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**Тематичний розділ:** Економіка та управління підприємствами

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## **MATRIX MODEL FOR ADMINISTRATIVE DECISION-MAKING: STAGES OF APPLICATION**

The article elucidates modern innovative methods for diagnosing the efficiency of enterprise management. The study has revealed that within the framework of elaboration of the model of adaptive management of socio-economic efficiency of enterprises it is expedient to use a matrix method with the calculation of a generalized efficiency indicator. The article focuses on the stages of selection of those indicators which are the most essential for the analysis and assessment of the efficiency of the enterprise management.

**Keywords:** diagnostics, efficiency, index, integral index, matrix, model, estimation, enterprise, management, financial results.

**Setting of a problem.** At the current stage of market relations development in Ukraine, the issue of regulating the development of enterprises requires new approaches to its solution. Non-interference of the state into the economic activity of enterprises motivates them to seek out the ways of survival under the market economic conditions, find the ways to update management mechanisms and thus ensure the growth of the economic potential and competitiveness.

In connection with this, there is a need for a new, scientifically grounded approach to improve the mechanism of enterprise management and methods for diagnosing the effectiveness of this management, taking into account their internal features and the dynamics of the external environment [1].

The tendencies and problems of the Ukrainian trade enterprises development predetermine the need to develop a scientifically-grounded concept for improving the

management system, adapting it to the current conditions of the Ukrainian society development. Modern methods of improving the efficiency of enterprises need innovative methods for diagnosing the effectiveness of their management [7].

**Analysis of recent researches and publications.** The theoretical and applied foundations of the enterprises functioning specificity have been developed by the researchers I. Abdukarimov, M. Aliman, V. Apopij, S. Babenko, V. Honcharenko, J. Kachmaryk, I. Markina, A. Friedman and others. The main concepts of the theory of enterprise management efficiency are elucidated in the scientific works of M. Baidakov, B. Binkin, A. Vinogradova, V. Zhyhalov, J. Zelenevsky, G. Emerson, F. Quesnay, T. Kotarbiński, W. Petty, D. Ricardo, A. Sadekova, M. Tuhun-Baranovsky, N. Ushakova and others. Despite a considerable number of studies, the issue of increasing the productivity of enterprises activities through improving the mechanism for diagnosing their management efficiency is still hotly debated. Thus scientific substantiation of modern innovative methods of diagnosing the efficiency of enterprise management is an urgent problem which requires immediate solution.

In the development of the adaptive management model for socio-economic efficiency of enterprises, in our opinion, it is advisable to use a matrix method with the calculation of a generalized efficiency indicator.

In economic literature, researchers pay considerable attention to the methods of conducting a comprehensive analysis of the efficiency of enterprises, including the matrix method. In their works L. V. Frolova, L. V. Semerun, M. I. Arich, L. M. Achkasova, J. S. Tsal-Tsalko and many other researchers propose to conduct the diagnostics of the enterprise financial management effectiveness using the matrix method. They use different sets of input parameters [5, 8]. In our opinion, the use of this method is also justified for the assessment of the efficiency of enterprises on the whole.

**Identification of previously unsolved issues of the problem.** Although considerable amount of research has been devoted to the assessment of the efficiency of enterprises, few attempts have been made to develop mechanisms for implementation of the innovative methods of enterprise management. Therefore, the issue of introducing innovative methods for diagnosing the management of enterprises and organizations is

an urgent problem.

**Goal setting.** The purpose of this research is to substantiate a strategy of diagnosing the enterprise financial management effectiveness based on the use of the matrix method.

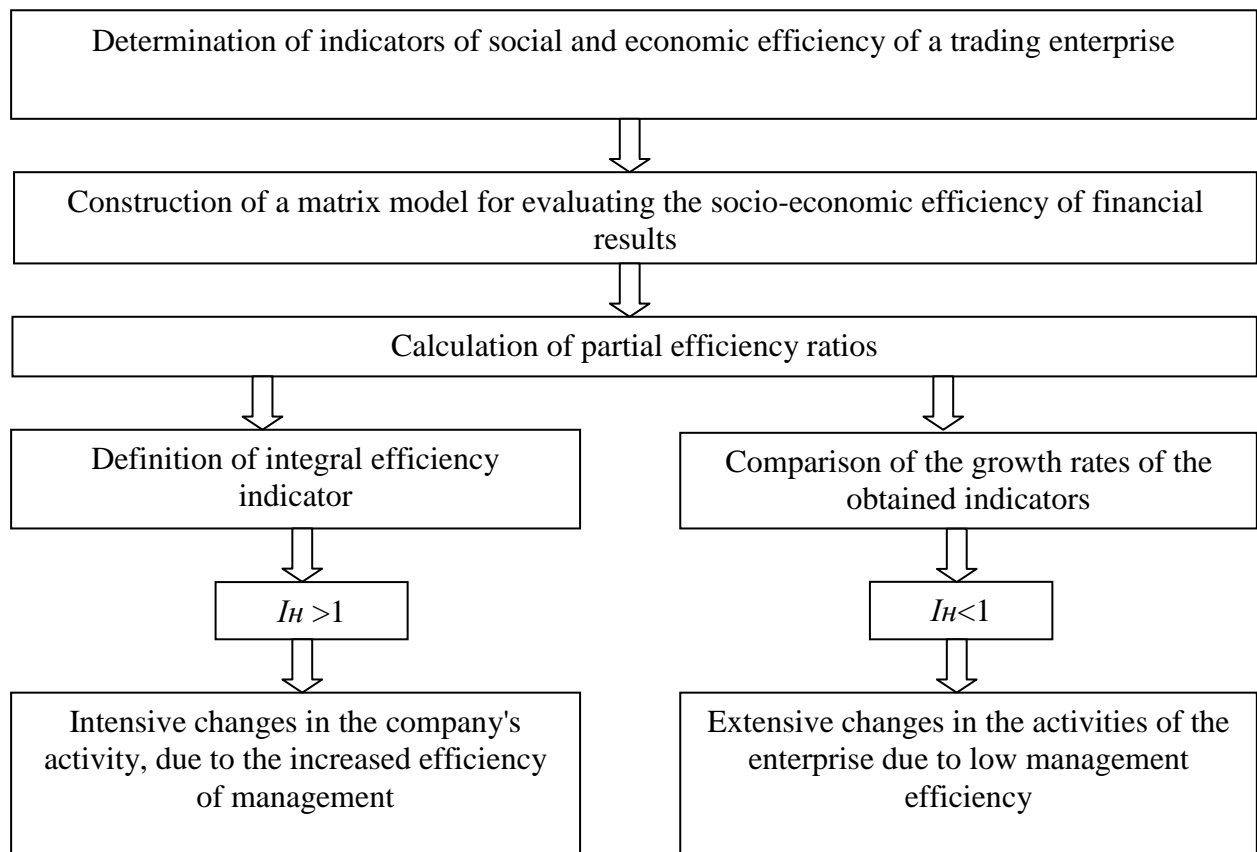
**Presentation of basic material of the research.** Any enterprise, regardless its size, a sphere of activity, profitability or loss-making business, is a complex economic system. Therefore, the efficiency of production is a complex concept too. Its assessment in terms of the individual indicators will always be incomplete and one-sided. For example, in case of high level of labor productivity, an enterprise may be low-profitable or even loss-making for one reason or another. Being highly profitable, it may still have poor balance structure.

In view of this, it is necessary to conduct the assessment and analysis using not the individual indicators but the system of indicators (or the «matrix of indicators» as suggested in this study). Such an approach will, on the one hand, promote control over the implementation of the plan and, on the other hand, it will serve the basis for making management decisions.

The matrix model of analysis will allow to evaluate the decisions made in the past and to substantiate the decisions made on the basis of interconnections and dependencies of different indicators.

With the help of the matrix method, it is possible not only to characterize the state of the enterprise and the dynamics of its development in general but also to determine the changes in the results of work and to identify the reserves for improving the efficiency of its activities.

The study has revealed that the matrix of cost-benefit ratio confers an objective description of the effectiveness of the available resources utilization, the strategic income being the profits amount. The structural and logical scheme of constructing a matrix model for assessing the efficiency of enterprise management is shown in Fig. 1.



**Fig. 1. The structural-logical scheme of constructing a matrix model for diagnosing the enterprise management efficiency** (*modified by the authors, based on [10]*)

When choosing the indicators to construct the matrix, it is necessary to follow a number of requirements.

Indicators of the state of various enterprises should:

- be comparable;
- vary depending on the state of the enterprise as a whole, and its structural divisions in particular;
- be accessible and reliable;
- reflect the results of operations and the costs and resources required to obtain these results.

It is recommended to conduct the selection of the key indicators for the analysis and assessment in several stages.

At the first stage, it is advisable to evaluate information. As a result of this assessment, from the initial set of the indicators will be excluded the indicators, the amount of which is calculated as a quotient of the division (productivity, profitability, capital productivity,

etc.).

At the second stage it is necessary to select the indicators, that reflect the main results of the enterprise activities in general, and its structural subdivisions, in particular. Similarly, it is necessary to select the indicators that reflect the resources and costs necessary for production.

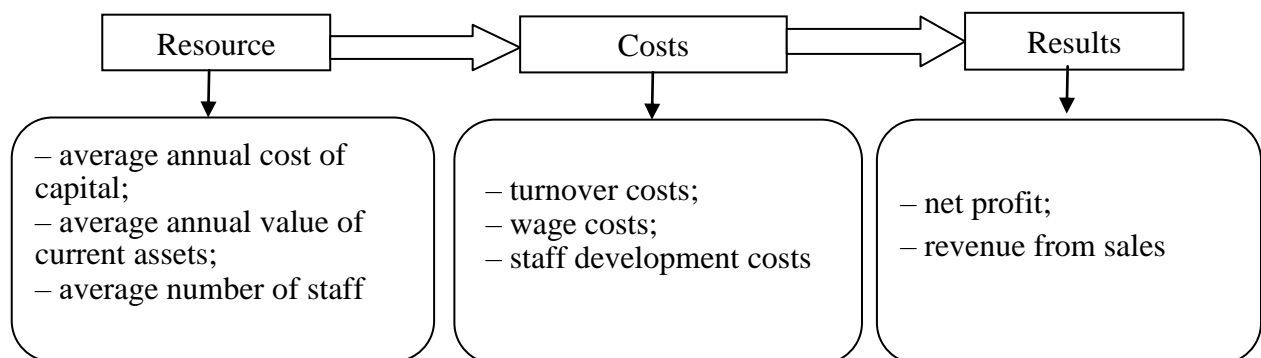
The list and number of indicators may vary. They are determined depending on the type of activity of the enterprise and other factors.

At the third stage, a set of indicators is adjusted taking into account the frequency of observation and the indicators available for calculation.

When compiling the list of the enterprise efficiency indicators, it is important that they reflect all aspects of the process under investigation. The assessment of the enterprise management efficiency must reflect the interconnections between its resources availability, the cost-benefit ratio in accordance with the following scheme (1):

$$\text{Resources} \rightarrow \text{Costs} \rightarrow \text{Results} \quad (1)$$

In order to carry out a comprehensive analysis it is proposed to include the following indicators into the matrix model (Fig. 2):



**Fig. 2. Indicators of the integrated assessment of the enterprise management efficiency**

We believe that the inclusion of this set of indicators in the matrix model will ensure the objectivity and completeness of the conclusions of the diagnostic system.

At the next stage of the study, it is necessary to construct a matrix 8x8 in the form of table 1. The elements of the table reflect the ratios, obtained by the division of the initial indicators of the normative model.

Table 1

**Matrix model for assessing the enterprise management effectiveness**

Denominator	Numerator	Results		Costs			Resource		
		1. Net profit (P)	2. Revenue from sales (R)	3. Expenses of circulation (C)	4. Salary costs (SC)	5. Staff development costs (SD)	6. Current assets (CA)	7. Average annual cost of capital (CC)	8. Average number of staff (AS)
Results	1. Net profit (P)	P/P 1,000	R/P Fixing income from sales	C/P Assignment of expenses for return on profit	SC/P Assignment of labor costs for profits	SD/P Fixing the costs of personnel development by profit	CA/P Fixing current assets by profit	CC/P Fixing capital by profit	AS/P Fixing workforce by profit
	2. Revenue from sales (R)	P/R Profitability of revenues	R/R 1,000	C/R Fixing the expenses of the turnover on the income from the sale	SC/R Assignment of expenses on labor remuneration	SD/R Fixing the cost of personnel development by income	CA/R Fixing current assets by income from sales	CC/R Fixing capital by income from sales	AS/R Fixing workforce by income from sales
Costs	3. Expenses of circulation (C)	P/C Profitability of expenses of circulation	R/C Revenue from realized costs	C/C 1,000	SC/C The share of labor costs in turnover costs	SD/C The share of costs for staff development in turnover costs	CA/C Fixing current assets at cost	CC/C Fixing capital by turnover	AS/C Fixing labor at the expense of turnover
	4. Salary costs (SC)	P/SC Cost-effectiveness of labor costs	R/SC Revenue from labor costs	C/SC Confirmation of the cost of treatment for labor costs	SC/SC 1,000	SD/SC Cost ratios for staff development and labor costs	CA/SC Fixing current assets by labor costs	CC/SC Fixing capital for labor costs	AS/SC Fixing workforce for labor costs
	5. Staff development costs (SD)	P/SD Cost-effectiveness of personnel development costs	R/SD Revenue for personnel development costs	C/SD Assignment of the expenses of treatment for expenses personnel development	SC/SD The ratio of labor costs and staff development costs	SD/SD 1,000	CA/SD Assignment of current assets to expenses for personnel development	CC/SD Assignment of capital to staff development costs	AS/SD Fixing workforce costs for staff development
Resource	6. Current assets (CA)	P/CA Profitability of current assets	R/CA Return on current assets	C/CA Fixing the costs of working on working assets	SC/CA Fixing the cost of wages for working assets	SD/CA Fixing the costs of staff development for working assets	CA/CA 1,000	CC/CA Fixed capital for working capital	AS/CA Fixing labor for working assets
	7. Average annual cost of capital (CC)	P/CC Return on equity	R/CC Return on capital	C/CC Fixing the cost of capital treatment	SC/CC Fixing the cost of labor remuneration for capital	SD/CC Fixing the cost of personnel development by capital	CA/CC The share of capital aimed at the formation of current assets	CC/CC 1,000	AS/CC Fixing the labor force by capital
	8. Average number of staff (AS)	P/AS Cost-effectiveness of the workforce	R/AS Productivity	C/AS Expenses of turnover per employee	SC/AS Average salary of 1 employee	SD/AS Development costs per employee	CA/AS Current assets per employee	CC/AS Capital per employee	AS/AS 1,000

Indicators for constructing a matrix are arranged in the reverse order (2).

$$\text{Results} \rightarrow \text{Costs} \rightarrow \text{Resources} \quad (2)$$

The tendency, when the growth rate of the results of the enterprise activity exceeds the growth rate of cost and resource supply, indicates the high efficiency of management and intensive development of the enterprise. The output data in the matrix model provide double interpretation: they reflect the results of the enterprise activity (located above the rows of the matrix), and the factors influencing these results (located to the left of the matrix columns). All elements of the matrix, located at the points of intersection of the corresponding rows and columns (the effective index and the factor of influence), are qualitative indicators (intensive factors) of the enterprise efficiency. These data are the results of the sequential division of each indicator in the upper row of the matrix on the indicators of the leftmost column.

Matrix elements at the intersection of rows and columns are separate indicators with their own meaning and content. Many of them, such as profitability, profits from sales, productivity, turnover, are widely known and used in the economic analysis. Other elements of the matrix reflecting the relationships and proportions between the output indicators lack proper attention.

After the matrix is formed, its aggregation is the next step. For this purpose, we use a method of direct proportional dependence, in which direct indicators of efficiency should increase if it increases, and the opposites point to decrease. Having divided the formed matrix model into three parts which reflect the results, resources and costs, we will receive six zones under the diagonal of the matrix, each of which has its particular economic content [10].

Each zone characterizes a separate aspect of the efficiency of enterprise management. The integral indicator of the efficiency of management is determined by the growth indices of relative indicators, presented under the diagonal of the matrix. If the final financial result of the enterprise's activity is a loss, then the formula is used to calculate the integral index, in which the profitability indicators change accordingly to the indicators of losses. Considering that the total of losses should decrease, the formula is modified as follows: the growth of the  $i$ - index of enterprise

profitability is replaced by  $[1 + (1 - I_{\text{эди}})]$  [3].

The effectiveness of the management of enterprise activities in accordance with the above recommendations has been verified on the case study of trading companies. The results of the assessment of management effectiveness are given in table 2.

Table 2

**Matrix of the assessment indexes growth of the management efficiency indicators at trading enterprises**

Enterprise	Indexes								
Enterprise №1		P	R	C	SC	SD	CA	CC	AS
	P	1							
	R	0,60680	1						
	C	0,62204	1,02511	1					
	SC	0,61026	1,00570	0,98107	1				
	SD	0,64947	1,07031	1,04410	1,06425	1			
	CA	0,60565	0,99810	0,97366	0,99245	0,93253	1		
	CC	0,59782	0,98520	0,96107	0,97962	0,92048	0,98708	1	
	AS	0,65633	1,08162	1,05513	1,07550	1,01057	1,08368	1,09787	1
Enterprise №2		P	R	C	SC	SD	CA	CC	AS
	P	1							
	R	1,00	1						
	C	1,25911	1,00604	1					
	SC	1,00000	1,00000	1,000	1				
	SD	1,18276	0,94504	0,93936	0,92376	1			
	CA	1,23180	0,98422	0,97831	0,96207	1,04146	1		
	CC	1,31231	1,04855	1,04225	1,02494	1,10953	1,06535	1	
	AS	1,47106	1,17539	1,16833	1,14893	1,24375	1,19423	1,12097	1
Enterprise №3		P	R	C	SC	SD	CA	CC	AS
	P	1							
	R	0,86070	1						
	C	0,84213	0,97842	1					
	SC	1,22951	1,42850	1,46000	1				
	SD	1,15102	1,33731	1,36680	0,93616	1			
	CA	1,44000	1,67306	1,70995	1,17120	1,25106	1		
	CC	0,60889	0,70744	0,72304	0,49523	0,52900	0,42284	1	
	AS	0,70000	0,81329	0,83123	0,56933	0,60816	0,48611	1,14962	1

On the basis of the indicator indexes presented in table 2, we can estimate the efficiency of the enterprise management in the identified areas and indicators scope that characterize every branch of the analysis (progressivity of changes in the end result, outlay-effectiveness, resource efficiency, changes in the resources cost-effectiveness, change in the structure of resources).

The next stage of the study is the calculation of the integral efficiency indicator



( $I_H$ ), which is defined as a geometric mean of the quotient indexes (3):

$$I_H = \sqrt[n]{\prod_{i=1}^n I_i}, \quad (3)$$

where  $I_i$  – quotient indicators;  
 $n$  – the number of indicators.

The results of the integrated assessment of the management efficiency of the enterprises under study are presented in table 3.

Table 3

**Integral indicators of the enterprise management effectiveness assessment**

Enterprise	Enterprise №1	Enterprise №2	Enterprise №3
Integral indicator	0,952	1,088	0,858
Conclusion based on the assessment results	Extensive changes in the company due to low management efficiency	Intensive changes in the company, due to increased management efficiency	Extensive changes in the company due to low management efficiency

**Conclusions.** When performing a comprehensive analysis of the quotient indicators, we suggest to distinguish the following states:

- reference state – the dynamics of indicators corresponds to the normative model;
- state of balance – there are certain deviations, especially in the distribution costs;
- the state of forthcoming crisis in efficiency – the deterioration in key indicators of activity, a significant deviation from the norm;
- the state of «balance perspective» – reducing losses, increase in profitability of the individual indicators;
- the state of crisis – the growth of indicators of losses, decrease in the rates of profitability.

We believe that the use of this approach will allow to assess the effectiveness of enterprise management comprehensively, identify vulnerabilities and diagnose the key issues that lead to their reduction.

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## **ЕТАПИ ЗАСТОСУВАННЯ МАТРИЧНОЇ МОДЕЛІ ДЛЯ ПРИЙНЯТТЯ УПРАВЛІНСЬКИХ РІШЕНЬ**

Досліджено сучасні інноваційні методи діагностики ефективності управління підприємств. Доведено, що у межах розробки моделі адаптивного управління соціально-економічною ефективністю підприємств доцільно застосовувати матричний метод із розрахунком узагальнюючого показника ефективності. Розглянуто етапи вибору основних показників для аналізу й оцінки ефективності управління підприємств.

**Ключові слова:** діагностика, ефективність, індекс, інтегральний показник, матриця, модель, оцінка, підприємство, управління, фінансові результати.

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## **ЭТАПЫ ПРИМЕНЕНИЯ МАТРИЧНОЙ МОДЕЛИ ДЛЯ ПРИНЯТИЯ УПРАВЛЕНЧЕСКИХ РЕШЕНИЙ**

Исследованы современные инновационные методы диагностики эффективности управления предприятий. Доказано, что в пределах разработки адаптивного управления социально-экономической эффективностью предприятий целесообразно применять матричный метод с расчетом обобщенного показателя эффективности. Рассмотрены этапы выбора основных показателей для анализа и оценки эффективности управления предприятий.

**Ключевые слова:** диагностика, эффективность, индекс, интегральный показатель, матрица, модель, оценка, предприятие, управление, финансовые результаты.