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Methodological approach to the determination of efficiency of national intellectual capital use in the knowledge-based economy

Introduction. *In the world of big business, one of the leading trends is the increase of the role of intellectual assets and intangible variables. As a result, these new variables are considered as the drivers for entailing like-for-like economic growth and spreading globalization processes throughout the world. That is why the investigation of theoretical and practical aspects of the estimation of national intellectual capital (NIC) is an actual both scientific and practical task.*

Purpose. *The purpose of this paper is to propose the methodological approach to the determination of the efficiency of national intellectual capital use in the knowledge-based economy, test the approach in Ukrainian economy and, on its basis, to make some recommendations on how to increase NIC use in Ukraine under given conditions.*

Results. *The methodological approach to the determination of the efficiency of national intellectual capital (NIC) use in the knowledge-based economies has been proposed. It involves the following stages: formation of a set of partial indicators that characterizes the efficiency of the use of the components of NIC (the coefficient of literacy rate, the coefficient of qualification, the coefficient of knowledge of foreign languages, the coefficient of enterprises' implementation of organizational innovations, the coefficient of enterprises' implementation of marketing innovations, the coefficient of enterprises' implementation of advanced technologies, the coefficient of science intensity of the state budget, the coefficient of innovation products, the coefficient of employment in the science intensive sectors, the coefficient of publication activity, the coefficient of engineering and technical activity, the coefficient of invention activity), calculation of general coefficients of the efficiency of the use of the components of NIC (general coefficient of national human capital use, general coefficient of national process capital use, general coefficient of national marketing capital use, general coefficient of national capital of development and renewal use), calculation of coefficients of efficiency of the use of the components of NIC, calculation of integral coefficient of the efficiency of NIC use, making some scientific and practice recommendations on how to increase the efficiency of NIC use. Ukrainian economy from 2010 to 2017 has been used as a basis for an implementation of the methodological approach.*

Conclusions. *It has been founded that, in spite of great scientific and technical potential, NIC use of Ukraine is not effective. The research also has been showed that the efficiency of the use of the national process and national market capital is very low in Ukraine. The recommendations on how to increase the efficiency NIC use of Ukraine have been also determined in this article, in particular, it is proposed to improve the legal and regulatory framework for structural and innovation transformations, develop the venture entrepreneurship, develop the industries belonging to the fifth and sixth technological wave, give the tax privileges for innovation entrepreneurs.*

Key words: *national intellectual capital, national market capital, national process capital, knowledge-based economy, national innovation system, venture enterprise, market innovation.*

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Методичний підхід до визначення ефективності використання національного інтелектуального капіталу в економіці, заснованій на знаннях

Розроблено методичний підхід до визначення ефективності використання національного інтелектуального капіталу (НІК) у країнах, економіки яких засновані на знаннях. Визначено основні етапи

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практичної реалізації даного підходу: формування сукупності показників, які характеризують ефективність використання складових НІК, розрахунок коефіцієнтів ефективності використання складових НІК, розрахунок узагальнюючого коефіцієнта ефективності використання НІК, розробка науково-практичних рекомендацій щодо підвищення ефективності використання НІК. Пропонований методичний підхід апробовано на прикладі економіки України у 2010-2017 рр. і виявлено, що, незважаючи на потужний науково-технічний потенціал країни, використання її НІК є неефективним, причому особливо низькою є ефективність використання національного процесного і національного ринкового капіталів України. Також у статті запропоновано заходи щодо підвищення ефективності використання НІК України, а саме удосконалення нормативно-правового забезпечення структурно-інноваційних перетворень, розвиток системи венчурного фінансування, розвиток галузей, які належать до п'ятого та шостого технологічних укладів, надання податкових пільг для суб'єктів інноваційного підприємництва.

***Ключові слова**: національний інтелектуальний капітал; національний ринковий капітал; національний процесний капітал; економіка; заснована на знаннях; національна інноваційна система; венчурне підприємство; маркетингові інновації.*

Statement of the problem. In the world of big business, one of the leading trends is the increase of the role of intellectual assets and intangible variables. As a result, these new variables are considered as the drivers for entailing like-for-like economic growth and spreading globalization processes throughout the world. That is why the investigation of theoretical and practical aspects of the estimation of national intellectual capital (NIC) is an actual both scientific and practical task.

Analysis of recent researches and publications. Many famous scientists devoted their writings to the investigation of the theoretical and practical aspects of the process of the estimation of national intellectual capital. One of the pioneers who studied the problems related to the estimation of NIC was L. Edvinsson and Malone. The economists proved that intellectual resources ensure the successful development both for companies and national economies. Afterwards R. Aleknaviciute, J. Dalmau-Porta, J. Duffy, J. Dumay, J. Hermas-Oliver, R. Labra, I. Macerinskiene, K. Marcin, A. Ramanauskaite, K. Rudzioniene, P. Sanchez, L. Serdukova [2], M. Tanaszi, A. Wildowidz-Giegiel, P. Wisniewski calculated NIC of Canada, Latvia, Poland, Russian Federation, Serbia, Slovak Republic, Spain, the United States using both quantitative and qualitative macroeconomic indexes. In turn, A. Karpenko, I. Karshin, A. Mohov, M. Ovchinnikov, E. Vashurin proposed to assess NIC using the following fields: scientific researches, technology development, and innovation, education, information and communication technologies, equipment, software products, and services. Meanwhile, D. Sedlyar [1] formed a set of indicators characterized the components of NIC (national human capital, national structural capital, national market capital, national social capital), generalized them and, on its basis, calculated NIC of Ukraine.

International organizations such as World Bank (WB), United Nations (UN), Organization for Economic Co-operation and Development (OECD) also made a significant contribution to the development of theory and practice of the estimation of NIC. In particular, World Bank's Report was pointed out that intellectual capital is a basis for national wealth and source of macroeconomic growth acceleration. Besides, World's Bank economists developed this methodology and proposed Knowledge Economy Index in 2004. In order to do this, the economists took the following steps: calculation of partial indexes (index of the economic and institutional regime, index of education, index of innovations, and index of information and communication infrastructure), calculation of integral index, and ranking of the use of scientific achievements in the real economy. In turn, the United Nation's experts proposed a monetary approach to the estimation of NIC based on capitalizing different forms of intellectual assets, namely inventions, patents, researches, managerial flexibility, and the stock market.

In spite of the fact that all above-mentioned authors have considerably contributed to the research of the stated problem, there is a need to carry out further investigations related to the determination of the efficiency of NIC used in the knowledge-based economy.

Setting objectives. For the reasons given above, the purpose of this paper is to propose the methodological approach to the determination of the efficiency of national intellectual capital use in the knowledge-based economy, test the approach in Ukrainian economy and, on its basis, to make some recommendations on how to increase NIC use in Ukraine under given conditions.

Methodology. The methodological approach to the determination of the efficiency of national intellectual capital use in the knowledge-based economy is foreseen the following steps (graph 1).

At the beginning, the author formed a set of indicators (or partial coefficients) that characterizes the efficiency of the use of the components of NIC: national human capital, national process capital, national market capital, the national capital of renewal and development.

As we know, human capital is a component of NIC that reflects the stock of peoples' knowledge, skills, abilities, and creations which are inseparable from them and are formed at the national level. The efficiency of the use of this component of intellectual capital is characterized by the following indicators (or partial coefficients): coefficient of literacy rate, the coefficient of qualification, the coefficient of knowledge of foreign languages.

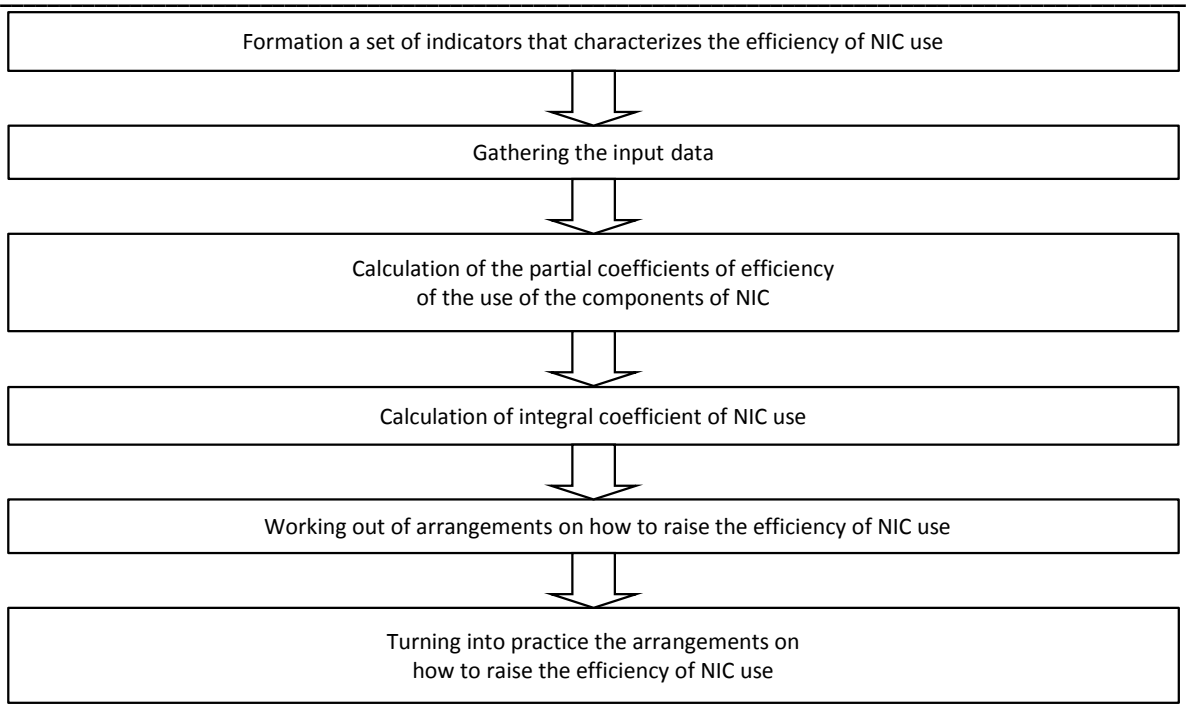

Figure 1 – **Consistency of the steps of determination of the efficiency of national intellectual capital use in the knowledge-based economy**

Source: suggested by the author

The coefficient of literacy rate characterizes the level of quality of education in the country. This coefficient is proposed to calculate in such way:

$$C_{LR} = \frac{N_{SE}}{N_T}, \quad (1)$$

where C_{LR} – the coefficient of literacy rate;

N_{SE} – population with general secondary education;

N_T – population aged more than 18 years.

The coefficient of qualification characterizes the level of interest of the population in updating their knowledge, skills, abilities, creations. This coefficient is proposed to calculate in such way:

$$C_Q = \frac{N_Q}{N_E} \quad (2)$$

where C_Q – coefficient of qualification;

N_Q – employed who increased their qualifications throughout the year;

N_E – employed.

The coefficient of knowledge of foreign languages characterizes the level of speaking of the population in one (or more) foreign language at the level not lower than B2 (accordingly to the European Qualifications Framework). This coefficient is proposed to calculate in such way:

$$C_{FL} = \frac{N_C}{N_T}, \quad (3)$$

where C_{FL} – coefficient of knowledge of foreign languages;

N_C – population with received the certificates at Level B2 in the Council of Europe's Common European Framework of Reference (CEFR level);

N_T – population of the country.

Process capital is a component of intellectual capital that reflects the sources of new knowledge created at the national level. The efficiency of the use of this component of intellectual capital is characterized by the following indicators: coefficient of enterprises' implementation of organizational innovations, the coefficient of enterprises' implementation of marketing innovations, the coefficient of enterprises' implementation of advanced technologies.

The coefficient of enterprises' implementation of organizational innovations characterizes the level of the introduction of new methods of management in industrial and non-production systems. This coefficient is proposed to calculate in such way:

$$C_{OI} = \frac{N_{OI}}{N_T}, \quad (4)$$

where C_{OI} – coefficient of enterprises' implementation of organizational innovations;

N_{OI} – number of enterprises that implemented organizational innovations throughout the year;

N_T – total number of enterprises.

The coefficient of enterprises' implementation of marketing innovations characterizes the level of creation of new types of products (or services). This coefficient is proposed to calculate in such way:

$$C_{MI} = \frac{N_{MI}}{N_T}, \quad (5)$$

where C_{MI} – coefficient of enterprises' implementation of marketing innovations;

N_{MI} – number of enterprises that implemented marketing innovations throughout the year;

N_T – total number of enterprises.

The coefficient of enterprises' implementation of advanced technologies characterizes the level of introduction of the latest methods of industrial production. This coefficient is proposed to calculate in such way:

$$C_A = \frac{N_{AT}}{N_T}, \quad (6)$$

where C_{AT} – coefficient of enterprises' implementation of advanced technologies;

N_{AT} – number of enterprises that introduced advanced technologies;

N_T – total number of enterprises.

Market capital is a component of intellectual capital that reflects the conditions prevailing at the national level for conducting innovative entrepreneurship and development of knowledge-intensive sectors of the national economy. The efficiency of the use of national market capital is characterized by the following indicators: the coefficient of science intensity of the state budget, the coefficient of innovative products, and the coefficient of employment in the science-intensive sectors.

The coefficient of science intensity of the state budget characterizes the share of public expenditures on science in the GDP. This coefficient is proposed to calculate in such way:

$$C_{SI} = \frac{E_S}{GDP}, \quad (7)$$

where C_{SI} – coefficient of science intensity;

E_S – public expenditures on science;

GDP – size of GDP.

The coefficient of innovation products characterizes the share of innovative products sold in the total output. This coefficient is proposed to calculate in such way:

$$C_{IP} = \frac{O_I}{O_T}, \quad (8)$$

where C_{IP} – coefficient of innovation products;

O_I – volume of innovation output;

O_T – volume of total output.

The coefficient of employment in the science-intensive sectors characterizes the level of employment of the country's population in the non-raw industries where the main factor of production is not financial, but intellectual capital. This coefficient is proposed to calculate in such way:

$$C_{ESI} = \frac{N_{ESI}}{N_E}, \quad (9)$$

where C_{ESI} – coefficient of employment in the science intensive sectors;

N_{ESI} – number of employed in the science intensive sectors;

N_E – employed.

The capital of renewal and development is a component of intellectual capital that reflects the abilities of the population in making applied researches and inventions, for example, patents, industrial examples, know-how, and others. The efficiency of the use of national capital of renewal and development is characterized by the following indicators: the coefficient of publication activity, the coefficient of engineering and technical activity, the coefficient of invention activity.

The coefficient of publication activity characterizes the level of researches' activity in publishing their scientific writings (monographs, articles, proceedings, preprints, etc.). This coefficient is proposed to calculate in such way:

$$C_{SA} = \frac{N_P}{1000}, \quad (10)$$

where C_{SA} – coefficient of publication activity;

N_P – number of publications per 1000.

The coefficient of engineering and technical activity characterizes the level of researches' activity in making advanced technology, namely software, hardware. This coefficient is proposed to calculate in such way:

$$C_{ETA} = \frac{N_{ETA}}{1000}, \quad (11)$$

where C_{ETA} – coefficient of engineering and technical activity;

N_{ETA} – number of advanced technology per 1000.

The coefficient of invention activity characterizes the level of population activity in making basic and applied researches. This coefficient is proposed to calculate in such way:

$$C_{IA} = \frac{N_{IA}}{1000}, \quad (12)$$

where C_{IA} – coefficient of invention activity;

N_{1A} – number of inventions per 1000.

It would be fair to admit that the main advantage of a set of partial coefficients above is that it ensures formalization, interconnectivity, unidirectionality, and comparability of them, their groups and the whole system. Furthermore, it also allows us to form an integral coefficient of efficiency of the use of national intellectual capital. By the same token, the relationship among these variables can be written as:

$$IC_{NIC} = \frac{\sum C_p}{n}, \quad (13)$$

where IC_{NIC} – integral coefficient of efficiency of the use of national intellectual capital;

$C_{p(1...n)}$ – partial coefficients;

N – number of partial coefficients (n=12).

The authors believe, that to express the results of the calculation of efficiency of the use of NIC and interpret them in an economic way, it is significant to use criterion scale (Table 1).

Table 1 **Criterion scale for determination of efficiency of national intellectual capital use**

Value of integral coefficient	Characteristic of efficiency of NIC use
0,00 – 0,10	Extremely low
0,11 – 0,25	Very low
0,26 – 0,40	Low
0,41 – 0,60	Middle
0,61 – 0,75	High
0,76 – 0,90	Very high
0,91 – 1,00	Extremely high

Source: submitted by authors

In order to test this approach, the author determined the efficiency of NIC use of Ukraine. For this reason, the author gathered all needed information and calculated the general coefficient of efficiency of the use of NIC of Ukraine from 2010 to 2017 (Table 2).

As we see, despite on powerful intellectual and technical potential of Ukraine the efficiency of its NIC use is very low. In particular, the value of the coefficient of efficiency of national human capital use was the highest in this period (approximately 0,4). Similarly, the efficiency of national capital of development and renewal use is also high, in particular, scientific activity rate was 0,714 in 2010 and 0,811 in 2013. At the same time, the efficiency of national process capital use is extremely low that, in author's opinion, is caused by the lack of necessary needed financial resources of enterprises and, consequently, low activity of them to introduce organizational and product innovations. In addition to this, the efficiency of the national market capital use of Ukraine is also low that indicates to structural reforms and innovation transformations of the national economy toward to accelerated development of science intensive industries have not yet been implemented in Ukraine.

Now consider integral coefficient of efficiency of NIC use of Ukraine in given period. That shows that the corresponding value of general coefficient varies from 0,185 in 2010 to 0,269 in 2017 that it has been proved the author's hypothesys that NIC use of Ukraine is not effective.

Taking into account abovementioned findings, the author makes some recommendations on how to increase the efficiency of the use of NIC of Ukraine. Firstly, it is significant to improve the legal framework for the protection of intellectual property rights and simplify the procedure of issuing patents for intellectual property products by reducing the cost of issuing patents for intellectual products and inventions. Secondly, it is advisable to create a unified state system of technical regulations and align it with international standards. It is undoubtedly that it will increase the access of innovation business entities to the sources of venture financing and promote the development of system "knowledge – production – knowledge". Thirdly, it should be completed the structural reorganization of national economy of Ukraine toward development of science intensive sectors of the economy and producing of innovation products. These measures will help to accelerate economic growth, increase life quality of the population, construct pro-European system of social privileges and guarantees in the long run in Ukraine.

Table 2 **Calculation of integral coefficient of efficiency of national intellectual capital use of Ukraine**

Indicators	Years							
	2010	2011	2012	2013	2014	2015	2016	2017
Coefficient of literacy rate	0,978	0,979	0,984	0,981	0,98	0,964	0,969	0,961
Coefficient of qualification	0,108	0,096	0,094	0,116	0,089	0,091	0,124	0,139
Coefficient of knowledge of foreign languages	0,109	0,124	0,129	0,134	0,139	0,149	0,154	0,155
General coefficient of efficiency of national human capital use	0,398	0,4	0,402	0,41	0,401	0,401	0,416	0,418
Coefficient of enterprises' implementation of organizational innovations	0,001	0,001	0,001	0,001	0,001	0,002	0,003	0,005
Coefficient of enterprises' implementation of marketing innovations	0,002	0,001	0,001	0,001	0,001	0,002	0,003	0,007
Coefficient of enterprises' implementation of advanced technologies	0,003	0,002	0,003	0,003	0,002	0,004	0,006	0,008
General coefficient of efficiency of national process capital use	0,002	0,001	0,002	0,002	0,001	0,003	0,004	0,01
Coefficient of science intensity of the state budget	0,023	0,024	0,024	0,029	0,026	0,017	0,019	0,022
Coefficient of innovation products	0,003	0,002	0,002	0,003	0,002	0,003	0,005	0,006
Coefficient of employment in the science intensive sectors	0,051	0,056	0,059	0,054	0,039	0,043	0,069	0,084
General coefficient of efficiency of national marketing capital use	0,032	0,027	0,021	0,029	0,022	0,021	0,031	0,037
Coefficient of publication activity	0,714	0,792	0,794	0,811	0,804	0,762	0,759	0,764
Coefficient of engineering and technical activity	0,102	0,119	0,122	0,134	0,139	0,146	0,149	0,151
Coefficient of invention activity	0,103	0,118	0,123	0,136	0,127	0,124	0,139	0,137
General coefficient of efficiency of national capital of renewal and development use	0,306	0,343	0,346	0,357	0,359	0,344	0,349	0,351
Integral coefficient of efficiency of NIC use	0,185	0,193	0,193	0,2	0,196	0,193	0,2	0,203

Source: insured by the authors [5]

Conclusions. Thus, author's methodological approach to the determination of efficiency of national intellectual capital use in the knowledge-based economy has been proposed. It involves the following stages: formation of a set of partial indicators that characterizes the efficiency of the use of the components of NIC (coefficient of literacy rate, coefficient of qualification, coefficient of knowledge of foreign languages, coefficient of enterprises' implementation of organizational innovations, coefficient of enterprises' implementation of marketing innovations, coefficient of enterprises' implementation of advanced technologies, coefficient of science intensity of the state budget, coefficient of innovation products, coefficient of employment in the science intensive sectors, coefficient of publication activity, coefficient of engineering and technical activity, coefficient of invention activity), calculation of general coefficients of the efficiency of the use of the components of NIC (general coefficient of national human capital use, general coefficient of national process capital use, general coefficient of national marketing capital use, general coefficient of national capital of development and renewal use), calculation of integral coefficient of the efficiency of NIC use, making some scientific and practice recommendations on how to increase the efficiency of NIC use. In order to test this approach, the author determined the efficiency of NIC use of Ukraine in 2010-2017. The study showed that despite on great scientific and technical potential, NIC use of Ukraine was not effective. It also has been founded that efficiency of national process capital use and national market capital use was very low in Ukraine. It also has been made some practical recommendations on how to increase the efficiency NIC use of Ukraine, in particular, it is proposed to improve the legal and regulatory framework for structural and innovation transformations, develop the venture entrepreneurship, develop the

sectors belonging to the fifth and sixth technological wave, give the tax privileges for innovation entrepreneurs.

Therefore, further author's scientific researches will be directed towards to the development of science intensive sectors and making practical recommendations on the implementation of the identified measures to improve the efficiency of the use of intellectual capital as a component of economic growth acceleration in Ukraine.

References:

1. Sedlyar, D. O. (2014). "Intellectual capital of the national economy: methodical principles". *Globalni ta natsionalni problemi ekonomiki,* vol.2, pp. 17-22.
2. Serdukova, L. O. (2013). "Formation, development and use of intellectual capital in the innovation system", Ph.D. Thesis, Economika i upravlenie narodnim hozyaistvom, Saratov, Russia.
3. Cherkashyna, T. S. (2017). "Estimation and forecasting of the value of national intellectual capital in terms of structural and innovative transformations". *Finansovii prostir*, vol. 3 (27), pp. 62-68.
4. Wiśniewski, P. & Wildowicz-Giegiel, A. (2014). "National Intellectual Capital (NIC) – New Metrics". *Review of Business and Economics Studies*, vol. 2, iss. 4, pp.72-79.
5. Official site of the State Department of statistics of Ukraine, retrieved from: www.ukrstat.gov.ua (Accessed 01 September 2018).
6. Kianto, A., Ritala, P., Vanhala, M. and Hussinki, H. (2018). "Reflections on the criteria for the sound measurement of intellectual capital: A knowledge-based perspective". *Critical Perspectives on Accounting*. https://doi.org/10.1016/j.cpa.2018.05.002 (Accessed 01 September 2018).
7. McDowell, W. C., Peake, Wh. O., Coder, LeAnne and Harris, M. L. (2018). "Building small firm performance through intellectual capital development: Exploring innovation as the "black box". Journal of Business Research, vol. 88, pp. 321-327. https://doi.org/10.1016/j.jbusres.2018.01.025 (Accessed 01 September 2018).
8. Gogan, L. M., Artene, A., Sarca, I., Draghici, A. (2016). The Impact of Intellectual Capital on Organizational Performance. Procedia - Social and Behavioral Sciences, vol. 221, pp. 194-202. https://doi.org/10.1016/j.sbspro.2016.05.106 (Accessed 01 September 2018).