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INDEX-MATRIX APPROACHES OF ANALYSIS OF EFFECTIVE USE OF THE INTELLECTUAL POTENTIAL IN NATIONAL ECONOMY

ІНДЕКСНО-МАТРИЧНІ ПІДХОДИ АНАЛІЗУ ЕФЕКТИВНОСТІ ВИКОРИСТАННЯ ІНТЕЛЕКТУАЛЬНОГО ПОТЕНЦІАЛУ В НАЦІОНАЛЬНІЙ ЕКОНОМІЦІ

ANNOTATION

This article discusses the index-matrix model usage analysis and enhance intellectual potential. Based on introduced Techniques it was built the index-matrix model of efficiency of usage and enhance the intellectual potential in the national economy. Designed matrix models give a clearer picture of the activities of implementing intellectual potential that can be used in further economic and statistical studies. This method allows to determine the potential opportunity to enhance intellectual potential in a stable state of the economy, and investigate the impact of the major factors in the revitalization of intellectual potential through the introduction of various measures to stimulate this process. Results of the study demonstrate the importance of a comprehensive approach in analyzing the intellectual potential in the national economy.

Keywords: index-matrix analysis; activation of intellectual potential; national economy; effectiveness; economic efficiency; productivity economy.

АНОТАЦІЯ

У статті розглядаються індексно-матричні моделі аналізу використання та активізації інтелектуального потенціалу. На основі представленої методики було побудовано індексно-матричну модель ефективності використання та активізації інтелектуального потенціалу в національній економіці. Розроблені матричні моделі дають більш чітке уявлення про показники ефективності реалізації інтелектуального потенціалу, які можуть бути використані в подальших економічних та статистичних дослідженнях. Цей метод дозволяє визначити можливість потенційної активізації інтелектуального потенціалу в стабільному стані економіки, а також дослідити вплив основних факторів на активізацію інтелектуального потенціалу за рахунок запровадження різних заходів зі стимулювання даного процесу. Результати дослідження демонструють важливість застосування комплексного підходу при аналізі використання інтелектуального потенціалу в національній економіці.

Ключові слова: індексно-матричний аналіз; активізація інтелектуального потенціалу; національна економіка; ефективність; економічна ефективність; продуктивність економіки.

АННОТАЦИЯ

В статье рассматриваются индексно-матричные модели анализа использования и активизации интеллектуального потенциала. На основе представленной методики была построена индексно-матричная модель эффективности использования и активизации интеллектуального потенциала в национальной экономике. Разработанные матричные модели дают более четкое представление о показателях эффективности реализации интеллектуального потенциала, которые могут быть использованы в дальнейших экономических и статистических исследованиях. Этот метод позволяет определить возможность потенциальной активизации интеллектуального потенциала в стабильном состоянии экономики, а также исследовать влияние основных факторов на активизацию интеллектуального потенциала за счет введения различных мер по стимулированию данного процесса. Результаты исследования демонстрируют важность применения комплексного подхода при анализе использования интеллектуального потенциала в национальной экономике.

Ключевые слова: индексно-матричный анализ; активизация интеллектуального потенциала; национальная экономика; эффективность; экономическая эффективность; производительность экономики.

Problem setting. The study of the dynamics of economic efficiency from the use of intellectual potential in the national economy is a complex process and is not granted because it is difficult to determine the basis for calculating the performance indicators.

In our study we try to identify and systematize indicators of economic efficiency of intellectual potential in its implementation in the national economy by using index-matrix models.

Recent research and publications analysis. Matrix analysis methodology which was developed by renowned Estonian scientists [2-3, 8-9] will consider the level of conversion efficiency in intellectual potential to intellectual capital, organize analysis and interpret indicators of economic efficiency of the use of intellectual potential to a single model.

The research objective. The purpose of this paper is a synthesis and application in practice of index-matrix modeling of economic efficiency indicators from realization of the intellectual potential of the national economy.

Key research findings. Modern interpretations of effectiveness, economic efficiency, productivity economy relies on a wide range of factors that have an impact and determine the level of performance in time, space and scale of any economic system. The factors that determine changes in the level of efficiency and productivity of the national economy in terms of predictive capacity is primarily the increased use of intellectual potential, reducing the gap between the training and retraining of scientific and professional personnel and implementation of acquired knowledge and experience in their actual implementation – intelligent products, increase the motivation for the development and implementation of intelligent products, general trends to improve predictive potential, an increase in return of invested funds forming intellectual potential, reduction of certain expenditure items in the process of forma-

tion and implementation of intellectual capacity, improve profitability as the most intelligent products and intellectual resources, creating appropriate conditions for the growth and preservation of intellectual capacity within the country and more.

Thus, the effectiveness of the implementation of intellectual potential factors is an umbrella category that includes all of the above factors. So, the individual indicator can not be considered as a direct reflection of the effectiveness or efficiency in general. The content of all these indicators are indicators of intensity, but as all relevant phenomena are part of the category of efficiency, they are both partial and performance indicators, and each reflects the level of efficiency and changes in certain circumstances.

Increased productivity and increased intellectual capacity will be based on the intensification of the creation and implementation of intellectual products, but not every step or action increasing intensity leads to an increase in actual performance.

One of these indicators is to motivate academic and professional staff to enhance the intellectual activity to create intelligent products this figure may not lead to higher overall efficiency if an intensification of intellectual potential accompanied by is excessive costs for development and implementation of intelligent products. In addition, the overall efficiency of the national economy from activation intellectual capacity will not grow if the increase in the intensity of the introduction of intellectual potential of individual organizations, enterprises, institutions, or certain activities accompanied by decreased activity in other organizations, in other areas, directions, fields, sphere of activities.

So increase of aggregate productivity and efficiency of the national economy from the sale of intellectual potential is a comprehensive equilibrium increase in the intensity of intellectual activity and sales of intelligent products simultaneously in many sectors, the sides and aspects.

There is a certain contradiction in the approach to measure the performance and efficiency that is in any attempt to determine the level of efficiency as a ratio of two absolute values will be received index, which is not common, but a partial indicator of efficiency. Accordingly, the use of models based on these indicators can not give unbiased information about effectiveness. Out of this situation is to search for a particular way of modeling efficiency level that would allow adequately reflect the nature of the category of efficiency.

Another methodological error that prevents solving the problem of measuring performance is a fuzzy concept of the study objectives and measure performance. Most modern researchers try establish unified procedures which made it possible to answer all the questions that arise in economic activity due to the efficiency, while practice requires precise numerical information to solve two different problems:

- Detailed expose of the level of efficiency and increase of its reserves (task adequately reflected);
- Ranking intellectual resources for the implementation of the reached performance (task rankings).

The task adequately reflected in its methodology is a primary, as based on data derived from its implementation, can be the way to solve the problem of ranking.

To display the total productivity and efficiency of the implementation of intellectual potential and further increase of reserves, modern scholars often distinguish indicators such intensity as partial performance or performance factor productivity:

1) Personnel intellectual potential productivity, which can be measured by indicators:

1.1) the creation of intellectual products – the ratio between the value of created intellectual products – Q and the time spent on their creation – H;

1.2) specific time spent on creating intellectual products (resources) – H/Q;

2) Intellectual potential material efficiency is the ratio of created intellectual products – Q in monetary terms to material expenses for intellectual resources – C, or inverse proportion between these indicators (C/Q);

3) The return on intellectual potential, which can be:

3.1) profitability of intellectual products – the ratio between profit – M and the value of the created intellectual products – Q;

3.2) profitability of intellectual resources – M/C.

Fig. 1 shows all of the above indicators of intensity and four quantitative performance indicators H, Q, S, M, the ratio between them is the personnel intellectual potential productivity, material efficiency and profitability of intellectual resources.

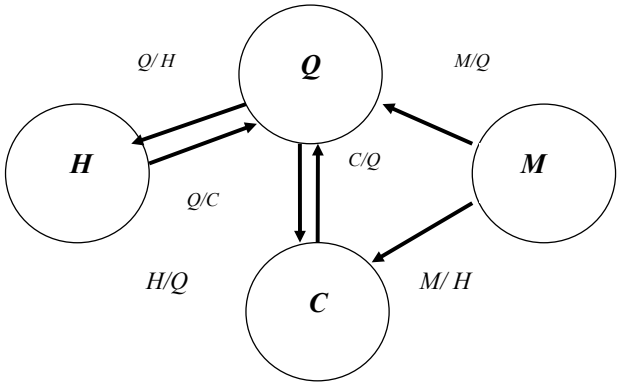

Fig. 1. Indicators of efficiency factor activation of intellectual potential

Source: it is built on giving data [3] by the author

Indicators cover some vicious intensity field between the initial quantitative performance indicators. This field relations. Fig. 1 allows you to find out that of 12 possible relationships between

the four output parameters Q, H, C, M indicator of the intensity reached only six. Thus, we can conclude that set of partial performance indicators, which are often used for it's characteristics do not give a complete picture of quality economic relationships that form the level of efficiency. This finding points to the correct path for the next overcoming the before mentioned problems.

For a more thorough knowledge of the field of relations, which formed effectiveness factors of enhance of intellectual capacity, should cover all, without exception, all the relationship between output parameters, the relationship depicted in Fig. 2.

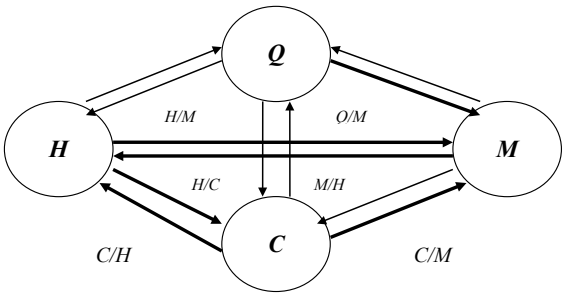

Fig. 2. A complete coverage of relations field
Source: it is built on giving data [3] by the author

Schematic representation of the field of relationship demonstrates how overall system field model of economic efficiency is more complete than normal traditional idea of the level of efficiency, as measured by not overall system set of indicators.

In Fig. 2 accept performance intensity, also is shown:

- return time creating intellectual resources – M/H, is the sum of earnings per hour, day, or a certain period of time it that a person or team needs to create intellectual products;
- measured time is required to manufacture intellectual resources of profit – N/M;
- measured intellectual production of profit – Q/M is the value of intellectual products is required for 1 USD of profit;
- related cost to the creation of intellectual resources or products to the time required for their establishment and implementation – S/N;
- measured time to exercise intellectual activity material costs necessary for the development of intelligent products – N/A;
- measured material costs necessary for the creation of intellectual resources of profit – S/M.

Diagram consists of two parts of different qualitative character:

- Quantification of output – output indicators of intellectual activities which restrict right performance and thus determine its specific content, but they are not part of the relations field;
- The system of all possible relationships between output parameters, so the field relations model.

Thus, when this approach modeling approach the level of efficiency is not the quotient of the result of the cost (or resources). The level of efficiency – is a field or overall system set of all possible indicators of intensity that bind together the quantitative results of intellectual activity proceedings.

Four quantitative output parameters, of course, is not enough to build a model of productivity and efficiency, on which you can make a really deep analysis of the causes of changes in aggregate productivity and efficiency or find additional reserves to its increase. To include another indicator – factor intensity in the model will need to complete the list of output parameters. This will increase the number of indicators of intensity (from 12 to 20). If the number of output parameters n, the total number of elements in the field of relations indicators (intensity) will be equal to:

$$n_2 - n.$$

Graphic model of the relationship field made it possible to bring some important theoretical principles of the plan. For the quantitative measurement of total productivity and efficiency advisable to start using a mathematical model in the form of a matrix (Fig. 3), which is identical described to the model graphic fields of relationship.

Matrix model of relations field can also identify untapped internal resources to improve efficiency. It is a versatile tool for research, measurement, comparison and evaluation of the functioning and development of intellectual potential of the national economy.

	Q	***H***	***M***	***C***
Q	1,0	*H/Q*	*M/Q*	*C/Q*
H	*Q/H*	1,0	*M/H*	*C/H*
M	*Q/M*	*H/M*	1,0	*C/M*
C	*Q/C*	*H/C*	*M/C*	1,0

Fig. 3. The matrix model of field relations, a model identical to Fig. 2
Source: it is built on giving data [3; 9] by the author

The model of efficiency in its structure is fundamentally different from other matrix models used in the modeling of economic phenomena, such as [1]. Elements of the last are additive, and the amount of the vector-rows and columns are balanced, then the field matrix model elements are interconnected by relationship multilateral.

All changes of aggregate ripple ties productivity and efficiency state are quantitatively reflected in the output parameters. Comparison of matrix of the following periods reveals that relations field components most influenced on

variations in aggregate productivity and efficiency (component indices which most deviated from the unit during the period). This approach makes it possible to solve an important theoretical issue – the problem of the importance of individual factors of efficiency enhance in the use of the intellectual potential of the national economy. This problem is specific to a market economy and business entities and various types of institutions that have available sufficient intellectual and innovative potential, but because of financial, social, economic, political, technological, technical or other reasons can not activate it, so have the low level of aggregate productivity and efficiency of the implementation of intellectual potential.

The structure of efficiency matrix is a square and all its elements are placed symmetrically along the main diagonal, is with the suffix placed in inverse order are reciprocal (Fig. 4), is: $b_{21} = 1/b_{21}$; $b_{31} = 1/b_{13}$.

C_j / a_i	C_1	C_2	…..	C_n	$= \overrightarrow{C_j}$
a_1	1,0	b_{12}	…..	b_{1n}	
a_2	b_{21}	1,0	…..	b_{2n}	
…..	…..	…..	1,0	…..	$= \lVert b_{ij} \rVert$
a_n	b_{n1}	b_{n2}	…..	1,0	

Fig. 4. Matrix model in general terms, for any number of parameters – *n*

Source: Reylyan (1989, p. 150-151)

From this it follows that any change in the efficiency of the numerical values of one of the two elements placed symmetrically with respect to the main diagonal, always growing, and the other – are reduced. Raising efficiency in the revitalization of intellectual activity increases the performance $b_{21} = Q/H$; $b_{13} = M/Q$; $b_{23} = M/H$; $b_{24} = C/H$; $b_{41} = Q/C$; $b_{43} = M/C$ – (shown in Fig. 5).

	Q	*H*	*M*	*C*
Q	1,0	*H/Q*	*M/Q*	*C/Q*
H	*Q/H*	1,0	*M/H*	*C/H*
M	*Q/M*	*H/M*	1,0	*C/M*
C	*Q/C*	*H/C*	*M/C*	1,0

Fig. 5. Intensity indicators that grow at higher efficiency level of intellectual potential

Source: it is built on giving data [2-3, 8-9] by the author

Next, you need to carry out the restructuring matrix model, placing encircled items under the diagonal (Fig. 6).

As a result of overall relations field is divided into two fundamentally different parts: below-diagonal (direct relationship field) and superdiagonal (inverse relationship field).

For common characteristic of changes in the state field of relationships and their measurement can be only limited by direct relationship field (additional consideration of the inverse relationship field expedient only in detailed factor analysis of all the circumstances of the performance change).

	M	*Q*	*C*	*H*
M	1,0	*Q/M*	*C/M*	*H/M*
Q	*M/Q*	1,0	*C/Q*	*H/Q*
C	*M/C*	*Q/C*	1,0	*H/C*
H	*M/H*	*Q/H*	*C/H*	1,0

Fig. 6. The ordered matrix model

Source: it is built on giving data [2-3, 8-9] by the author

Marsena William M. Saarapera, V. Venese propose to consider as the efficiency field as the field of relations, but in reviewing the effectiveness of intellectual capacity should summarize these concepts and consider them homogeneous.

Analysis of fig. 3-6 shows that in the initial model output parameters were in random order and in orderly patterns are in order of relative consistency, depending on the quality of the outcome of intellectual activity.

Using synthetic performance index, which can take the form of an arithmetic or geometric mean of all index fields direct relationship makes it possible to place any amount or set of elements of the system of intellectual potential of the national economy in order to increase their effectiveness and enhance intellectual activity of the intellectual potential in implementing economic space. Many useful analytical information can be obtained from matrix models as a result of the special relationship imitations state of the field under different conditions, for example, if the value of intellectual products will increase by X percent or staff performance of the intellectual potential rise in y percent etc.

Conclusions: The methodological basis of the analysis of the performance and efficiency of the intellectual potential of the national economy is the possibility of complex factor analysis based on field of relationships and related considerations of the economic square matrices. This method allows to determine the potential opportunity to enhance intellectual capacity in a stable state of the economy and the impact of the major factors in the revitalization of intellectual potential through the introduction of various measures to stimulate this process.

Construction of matrices based on field of relationship makes it possible to select accu-

rately the most essential parameters for the formulation and processing of certain economic and statistical tasks.

REFERENCES:

1. Леонтьев В.В. Спад и подъём советской экономической науки / В.В. Леонтьев // Экономические эссе. Теории, исследования, факты и политика. – М. : Политиздат, 1990. – С. 226.
2. Мересте У. Комплексный анализ основных результатов хозяйственной деятельности предприятий и объединений : [учеб. пособ.] / У. Мересте. – Таллинн. – 1983. – 74 с.
3. Мересте У. О матричном методе анализа экономической эффективности общественного производства / У. Мересте // Экономика и математические методы. – 1982. – Вып. 1. – Т. XVIII. – С. 138–149.
4. Мойсеєнко І.П. Управління інтелектуальним потенціалом : [монографія] / І.П. Мойсеєнко. – Львів : Аверс, 2007. – 304 с.
5. Мойсеєнко І.П. Управління інтелектуальним потенціалом суб'єктів господарювання в національній економіці : автореф. дис. … д. е. н. : спец. 08.00.03 / І.П. Мойсеєнко ; Львів. нац. ун-т ім. І.Франка. – Л., 2010. – 36 с.
6. Никифоров А.Є. Методологія вимірювання загальнонаціонального інтелектуального потенціалу: світовий досвід та його адаптація в Україні / А.Є. Никифоров // Вчені записки КНЕУ. – 2011. – № 13. – С. 326–337.
7. Никифоров А.Є. Компаративне міжкраїнове вимірювання інтелектуального потенціалу: методологія і методика / А.Є. Никифоров // Актуальні проблеми економіки. – 2012. – № 3. – С. 72–85 Електронний ресурс. – Режим доступу : http://nbuv.gov.ua/j-pdf/ape_2012_3_10.pdf.
8. Рейльян Я.Р. Опыт ФРГ в развитии теории анализа хозяйственной деятельности предприятий / Я.Р. Рейльян // Ученые записки Тартурского университета. Труды по экономическим наукам: Эффективность и анализ использования ресурсного потенциала в новых условиях хозяйствования. Тартурский университет. – Тартур, 1989. – 184 с.
9. Саарапера М., Венсел В. Построение факторных систем посредством матриц связи / М. Саарапера, В. Венсел // Труды Таллиннского политехнического института. – 1985. – № 605. – С. 83–98.