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# ASSESSMENT OF THE EFFICIENCY OF THE USE OF BASIC RESOURCES USING THE TOOLS OF TAXONOMIC ANALYSIS

# ОЦІНКА ЕФЕКТИВНОСТІ ВИКОРИСТАННЯ ОСНОВНИХ ЗАСОБІВ ІЗ ЗАСТОСУВАННЯМ ІНСТРУМЕНТІВ ТАКСОНОМІЧНОГО АНАЛІЗУ

*In the article uses taxonomy tools to evaluate the effectiveness of the use of fixed assets on the example of a strategically important state enterprise. The stimulators and disincentives of the impact on the capacity of using the company's assets have been determined: capital returns have a disincentive effect on the efficiency of the use of fixed assets of SE «Ukrvodshlyakh», all other indicators (factors of depreciation of fixed assets, suitability of fixed assets, capital adequacy, capital capacity) are defined as stimulators of influence.*

*A negative trend towards a reduction of the integral indicator of the taxonomy (the efficiency of the use of fixed assets) was revealed in four years, almost fivefold to a critically low level; the technical condition of fixed assets at the enterprise is dynamically deteriorating, which is also evidenced by the increase in the wear rate and the decrease in the suitability ratio of fixed assets. Such a situation is a clear signal for the managers of a strategically important state-owned enterprise regarding the need to find new management solutions and review the existing system of efficiency in*

*the use of fixed assets. it was found out that the technical condition of fixed assets in SE «Ukrvodshlyakh» is deteriorating dynamically, which is also evidenced by the increase in the wear rate and, accordingly, the decrease in the suitability ratio of fixed assets. It is positive that the rate of renewal of fixed assets at the enterprise is increasing dynamically. In order to increase the level of the company's return on capital, it is suggested to ensure one hundred percent utilization of the equipment. Also, a possible solution may be the sale of part of the unused fixed assets of the enterprise.*

*The successful functioning of fixed assets and production facilities depends on intensive and extensive factors of improving their use. The intensive direction of improving the efficiency of the use of fixed assets and production capacities involves increasing the degree of loading of equipment and machines per unit of time by modernizing equipment, establishing optimal modes of its loading, etc. Improving the structure of fixed assets is also an important direction for increasing the efficiency of the use of production facilities; improvement of planning, management and organization of work and production; reduction of capital intensity, increase of return on capital and labor productivity at the enterprise.*

***Keywords:*** *taxonomic analysis, effective use of fixed assets, assets, coefficients, return on capital, capital intensity, capital adequacy, integral indicator.*

*У статті за допомогою інструментів таксономії оцінено ефективність використання основних засобів на прикладі стратегічно важливого державного підприємства. Визначено стимулятори та дестимулятори впливу на рівень використання основних засобів підприємства: фондовіддача здійснює дестимулюючий вплив на ефективність використання основних засобів ДП «Укрводшлях», всі інші показники (коефіцієнти зносу основних засобів, придатності основних засобів, фондоозброєність, фондомісткість) визначено як стимулятори впливу.*

*Виявлено негативну тенденцію до зниження інтегрального показника таксономії (ефективності використання основних фондів) за чотири роки майже в 5 разів до критично низького рівня; технічний стан основних фондів на підприємстві динамічно погіршується, про що також свідчить підвищення рівня зносу та зниження коефіцієнта придатності основних фондів. Така ситуація є чітким сигналом для керівників стратегічно важливого державного підприємства щодо необхідності пошуку нових управлінських рішень та перегляду існуючої системи ефективності використання основних засобів. Встановлено, що технічний стан основних фондів ДП «Укрводшлях» динамічно погіршується, про що також свідчить підвищення рівня зношеності та, відповідно, зниження коефіцієнта придатності основних фондів. Позитивним є те, що темпи оновлення основних засобів на підприємстві динамічно зростають. З метою підвищення рівня рентабельності капіталу підприємства пропонується забезпечити стовідсоткове використання обладнання. Також можливим рішенням може бути продаж частини невикористаних основних засобів підприємства.*

*Успішне функціонування основних фондів і виробничих потужностей залежить від інтенсивних і екстенсивних факторів поліпшення їх використання. Інтенсивний напрямок підвищення ефективності використання основних фондів і виробничих потужностей передбачає підвищення ступеня завантаження обладнання і машин в одиницю часу шляхом модернізації обладнання, встановлення оптимальних режимів його завантаження тощо. Удосконалення структури основних фондів – також важливий напрям підвищення ефективності використання виробничих потужностей; вдосконалення планування, управління та організації праці і виробництва; зниження фондомісткості, підвищення фондовіддачі та продуктивності праці на підприємстві.*

***Ключові слова:*** *таксономічний аналіз, ефективне використання основних засобів, активи, коефіцієнти, фондовіддача, фондомісткість, фондоозброєність, інтегральний показник.*

***JEL Classification: C 52, D 24, M 11***

**Formulation of the problem.** Fixed assets in the structure of assets are an important resource of any enterprise, regardless of the form of ownership and type of activity. The process of production of goods and services, its permanence, continuity, economy directly depend on their required volume and effective use. Today, when the country's economy is going through the most difficult times, scientists pay special attention to the issue of rational organization of enterprise assets and their effective use, in particular, of fixed assets in their structure. Today, it is important to conduct a basic analysis and create such mechanisms for the effective use and management of the main assets of enterprises, which would ensure the potentially possible level of sustainability and profitability of economic entities. Therefore, the assessment of the effectiveness of the use of fixed assets on the example of a strategically important state enterprise using taxonomy tools, which allows combining multidimensional statistical material into a single quantitative characteristic, is timely and relevant.

**Analysis of recent research and publications.** Prominent domestic and foreign scientists, in particular, M. Bilyk, I. Bubnyak, I. Hrynyuk, E. Donin, M. Dyadyuk, A. Mazaraki, Yu. , Povazhnyi O., Filimonenkov O. and others. Such domestic researchers as: Z. Bajaev, O. Kozhushko, N.V. Plyuta, V. Sablina, and others were engaged in the study of the issue of using taxonomy tools to justify economic phenomena. However, measures to assess the effectiveness of the use of fixed assets of enterprises from the application of taxonomic analysis tools and obtaining the appropriate result in the process of asset management have not been fully developed to date.

**Formulation of the goals of the article.** The purpose of this study is to evaluate the effectiveness of the use of fixed assets of the strategically important state enterprise "UKRVODSHLYAH" using a taxonomic analysis.

**Presentation of the main research material.** Management of assets of business entities is the most important part of operations in the integral system of financial management of the enterprise. This is connected, first of all, with the constant movement of assets in the process of the economic activity of the enterprise and their place in ensuring all stages of the production and operational cycle. It is possible to evaluate the efficiency of the use of fixed assets by applying many characteristic indicators, which are based on the use of certain criteria and are determined by the system of organizational, economic and other parameters, that is, the evaluation of efficiency is a complex and multidimensional process, which can be summarized using a taxonomy. SE "Ukrvodshlyakh" is a strategically important state commercial enterprise, which is based on state property and is under the management of the Ministry of Infrastructure of Ukraine [1]. State-owned enterprise "Ukrvodshlyakh" has been entrusted by the state with functions related to the implementation of transport, technical and environmental policy in the operation of inland waterways and shipping locks of Ukraine, which are classified as objects of strategic importance for the economy and security of the state [1].

Tabl. 1 summarizes the methodological aspects of determining the selected coefficients of the technical condition and efficiency of the use of fixed assets, as well as their calculated values (the composition of the descriptive theoretical and methodological model of the taxonomic analysis observation matrix) for four years according to the official data of the financial statements of the enterprise "Ukrvodshlyakh" [2] .

*Table 1.* Methodology and calculated values of coefficients of technical condition and efficiency of use of fixed assets of SE "Ukrvodshlyah", [2,3]

| Coefficients | Calculation method | *2017* | *2018* | *2019* | *2020* |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Depreciation rate of fixed assets (Kz) | Кз = ОЗзн/ ОЗпв (1), where<br>ОЗзн – the amount of depreciation of fixed assets;<br>ОЗбв – book value of fixed assets | 0,63 | 0,66 | 0,66 | 0,67 |
| Coefficient of suitability of fixed assets (Kp) | Кз = Воз / ОЗбв (2), where<br>Воз – residual value of fixed assets; | 0,37 | 0,34 | 0,34 | 0,33 |

*Continuation of Table 1*

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Fund-raising (Kfo), hryvnias. | Кфо= ОЗбв/Кпр (3), where<br>Кпр – average annual number of employees | 652,14 | 598,87 | 620,11 | 649,52 |
| Capital capacity (Kfm), hryvnias. | Кфм = ОЗбв/ВП (4), where<br>ВП- volume of produced products (services) | 6,91 | 5,57 | 5,62 | 6,44 |
| Fund return (Kfv), hryvnias. | Кфв= ВП/ОЗбв | 0,14 | 0,18 | 0,18 | 0,16 |

The set of indicators included in the descriptive theoretical-methodological model of the observation matrix to determine the resulting integral indicator of the effectiveness of the management of fixed assets can be expanded depending on the goals of the analysis and access to primary data. One of the methods of taxonomic analysis can be applied to order the elements of this collection in relation to the distance to a certain point defined in space, which is the standard of regulation. On the basis of the specified method, synthetic values of the taxonomic index of the efficiency of the use of fixed assets of the enterprise are calculated [4].

So, based on the matrix of observations (Table 1) and with the help of the Excel editor, we will standardize the elements and form a matrix of standardized values. The indicators included in the observation matrix are heterogeneous, so we translate them into a comparable form by performing standardization according to the method presented in Tabl. 2.

*Table 2.* Algorithm for calculating indicators on each of the cycles of determining the synthetic multidimensional indicator

| Calculation stages | Calculation formula | Marking |
|---|---|---|
| 1 | 2 | *3* |
| Standardization of observation matrix elements | $Z_{iy} = \frac{x_{iy} - \overline{x_j}}{S_j}$<br>$S_i = \left( \sum_{i=1}^{m} \frac{(x_{ij} - \overline{x_j})^2}{m} \right)^{\frac{1}{2}}$<br>$\overline{x_j} = \frac{1}{m} \sum_{i=1}^{m} x_{ij}$ | $Z_{ij}$– standardized value of the j-th indicator in the i-th studied period ;<br>$X_{iy}$– the value of the j-th indicator in the i-th studied period ;<br>$\overline{X_j}$– the average arithmetic value of the jth indicator ;<br>*Sj* – standard deviation of the jth indicator ;<br>*m* – number of study periods |
| Construction of vector - etalon Z | $\left\{ \begin{array}{l} z_j = max\, z_{ij},\ \ if\ the\ j - stimulator \\ z_j = min\, z_{ij},\ \ if\ the\ j - destimulator \end{array} \right\}$ | *Zj* – development benchmark (benchmark vector) |
| Determination of the distance between matrix elements and the standard vector | $C_i = \left( \sum_{i=1}^{n} (z_{ij} - z_j)^2 \right)^{\frac{1}{2}}$ | $C_i$ – the distance between matrix elements and the reference vector;<br>n - the number of research indicators |

*Continuation of Table 2*

| 1 | 2 | 3 |
|---|---|---|
| *Calculation* of the integral indicator of the efficiency of management of the company's fixed assets | $k_i = 1 - d_i$<br>$d_i = \frac{C_i}{C_0}$<br>$C_0 = \overline{C_i}+2S_0$<br>$\overline{C_i} = \frac{1}{m}\sum_{i=1}^{m} C_i$<br>$S_0 = \left(\frac{1}{m}\sum_{i=1}^{m}(C_i - \overline{C_i})^2\right)^{\frac{1}{2}}$ | $k_i$ – modified taxonomy coefficient ;<br>$d_i$ – an indicator of the level of development ;<br>$C_0$ - the distance from each multidimensional unit to the standard point under the condition of a normal distribution of the random variable ;<br>$\overline{\tilde{N}_i}$– average distance between observations *Ci;*<br>$S_0$- mean square deviation of the distances between observations *Ci.* |

Standardization of indicators allows you to reduce different units of measurement in the form of a monetary indicator and coefficients to a dimensionless value, that is, to equalize the values of the characteristics [4]. The matrix of standardized values is presented in Tabl. 3.

*Table 3.* Matrix of standardized values

| | | | | |
|---|---|---|---|---|
| *z* | -1,66667 | 0,333333 | 0,333333 | 1 |
| | 1,666667 | -0,33333 | -0,33333 | -1 |
| | 0,998592 | -1,42156 | -0,45659 | 0,87956 |
| | 1,371681 | -1 | -0,9115 | 0,539823 |
| | -1,47059 | 0,882353 | 0,882353 | -0,29412 |

Next, we build the reference vector (Z). For this, it is necessary to divide all indicators into stimulators and destimulators. Stimulators include indicators, the increase of which improves the overall assessment of the object of research, destimulators, on the contrary, cause its deterioration, i.e. negatively affect the phenomenon or process under investigation [4]. In our case, the disincentive is the fund return. The rest of the indicators are determined by influence stimulators (Tabl. 4).

*Table 4.* Stimulators (destimulators) of the research object and coordinates reference vector

| Factor | Indicator | Stimulator/ destimulator | Coordinates of the reference vector |
|---|---|---|---|
| $x_1$ | Depreciation rate of fixed assets | Stimulator | 1 |
| $x_2$ | The adequacy ratio of fixed assets | Stimulator | 1,667 |
| $x_3$ | Fulfillment with main funds | Stimulator | 0,999 |
| $x_4$ | Fund capacity | Stimulator | 1,372 |
| $x_5$ | Fund return | Destimulator | -1,471 |

In our case, the capital return exerts a disincentive effect on the efficiency of the use of fixed assets of SE "Ukrvodshlyah". Return on assets is an indicator of business activity of the enterprise, the value of which indicates how many products are produced and how many services are provided for each hryvnia of financial resources invested in fixed assets. The use of this indicator speaks specifically about the efficiency of the use of the company's fixed assets. It is desirable for the enterprise to improve the efficiency of the use of the company's fixed assets during the period of the study.

The taxonomy coefficient acquires high values at high values of stimulants and low, respectively, at low values. Its most important advantage is that the calculation is reduced to one synthetic feature, which shows the vector and volume of changes in the processes described by the set of an arbitrary volume of initial features.

Next, we calculate the distance between matrix elements (individual observations) and the reference vector. The obtained distance is the starting point for calculating the indicator of the level of development (the taxonomy coefficient; the integral indicator of the efficiency of the use of fixed assets. The results of intermediate calculations and the taxonomy coefficient itself, which reflects the value of the integral indicator, are presented in Tabl. 5. For clarity, the indicator of the efficiency of the use of fixed assets of SE "Ukrvodshlyah » for four years is presented graphically in Fig. 1.

*Table 5.* Taxonomy coefficient (integral indicator of efficiency of use fixed assets of SE "Ukrvodshlyakh") for 2017-2020

| Indicators | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| $C_i$ | 2,062 | 2,908 | 4,504 | 6,321 |
| $\overline{C_i}$ | 3,94875 | 4,3095 | 4,3095 | 4,3095 |
| $S_0$ | 1,54 | 1,54 | 1,54 | 1,54 |
| $C_0$ | 7,02875 | 7,3895 | 7,3895 | 7,3895 |
| $d_i$ | 0,293367 | 0,393531 | 0,609513 | 0,855403 |
| $k_i$ | *0,707* | *0,606* | *0,390* | *0,145* |

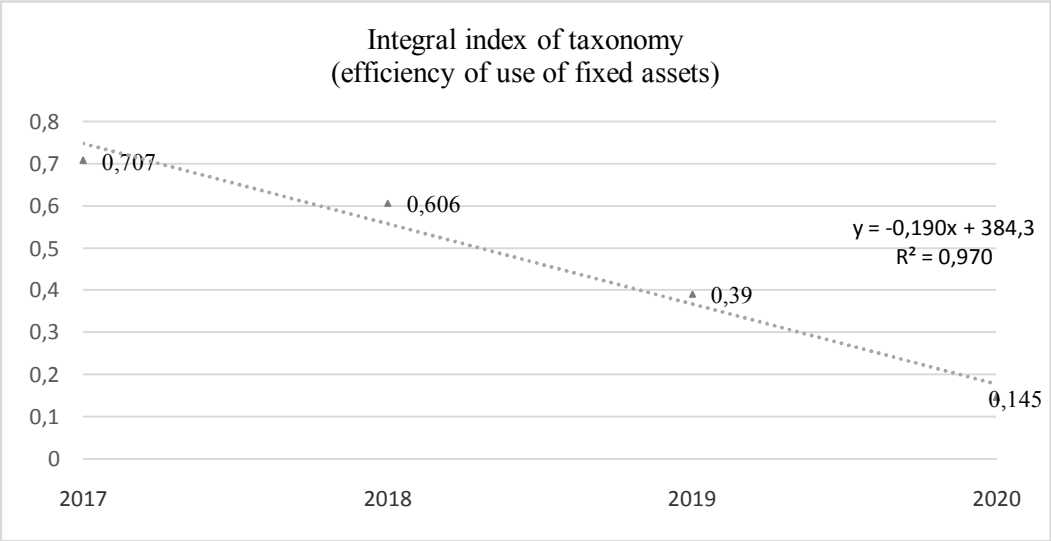


*Fig. 1.* Change in the integral indicator of the efficiency of the use of fixed assets SE "Ukrvodshlyakh" for 2017-2020, own development

*Source: according to [2-4]*

From Tabl. 5 and Fig. 1, it can be seen that the dynamics of changes in the integral indicator of the efficiency of management of fixed assets at the state-owned enterprise "Ukrvodshlyakh" is negative throughout the entire period: in 2017 it was 0.707 units, in 2020 it was already 0.145 units, decreasing by four years almost five.

Such a situation is a clear signal for the managers of a strategically important state-owned enterprise regarding the need to find new management solutions and review the existing system of efficiency in the use of fixed assets. The efficiency of the use of assets is higher, the closer the value of the integral indicator is to unity. In 2020, the integral coefficient reached a critical minimum level. Thus, the technical condition of the fixed assets in SE "Ukrvodshlyakh" is dynamically deteriorating, which is also evidenced by the increase in the wear rate and, accordingly, the decrease in the adequacy ratio of fixed assets. It is positive that the rate of renewal of fixed assets at the enterprise is increasing dynamically. The company's assets have decreased over four years by UAH 2.62 thousand, which is due to a decrease in the value of the company's fixed assets. In 2017-2020, the capital adequacy ratio decreased by UAH 0.47 from UAH 6.91 to UAH 6.44. Reducing this ratio makes it possible to increase the efficiency of the enterprise. The smaller this indicator, the better the company's equipment is used. In our case, a slight decrease in this indicator is a positive trend of the company's development. In order to increase the level of return on capital of the enterprise, it is necessary to ensure one hundred percent utilization of the equipment. Also, a possible solution may be the sale of part of the unused fixed assets of the enterprise.

**Conclusions.** The successful functioning of fixed assets and production facilities depends on intensive and extensive factors of improving their use. The intensive direction of improving the efficiency of the use of fixed assets and production capacities involves increasing the degree of loading of equipment and machines per unit of time by modernizing equipment, establishing optimal modes of its loading, etc. Improving the structure of fixed assets is also an important direction for increasing the efficiency of the use of production facilities; improvement of planning, management and organization of work and production; reduction of capital intensity, increase of return on capital and labor productivity at the enterprise. The application of the taxonomy method to assess the effectiveness of the use of the company's fixed assets is a new technique in scientific research of this issue. Further research in this area will be related to the selection of input data for the relevant calculations, as well as to the determination of the sequence and justification of the appropriate tools for the development of the savings mechanism associated with the implementation of measures to improve the efficiency of the use of fixed assets.

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