The scale of assessment for the reproduction level of the intellectual potential of society*

0< *IPR* <0.2	0.2< *IPR* <0.4	0.4< *IPR* <0.6	0.6< *IPR* <0.8	0.8< *IPR* <1
Very low level of reproduction for the intellectual potential of society	The low level of reproduction for the intellectual potential of society	The average level of reproduction for the intellectual potential of society	The high level of reproduction for the intellectual potential of society	Very high level of reproduction for the intellectual potential of society

Source: [1]

2. Brief problem solving and discussion

The determination made using the Table 7 replacement level for the intellectual potential of society is the last step in the measurement process. The results of such measurements can serve as the basis for decision-making in forming the development strategy of territorial units.

The preservation of a steady upward trend in the intellectual potential of society can be achieved by improving the condition of increasing funding for scientific and technical activities, strengthening the innovative activity of business entities, providing the sustainable rate of natural and mechanical population growth.
One of the variants for increasing the intellectual potential of regions is the use of foresight technology that will help to identify prospective scientific and technological directions, which can become the basis of the long-term innovative policy of a region's development and which can improve the competitiveness of the regional economy and the achievement of high socio-economic indicators, both in territorial and in macroeconomic aspects [6].

On the basis of the above mentioned information we can draw some conclusions and recommendations in order to overcome the problems of reproduction for the intellectual potential of society concerning regions, namely:

- it is necessary to create and maintain the functioning of the regional innovation centers "education-science-production", to support inventiveness, creativity, at the domestic and local levels, to introduce the status of the innovator that would provide additional payments for authors of original ideas and projects;
- take measures aimed at preserving the intellectual potential of research, educational, medical, government agencies, enterprises and organizations and to reform wages and income for qualified employees;
- to improve the state policy of financing the needs of science and education, and to protect intellectual property;
- to create conditions for attracting new sources of finance for intellectual resources of the regions.

Due to the fact that modern scientists have no unity of opinion in determining the category of "intellectual capacity", this creates a need to provide a unified definition, which can be used for all levels of the economic structure of the state. Intellectual potential is a combination of the intellectual abilities of the population or individual (knowledge, faculty, information, values, skills, etc.) and their possible expansion, development and use. In particular, the intellectual potential of a region is the potential opportunities of economic units to create, store and effectively use intellectual resources for the effective socio-economic development of the country.

Conclusion

The absence of effective teaching tools poses a number of challenges for researchers, including: the establishment of factors determining the reproduction features of the intellectual potential of society; definition of qualitative factors that influence the development of the intellectual potential of society; building a system of indicators to assess the impact of individual factors on the reproduction of the intellectual capacity; development

of an integrated indicator, with the help of which it is possible to determine the development level of the intellectual potential of society.

The proposed method is universal and suitable for calculating the estimation of the intellectual potential of regions with different levels of life, financing the possibilities of science, technology and innovation.
It is a well-known fact that the effective management of the formation and development of intellectual potential is only possible when a sufficiently large strategic projects exist, in which entire layers of the national economy are involved: education and science.
The preservation of a steady upward trend in the intellectual potential of society can be achieved by improving the condition of increasing funding for scientific and technical activities, strengthening the innovative activity of business entities, providing the sustainable rate of natural and mechanical population growth.
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Resources:
[1] VERETENNIKOVA O.V., KRIKUN N.O., *Methods of assessing the intellectual potential of the region*, 2013, 24 p.,
[2] GORODYANSKA L.V., *Management of intellectual capital and intellectual resources providing enterprises.* Actual problems of economy №1, 2008, 182p.
[3] DUBINA I. N., *Mathematical Foundations of Empirical Social and Economic Research:* Studies manual, Barnaul 2006.
[4] MARCHUK E. K., *Strategic orientation of society - motion proactive,* Strategic view, № 4, 1999, 175p.
[5] MAHOMET U. V., *The essential characteristics and structure of intellectual capital* enterprises Economic Space: Coll. Science. pr. № 25 Dnepropetrovsk: PSABA, 2009, 259p.
[6] NEDOSEKIN A.O., *Application of the theory of fuzzy sets to problems of financial management: Financial management,* Audit and financial analysis №2, 2000, 210p.
[7] ALBERT S. *Intellectual Capital as the Foundation for New Conditions relating to Organizations and Management Practices* / S. Albert, K. Bradley. – Milton Keynes : Open University Business School, 1996, 318 p. ASIN: B0018TPDKE
[8] REGIONALISATION IN EUROPE. Recommendation 1811 (2007) [Electronic resource]: reply from the Committee of Ministers adopted at the 1027th meeting of the Ministers' Deputies (21 May 2008) // Council of Europe Parliamentary Assembly: (PACE Web site). – Strasbourg Cedex, 2008. Available at: <http://assembly.coe.int/main.asp?Link=/documents/workingdocs/doc08/edoc11626.ht>

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