Application of taxonomic analysis in assessing the level of enterprise development in emergency situations

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CHRONICLE	ABSTRACT
	This article is devoted to the problems of forming analytical support for the management of economic activities of industrial enterprises under emergency situations. It is established that the current approaches of the formation of economic analysis in economic activities do not allow to fully assess the impact of emergencies on the financial conditions of the enterprises. Therefore, a taxonomic analysis technique is applied, which allows to represent the level of business development mathematically and to identify the most influential factors, including the consequences of emergencies. Methodological provisions for the use of taxonomic analysis are also developed, which consist of successive stages of application of analytical procedures for evaluating the development of the enterprise. This includes a comprehensive assessment of the level of development of the enterprise in the context of emergency situations by calculating an integrated taxonomic indicator; assessment of the structure and dynamics of the integrated emergency indicators and the assessment of the consequences of the emergency. The methodology is applied and tested on the example of activity of PAP "Novokramatorsky Automobile-Building Plant". Overall comprehensive assessment of the level of development of the enterprise allows us to identify advantages, disadvantages and "bottlenecks" in the activity of the enterprise. It also identifies and mobilizes internal economic reserves, optimize the financial and economic activity of the enterprise as a whole, as well as timely diagnose the presence and depth of the crisis. The methodology can be applied at the enterprises of different branches of national economics with different sizes.

1. Introduction

Economic activity of the enterprises is exposed to internal and external factors and can be both the cause of emergency situations (hereinafter referred to as ES) of anthropogenic nature, and can suffer in the result of it, having anthropogenic, natural and social nature. The above constrains the development of business entities and leads to negative consequences, in particular, enterprises and the economy of the state as a whole as a result of the ES significantly faces with financial and economic potential. Obviously, there is a need to develop an effective model or concept of enterprise development management, which

is based on effective organizational and economic mechanisms. The above determines the need for the formation of an appropriate information space, an important component of which is the system of economic analysis of the enterprise, which, first of all, has a practical orientation.

2. Literature review

The issue of economic analysis of the emergency effects is a specific issue, but the subject of research is not thoroughly studied. The issues were developed by the scientists, particularly by Dopp et al. (2019) proved, that for more detailed examination, it is advisable to use a taxonomy method to evaluate the economic activities of the entity. The scientists Ridyard et al. (2015) generated over 94 indicators and analyzed them on the basis of taxonomy, which should lead to a more accurate description of data collection methods. In the system of ecological and economic security of enterprises Chinese Researcher, Gao (2019) proposed to improve the financial and environmental environment to accelerate the improvement of laws and regulations on financial support for businesses, thereby contributing to the development of financial markets. After all, optimizing financial ecology will alleviate the big financing problem that businesses face. Uguen and Lassudrie (2010) proposed the introduction of an uncertainty management strategy (SUM), which complements the taxonomy method and eliminates potential risks. Shmidt and Khudyakova (2015) evaluated the economic sustainability of an enterprise on the basis of probabilistic-statistical methods. He et al. (2019) in their study used a mathematical model to investigate the determinants of financial decentralization and the relationship between financial decentralization and economic efficiency of enterprises. The results show that financial decentralization was related to the size of the population employed in enterprises, and this contributes to the increase of economic efficiency, affecting the efficiency of capital of enterprises. Melikhova et al. (2019) with the help of econometrics analysis researched correlation of economic indicators of the industrial plants and offered the model of estimation of the risks given the impact of the most significant financial analysis ratios and confirmed that the percentage of bankruptcies secured and stable activity was acceptable and indicated the high quality of the equation obtained. Oláh et al. (2019) conducted a comparative analysis of economic and financial risks in small and medium-sized enterprises in SMEs of the Visegrad group and Serbia. Valaskova et al. (2018) disclosed the financial risks of Slovak enterprises and formed a forecasting model that is implemented by identifying significant forecasts that affect the financial health of Slovak enterprises and their future prosperity. Pogrebova et al. (2017) formed the model estimates of the sustainability of an industrial enterprise on the basis of regression analysis, and proved that the sustainability of the industry's development depends, first of all, on the financial sustainability of the industrial enterprises. Viktorovna (2017) argued that rational production and efficient use of working capital significantly affect the production process, financial results of the enterprise and its financial condition. Foo and Witkowska (2008) proposed to use two methods of analysis in their research: discriminatory and taxonomic to explore the possibility of Southeastern Europe and independent transitional countries developing an entrepreneurial and business environment compatible with the newest members of the European Union.

Ukrainian scientists also used one of the taxonomy methods in their studies (Andrusiv et al., 2020). Their model made it possible to trace the causes of negative phenomena in the activities of the regions, to prevent their occurrence, and to develop a set of appropriate managerial influences to provide the state vectors of positive development. Kinash et al. (2019) proved in their work that it is appropriate to use different methods of mathematical analysis, which greatly expands the opportunities for identifying the "bottlenecks" of enterprise activity. Cherchata et al. (2020) and Andrusiv and Galtsova (2017) proposed a methodology for analyzing and evaluating business processes of enterprises, which involves identifying the "problematic" spheres of certain business processes by calculating weighted average, integral and overall indicators of efficiency and effectiveness. This allows us to evaluate the status of certain business processes of enterprises and their totality, and to set the priority of management actions for their improvement. The works of these scientists determine the foundations of the development of economic analysis sciences in the world and Ukraine, but some issues related to the economic analysis of the consequences of emergencies need to be resolved today to form an information space for managing them and to ensure an adequate level of enterprise security.

The purpose of the article is to assess the impact of emergencies on the activities of businesses based on a taxonomic analysis.

3. Methodology of scientific research

Taxonomy (from Greek to Greek τάξις - order and νόμος - law) - the doctrine of the principles and practice of classification and systematization of complex areas of reality, which usually have a hierarchical structure. One of the first began to use a special research method of aggregating the traits of Helvig. He proposed a taxonomic index, which is a synthetic value formed using all the traits that characterize the studied economic phenomenon. The value of the taxonomic method for the economic sciences was separately noted by the Polish scientist Plyuta (1980) in his work "Comparative Multidimensional Analysis in Economic Research. Methods of taxonomy and factor analysis". The author noted that most economic phenomena are in fact characterized by many different features, the number of which often reaches several tens. In such circumstances, the use of traditional methods become impossible. To solve these problems, the author proposed to use the taxonomy method. The method is based on the definition of the so-called taxonomic distance, that is, the distance between points of a

multidimensional space, the dimension of which is determined by the number of features that characterize the object being studied. Taking of business activity of the enterprise as a whole and the proposed directions of expanding the information base on the consequences of the emergency, we think that the method of economic analysis of the impact of the emergency situations on the indicators of economic activity should include two interrelated blocks: a general assessment of the impact of the emergency and an in-depth assessment of the consequences of the emergency (Fig. 1).
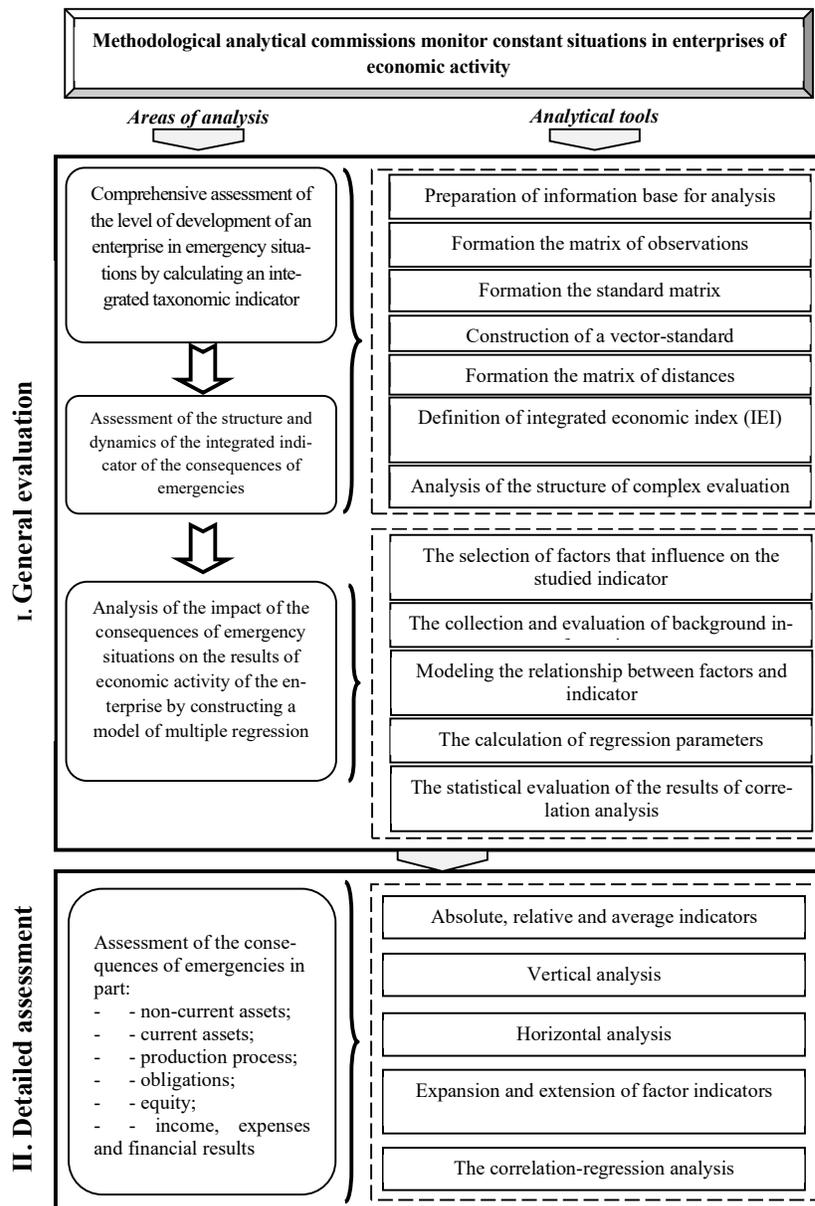
Fig. 1. The comprehensive method for analytical assessment of the impact of emergencies on the indicators of the enterprise

Thus, the economic analysis of the impact of the emergency on the indicators of economic activity should begin with a general assessment of the level of development of the enterprise for a number of periods, including and in the context of the emergency, by calculating a certain integrated (integrated) indicator, which will identify the general trends of enterprise development and characterize the share of the contribution of each single factor in the complex assessment of the level of development of the enterprise. In order to calculate the integrated taxonomic indicator of the level of enterprise development in the ES conditions, a set of analytical indicators was used in terms of such components as the state and efficiency of the use of fixed assets; efficiency of current assets; efficiency of labor resources usage; level of financial security; efficiency of the enterprise in general. In particular, it has been determined by experts that such analytical indicators should include: wear-out factor,

capital productivity ratio, depreciation capacity, current asset turnover ratio, inventory turnover ratio, material capacity, labor productivity, wage capacity, funded ratio, autonomy ratio, working capital to current asset ratio, working capital to inventory ratio, product profitability, return on sales, profitability of the business activity. The choice of these analytical indicators was primarily due to their importance in the formation of information and analytical support for the managerial decision making on prevention and liquidation of consequences of the ES.

3.1. Taxonomic analysis stages of the enterprise's development level in the conditions of the ES

The first stage. The initial information system for the calculation of the integrated indicator of the level of enterprise development in the ES conditions is formed: the justification and selection of the system of indicators is carried out; collecting and evaluating the source information.

The second stage. A matrix of observations X (representation of the output data in the form of a matrix allows us to determine the change in the value of the studied properties as regarding to the one object at different time intervals as to different objects):

$$X = \begin{Bmatrix} x_{11} & x_{12} & ... & x_{1j} \\ x_{21} & x_{22} & ... & x_{2j} \\ x_{i1} & x_{i2} & ... & x_{ij} \end{Bmatrix}, \tag{1}$$

where x_{ij} – value of j-th index of the object under investigation in the i-th period; i – serial number of the studied period from 1 to n; j – counting number of the index under investigation for each period from 1 to m.

Thus, data regarding the objects (or years) form rows, and the values of indicators form columns.

The third stage. The standardization of indicators is carried out as they describe the various properties of the research object and, accordingly, are heterogeneous with different units of measurement. The above-mentioned allows to compare the indicators of the enterprise development level in the conditions of the ES and to narrow down them to a common integrated indicator. Such standardization operations involve replacing the indicator value with a coefficient that characterizes the correlation of deviation of each particular indicator value from the average value of the indicator for all objects (or periods) to the standard deviation for this indicator. Mathematically, this transformation is carried out according to the following formula:

$$Z_{ij} = \frac{x_{ij} - \overline{x}_j}{\sigma_j}, \tag{2}$$

where Z_{ij} – the standardized property j for i-th period; $\overline{x}_j$ – average arithmetic value of j-th indicator; σ_j – mean deviation of j-th indicator:

$$\sigma_j = \left[\frac{1}{m} \sum \left(x_{ij} - \overline{x}_j \right)^2 \right]^{\frac{1}{2}}. \tag{3}$$

As a result of standardization of indicators of the observations matrix, the following standardized matrix is formed:

$$Z = \begin{Bmatrix} Z_{11} & Z_{12} & ... & Z_{1j} \\ Z_{21} & Z_{22} & ... & Z_{2j} \\ Z_{i1} & Z_{i2} & ... & Z_{ij} \end{Bmatrix}. \tag{4}$$

Fourth stage. Selection of reference points for each indicator of the level of operation of the entity is carried out, based on the fact that in one-dimensional space there is a pairwise comparison of indicators. For each indicator (property) the reference point is the distance to which the integrated indicator of the enterprise development level will be calculated. In order to construct a vector-reference, the distribution of properties (indicators) on stimulants and disincentives is carried out. Stimulants are indicators, the increase of which improves the overall assessment of the functioning of the research object, and the disincentives, on the contrary, lead to worsening. Reference is considered a point (vector), formed by the rule: among properties-stimulants properties with maximum values are selected, and among the signs-disincentives properties with minimal values are selected. Thus, the greatest value of stimulants and the least value of the disincentives form a vector-reference: $Z_{0j} = (Z_{01}, Z_{02}, ..., Z_{0m})$. Accordingly, the coordinates of the point-reference are:

$$Z_{0j} = \begin{cases} \max Z_{ij} & j \in I \\ \min Z_{ij} & j \notin I \end{cases} j = 1, ..., m \tag{5}$$

where I is the set of stimulants.

The fifth stage. The matrix of distances is formed, on the basis of which, subsequently, the general enterprise development level in each of the studied periods is determined:

$$C = \begin{Bmatrix} C_{11} & C_{12} & ... & C_{1j} \\ C_{21} & C_{22} & ... & C_{2j} \\ C_{i1} & C_{i2} & ... & C_{ij} \end{Bmatrix}, \tag{6}$$

where C_{ij} – is a multidimensional Euclidean distance (quasi-distance) between individual observations and a vector-reference for each distinct indicator of the enterprise development level:

$$C_{ij} = \left(Z_{ij} - Z_{0j} \right)^2, \tag{7}$$

where Z_{0j} – is the standardized value of j in the point-reference.

The sixth stage. For each period under investigation an integrated taxonomic indicator of the enterprise development level (ITI) is determined due to the following sequence:

– the distance vector is determined: $C_{i0} = \left(C_{10}, C_{20}, ..., C_{n0} \right)$, which is the basis for calculating the taxonomy ratio, according to the following formula:

$$C_{i0} = \sqrt{\sum_{j=1}^{n} \left(Z_{ij} - Z_{0j} \right)^2}. \tag{8}$$

The closer the unit of the population under the study is to the point-reference, the lower the value of C_{i0} and the higher the quality of the property under the study. The above calculations allow constructing the previous rating of enterprise development level as the whole as well as for the highlighted vectors: the level of efficiency of the use of fixed assets, current assets and labor resources, as well as the level of financial support and efficiency of the enterprise;

– the arithmetic mean of calculated pre-distances between standardized indicators in the *i-th* period and in the reference is calculated:

$$\overline{C_0} = \frac{\sum_{i=1}^{n} C_{i0}}{n}. \tag{9}$$

– the mean square deviation from the point-reference is determined:

$$\sigma_0 = \sqrt{\frac{\sum_{i=1}^{n} \left(C_{i0} - \overline{C_0} \right)^2}{n}}. \tag{10}$$

– the indicator of quality of functioning object under the investigation in the *i-th* period is calculated:

$$C_0 = \overline{C_0} + 2\sigma_0. \tag{11}$$

– the taxonomy ratio is determined:

$$d_i = \frac{C_{i0}}{C_0}. \tag{12}$$

– the integrated taxonomic indicator of the enterprise development level in the ES conditions is calculated:

$$IT\text{Ц} = 1 - d_i. \tag{13}$$

Given indicator is interpreted as follows: the object under study in given period has the higher level of development, the closer to 1 is the value of the indicator of its development level. In addition, we consider that in order to strengthen the conclusions, it would be advisable to conduct an assessment of the enterprise development level, for which we propose the use of the Harrington scale: from 0.00 to 0.36 - low (weak) development level; from 0.36 to 0.64 – average level; from 0.64 to 1.00 – effective development level.

Seventh stage. At the last stage the weight (influence) of the selected indicators in the complex assessment of the enterprise development level is determined. In particular, an analysis of the integrated assessment structure obtained by the taxonomic method is conducted, and conclusions are drawn about the impact of individual indicators on such a comprehensive assessment. The evaluation structure is characterized by the specific weight of the contribution of each indicator to the complex indicator (its weight) and, accordingly, is determined by the formula:

$$w_{ij} = \frac{(Z_{ij} - Z_{0j})^2}{\sum_{j=1}^{n}(Z_{ij} - Z_{0j})^2} \times 100, \tag{14}$$

where w_{ij} is the value of the indicator in the evaluation of given object for the certain period. The general influence of the selected indicators on the complex assessment of the enterprise development level is defined as the arithmetic mean of calculated shares:

$$\overline{w_j} = \frac{\sum w_{ij}}{n}. \tag{15}$$

The indicator allows us to determine the specific weight of the contribution of each individual factor in the comprehensive assessment of the enterprise development level. An assessment of the structure of the integrated indicator of consequences of the ES will determine importance of their components in the management of the consequences of the ES. The results of such an assessment will determine the direction of further in-depth analysis of the impact of the consequences of the ES on the indicators of economic activity. In particular, the priority directions of in-depth analysis will be those components of the integrated indicator of consequences of the ES, which will occupy the largest share in the assessment of its structure. Summarizing the above, we can state that the classical taxonomic analysis algorithm has the following form: «observation matrix» → «matrix of standardized values of properties» → «properties-stimulants and properties-disincentives» → «vector-reference» → «distance matrix» → «taxonomic distance for each object / period» → «taxonomic indicator for each object / period» → «taxonomic indicator structure». The proposed estimation of the enterprise development level by calculating the taxonomic indicator allows to determine the advantages, disadvantages and «bottlenecks» in the activity of the enterprise, identify and mobilize domestic economic reserves, optimize the financial and economic activity of the enterprise as a whole, as well as diagnose in time the presence and depth of the crisis phenomena development.

4. Results and discussion

We will examine the above-mentioned methodology for constructing an integrated taxonomic indicator of the enterprise development level using the results of the activity of PJSC «Novokramatorsk machine-building plant» (hereinafter referred to as PJSC «NKMZ»), which, since 2014, operates under difficult financial and political crisis conditions as well as in the conditions of conducting an antiterrorist operation (hereinafter referred to as ATO). First of all, in order to form the initial data for constructing integrated indicators of the development level of PJSC «NKMZ» during 2013-2018, including in the conditions of ATO, based on the data of its financial statements, the calculation of the above indicators of the efficiency of resource use, financial support and overall efficiency of PJSC «NKMZ» was conducted (Table 1). On the basis of Table 1, a matrix of observations is generated:

Table 1
Output data of PJSC "NKMZ" for the integrated taxonomic indicator

Nₒ	Indicator	Marking	Indicators value by year					
			2013	2014	2015	2016	2017	2018
State and effectiveness of fixed assets								
1.	Capital productivity ratio	CP	1,93	1,64	1,71	1,52	1,61	1,6
2.	Wear-out factor	WOF	44,5	44,4	44,9	48,9	49,0	49,7
3.	Depreciation capacity	DC	0,054	0,064	0,063	0,067	0,066	0,038
The efficiency of working assets (working capital)								
4.	Current asset turnover ratio	CAT	1,04	0,86	1,01	0,94	0,95	0,87
5.	Inventory turnover ratio	ITR	3,30	2,37	2,61	2,56	2,80	2,6
6.	Material capacity	MC	0,57	0,53	0,40	0,449	0,446	0,54
Efficiency of Labor								
7.	Labor productivity	LP	208,95	185,44	222,94	234,97	298,36	337,70
8.	Wage capacity	WC	0,24	0,29	0,26	0,30	0,25	0,28
The level of financial security								
9.	Funded ratio	FR	5,20	3,84	4,58	3,06	5,80	4,42
10.	Autonomy ratio	AR	88	83	87	81	90	86
11.	Working capital to current asset ratio	WCCA	0,81	0,74	0,78	0,66	0,83	0,77
12.	Working capital to inventory ratio	WCI	2,26	1,92	2,03	1,93	2,51	2,28
Efficiency of enterprise activity								
13.	Product profitability	PP	33	34	45	43	39	47
14.	Return on sales	RS	3,32	1,48	8,96	-1,73	32,9	17,96
15.	Profitability of the business activity	PBA	4	3	9	11	32	15

Source: calculated by the authors on the basis of data of PJSC «NKMZ», published on the site SMIDA

$$X = \begin{vmatrix} 1.93 & 44.5 & 1.04 & 3.30 & 5.20 & 33 & 3.3 & 4 & 0.57 & 0.24 & 0.05 & 209 & 88 & 0.81 & 2.26 \\ 1.64 & 44.4 & 0.86 & 2.37 & 3.84 & 34 & 1.5 & 3 & 0.53 & 0.29 & 0.06 & 185 & 83 & 0.74 & 1.92 \\ 1.71 & 44.9 & 1.01 & 2.61 & 4.58 & 45 & 9.0 & 9 & 0.40 & 0.26 & 0.06 & 223 & 87 & 0.78 & 2.03 \\ 1.52 & 48.9 & 0.94 & 2.56 & 3.06 & 43 & -1.7 & 11 & 0.45 & 0.30 & 0.07 & 235 & 81 & 0.66 & 1.93 \\ 1.61 & 49.0 & 0.95 & 2.80 & 5.80 & 39 & 32.9 & 32 & 0.44 & 0.25 & 0.07 & 298 & 90 & 0.83 & 2.51 \\ 1.60 & 49.7 & 0.87 & 2.60 & 4.40 & 47 & 18.0 & 15 & 0.54 & 0.28 & 0.04 & 338 & 86 & 0.77 & 2.28 \end{vmatrix}$$

Then, based on the data of the observation matrix, the average values of the indicators and their mean square deviations were calculated, which allowed to standardize the indicators (in order to bring them to a single dimensionless value) and construct a matrix of standardized values:

$$Z = \begin{vmatrix} 1.83 & -0.94 & 1.32 & 1.85 & 0.74 & -1.23 & -0.55 & -0.79 & 1.22 & -1.25 & -0.70 & -0.67 & 0.65 & 0.75 & 0.45 \\ -0.21 & -0.98 & -1.18 & -1.05 & -0.66 & -1.06 & -0.69 & -0.88 & 0.63 & 0.83 & 0.30 & -1.08 & -0.86 & -0.42 & -1.00 \\ 0.28 & -0.79 & 0.90 & -0.30 & 0.10 & 0.83 & -0.12 & -0.31 & -1.31 & -0.42 & 0.30 & -0.43 & 0.35 & 0.25 & -0.53 \\ -1.06 & 0.79 & -0.07 & -0.46 & -1.47 & 0.49 & -0.94 & -0.13 & -0.57 & 1.25 & 1.30 & -0.22 & -1.46 & -1.75 & -0.96 \\ -0.42 & 0.83 & 0.07 & 0.29 & 1.36 & -0.20 & 1.73 & 1.85 & -0.72 & -0.83 & 0.30 & 0.86 & 1.26 & 1.08 & 1.52 \\ -0.49 & 1.10 & -1.04 & -0.33 & -0.06 & 1.18 & 0.58 & 0.25 & 0.78 & 0.42 & -1.70 & 1.55 & 0.05 & 0.08 & 0.53 \end{vmatrix}$$

The next step, taking into account the impact of each indicator (factor) on the entity development level, is the distribution of properties of stimulants and disincentives. In particular, in this case, the stimulants include: capital productivity ratio, current asset turnover ratio, inventory turnover ratio, labor productivity, funded ratio, autonomy ratio, working capital to current asset ratio, working capital to inventory ratio, profitability of the business activity, return on sales, product profitability. Accordingly, the disincentives are: wear-out factor, depreciation capacity, material capacity, wage capacity. Furthermore, based on the realized distribution of indicators for stimulants and disincentives, from the data of standardized matrix the formation of the vector-reference is carried out:

$$Z_{0j} = (1,83; -0,98; 1,32; 1,85; 1,36; 1,18; 1,73; 1,85; -1,31; -1,25; -1,70; 1,55; 1,26; 1,08; 1,52)$$

The next step is to create a distances matrix between individual observations and elements of the vector-reference:

$$C = \begin{vmatrix} 0.00 & 0.00 & 1.00 & 0.00 & 0.00 & 6.40 & 0.38 & 0.37 & 0.11 & 1.14 & 4.93 & 0.00 & 5.81 & 5.20 & 6.97 \\ 4.16 & 0.00 & 4.00 & 6.25 & 8.41 & 3.76 & 4.08 & 4.49 & 2.25 & 6.35 & 6.92 & 4.33 & 5.02 & 5.86 & 7.45 \\ 2.40 & 0.04 & 4.00 & 0.18 & 4.62 & 0.00 & 1.59 & 0.83 & 0.69 & 4.20 & 3.92 & 0.69 & 0.12 & 3.42 & 4.67 \\ 8.35 & 3.13 & 9.00 & 1.93 & 5.34 & 0.55 & 8.01 & 7.40 & 8.01 & 6.15 & 3.13 & 6.25 & 0.48 & 7.13 & 3.92 \\ 5.06 & 3.28 & 4.00 & 1.56 & 2.43 & 0.35 & 0.00 & 0.00 & 0.00 & 0.00 & 0.48 & 0.18 & 1.90 & 0.00 & 0.00 \\ 5.38 & 4.33 & 0.00 & 5.57 & 4.75 & 4.37 & 2.02 & 1.46 & 1.00 & 0.98 & 0.00 & 2.79 & 0.00 & 1.32 & 2.56 \end{vmatrix}$$

This matrix of distances allows to calculate complex taxonomic indicators by the separated vectors of assessing the enterprise development level (Table 2).

Table 2
Interim results of integrated assessment of the development level of PJSC «NKMZ»

Year	Efficiency of use						The level of financial security		Efficiency of enterprise activity	
	Fixed assets		Current assets		Labor resources					
2013	1,00	1	2,53	3	2,22	4	1,42	2	4,24	5
2014	2,86	3	4,29	6	3,35	6	4,14	5	4,28	6
2015	2,54	2	2,19	2	2,15	3	2,70	4	2,87	3
2016	4,53	6	2,80	4	3,06	5	5,44	6	3,39	4
2017	3,51	5	2,08	1	0,81	1	0,00	1	1,38	1
2018	3,12	4	3,83	5	1,67	2	2,34	3	1,97	2

Source: author's development

Analyzing the interim indicators of the complex assessment of the enterprise development level it should be taken into account that the closer the unit of the population under study is to the point-reference, the higher the quality of the property under the study will be, that is, the best indicator among the studied periods is the indicator with the smallest value and, accordingly,

the reduction of the calculated complex taxonomic indicators is a positive trend and shows an improvement in the level of resource use and, conversely, a worsening in the growth of presented indicators (Fig. 2).
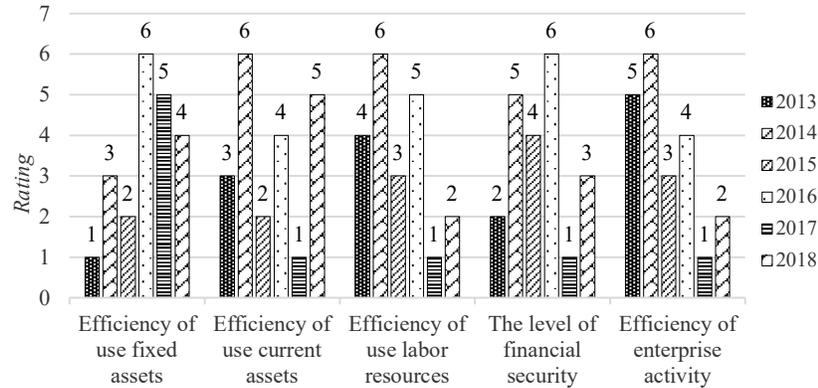
Fig. 2. The rating of years concerning the development level of PJSC «NKMZ» in the context of certain areas of its performance assessment

Source: author's development

The conducted researches allow to state that in 2017 the highest level of taxonomic ratio is observed for mostly all selected vectors of complex assessment of PJSC «NKMZ» performance, in particular, in 2017 there is the highest level of effectiveness of use of current assets and labor resources, financial support and effectiveness of the enterprise performance as a whole. And only regarding the level of use of fixed assets, it should be noted, its significant worsening compared to 2013-2015 and a slight improvement compared to 2016. First of all, this situation was caused by losses and damage to non-current tangible assets as a result of the ATO, as well as the corresponding capital expenditures for the repair and modernization of damaged objects and for the purchase of lost objects. Regarding the low taxonomic indicators, they were observed in 2016, because it is characterized by a worsening in all directions of the enterprise development level and, first of all, in terms of the level of use of fixed assets and financial security, as well as low indicators are observed with regard to the effectiveness of the use of labor, working capital and the effectiveness of activities in general, which was again caused by the functioning of PJSC «NKMZ» in the conditions of ATO. It is clear that this resulted in a sharp decline in the level of enterprise development in general, as evidenced by the following calculations of the integrated taxonomic indicator:

$$C_{i0} = (5,68;8,56;5,60;8,88;4,39;6,04); \quad \overline{C}_0 = \frac{5,68+8,56+5,60+8,88+4,39+6,04}{6} = 6,53;$$

$$\sigma_0 = \sqrt{\frac{(5,68-6,53)^2 + (8,56-6,53)^2 + (5,60-6,53)^2 + (8,88-6,53)^2 + (4,39-6,53)^2 + (6,04-6,53)^2}{6}} =$$

$$= 1,79$$

$$C_0 = \overline{C}_0 + 2\sigma_0 = 6,53 + 2 \times 1,79 = 10,11 \cdot$$

It should be borne in mind that this calculation methodology of integrated indicators suggests that the best indicator among the periods under the study is the indicator with the highest value and, accordingly, the increase in the calculated integrated indicators is a positive trend and indicates an improvement in the enterprise development level (Table 3). Thus, the calculation of the integrated taxonomic indicator for 2013-2018 confirms preliminary conclusions regarding the lowest development level of PJSC «NKMZ» in 2016 and the highest in 2017. Thus, the highest growth rates of taxonomic indicators are observed in 2017, in particular, compared to 2013, the level of development of PJSC «NKMZ» has grown by 29,55%, and compared to the previous 2016 - by 375%. Accordingly, the lowest growth rates, i.e. negative, are observed in 2016, when the level of the company's development decreased by 72.73% compared to 2013 and by 73.33% compared to the previous year.
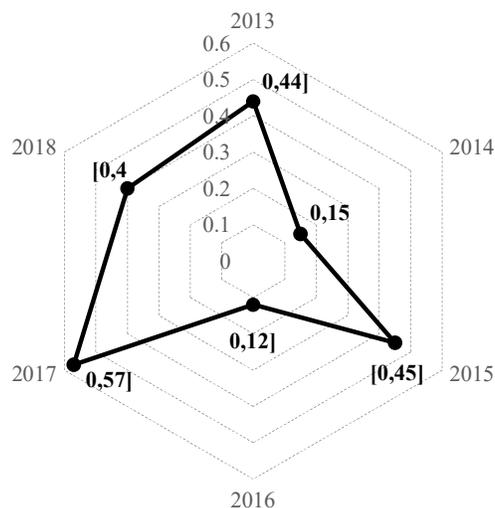
Table 3
The development level of PJSC «NKMZ» in the conditions of ATO

Years	ITI	Increment Rate, %		Place (rating) in the development of the enterprise
		fixed base	*chain-linked*	
2013	0,44	-	-	3
2014	0,15	-65,91	-65,91	5
2015	0,45	2,27	200,00	2
2016	0,12	-72,73	-73,33	6
2017	0,57	29,55	375,00	1
2018	0,40	-9,09	-29,82	4

Source: author's development

The indicated negative trend of the development level of PJSC «NKMZ», primarily is caused due to the fact that the acute social and political situation in Ukraine led to a sharp decline in the activity of the industrial market. The expansion of production rates affected metallurgical enterprises, mining and concentrating complexes and mines, which make up a significant share of consumers of products of PJSC «NKMZ». The situation was also aggravated by the fears of foreign customers regarding the placement of orders at enterprises in Donetsk Region. However, in 2017, thanks to a sound financial policy, PJSC «NKMZ» managed even in difficult economic conditions at its own expense to invest in the technical re-equipment of production, in particular, a large-scale program of technical re-equipment and modernization of metallurgical production, technical re-equipment of mechanical assembly production, aesthetic transformation of production processes and production culture. In general, it should be noted that the calculated integrated taxonomic indicators show that the development level of PJSC «NKMZ», even with the highest value of the taxonomic indicator in 2015, is average, since it is 0,57, i.e., it does not exceed 60% (Fig. 3).

Fig. 3. Dynamics of the integrated taxonomic indicator of the development level of PJSC «NKMZ» during 2013-2018

Source: author's development

As the diagram shows, during 2013-2018 PJSC «NKMZ» does not have a stable tendency to increase the integrated taxonomy indicator, in particular, it can be traced as «jump-like» tendency of the development level of the enterprise: in 2014 and 2016 rather weak level of development is observed, and in 2013, 2015, 2017 and 2018 the average level of development is observed, i.e., over the past six years, the company was unable to achieve an effective level of development. Moreover, starting from 2016, this tendency is due to the fact that PJSC «NKMZ» continues to operate in difficult financial and political crisis and in the conditions of ATO. The analysis of the structure of the integrated assessment obtained by the taxonomic method will make it possible to determine the significance of each of the indicators under the study and their impact on such a comprehensive assessment (Table 4).
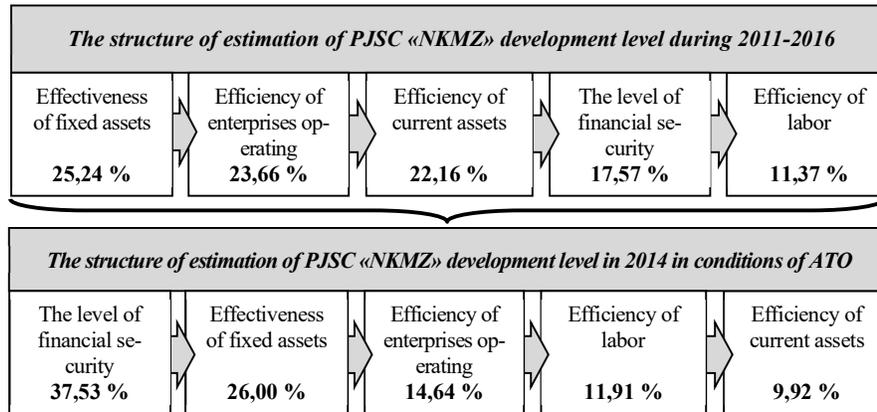
Table 4
The importance of the separated vectors of the development level of PJSC «NKMZ» in its complex assessment, %

Year	Efficiency of use			The level of financial security	Efficiency of enterprise activity	Total
	Fixed assets	Current assets	Labor resources			
2013	3,10	19,81	15,25	6,22	55,62	100
2014	11,13	25,12	15,33	23,42	25,00	100
2015	20,53	15,30	14,70	23,30	26,17	100
2016	**26,00**	**9,92**	**11,91**	**37,53**	**14,64**	**100**
2017	64,13	22,58	3,39	0,00	9,90	100
2018	26,58	40,21	7,63	14,95	10,63	100
Average weight of the indicator	**25,24**	**22,16**	**11,37**	**17,57**	**23,66**	**100**

Source: author's development

An analysis of the structure of the taxonomic indicator of the development level of PJSC «NKMZ» shows that in average the largest impact on the overall development of the enterprise during 2013-2018 had the effectiveness of the use of fixed assets (25.24%), and the least - the effectiveness of labor resources (11.37%) (Fig. 4).

The structure of estimation of PJSC «NKMZ» development level during 2011-2016				
Effectiveness of fixed assets **25,24 %**	Efficiency of enterprises operating **23,66 %**	Efficiency of current assets **22,16 %**	The level of financial security **17,57 %**	Efficiency of labor **11,37 %**

The structure of estimation of PJSC «NKMZ» development level in 2014 in conditions of ATO				
The level of financial security **37,53 %**	Effectiveness of fixed assets **26,00 %**	Efficiency of enterprises operating **14,64 %**	Efficiency of labor **11,91 %**	Efficiency of current assets **9,92 %**

Fig. 4. Values of the separated development vectors
of PJSC «NKMZ» in its complex assessment
Source: author's development

It is clear that in the context of different years there have been structural changes and the importance of factors has changed. In particular, in 2016, where the lowest integrated taxonomic indicator is observed, the most significant were the level of financial provision (37,53%) and the efficiency of the use of fixed assets (26,00%). Thus, the worsening in the development level of PJSC «NKMZ» in 2016 has had the greatest impact in reducing the indicators of the effectiveness of the use of fixed assets and financial security. At the same time, the lowest impact was on the use of labor resources. In view of the above, it is necessary to consider in more detail the importance of each indicator selected for the comprehensive assessment of the development level of PJSC «NKMZ» (Table 5).

Table 5
The estimation structure of development level of PJSC «NKMZ» during 2013-2018

Year	The structure of the complex assessment of the level of enterprise development by indicators,%							
	CP	WOF	DC	CAT	ITR	MC	LP	WC
1	2	3	4	5	6	7	8	9
2013	0,00	0,00	3,09	0,00	0,00	19,81	15,25	0,00
2014	5,68	0,00	5,45	8,52	11,47	5,13	9,43	5,90
2015	7,66	0,12	12,75	0,56	14,74	0,00	12,50	2,20
2016	**10,60**	**3,98**	**11,42**	**2,45**	**6,77**	**0,70**	**3,98**	**7,93**
2017	26,31	17,03	20,79	8,12	12,65	1,81	2,47	0,92
2018	14,73	11,84	0,00	15,25	13,01	11,96	0,00	7,63
Average weight of the indicator	**10,83**	**5,49**	**8,92**	**5,82**	**9,77**	**6,57**	**7,27**	**4,10**

Year	The structure of the complex assessment of the level of enterprise development by indicators,%							Total
	FR	AR	WCCA	WCI	PP	RS	PBA	
1	10	11	12	13	14	15	16	17
2013	1,19	1,15	0,34	3,54	17,97	16,09	21,57	100,00
2014	5,56	6,13	3,07	8,66	6,84	7,99	10,16	100,00
2015	5,06	2,64	2,20	13,40	0,39	10,91	14,88	100,00
2016	**10,17**	**9,39**	**10,17**	**7,81**	**0,60**	**9,05**	**4,98**	**100,00**
2017	0,00	0,00	0,00	0,00	9,90	0,00	0,00	100,00
2018	5,52	4,01	2,74	2,68	0,00	3,62	7,01	100,00
Average weight of the indicator	**4,58**	**3,89**	**3,08**	**6,02**	**5,95**	**7,94**	**9,76**	**100,00**

Source: author's development

Estimation of the structure of the integrated taxonomic indicator of the development level of PJSC «NKMZ» in 2018 showed that its reduction had the greatest impact on the growth of depreciation capacity and the reduction of return on used fixed assets, as well as the worsening of funding, in particular, the reduction of overall solvency, the level of maintenance of own working capital and increase in the level of dependence of the enterprise activity on external sources of financing (Fig. 5).
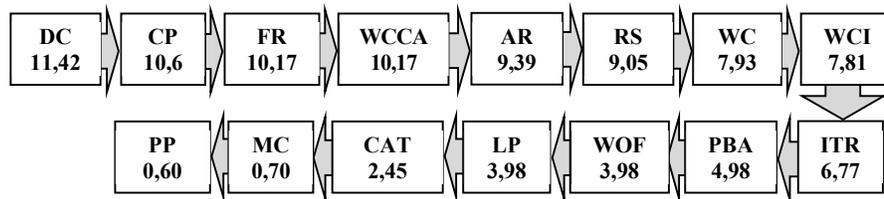
Fig. 5. Ranking of indicators by their importance in the evaluation
the development level of PJSC «NKMZ» in 2018 in conditions of ATO, %

*Source***:** author's development

The determined sequence of indicators allows us to divide them due to priority in managing the development level of PJSC «NKMZ» in the conditions of the ATO, since, having increased the priority characteristics along with others, the enterprise development level will grow faster due to other equal conditions.

5. Conclusions

Thus, taxonomic analysis has allowed us to obtain an integrated indicator that summarizes the value of many features, takes into account the impact of all individual indicators as well as generally reflects the dynamics of enterprise development relatively to the desired vector. The application of taxonomic analysis allowed transforming the non-comparable indicators into a dimensionless scale, which made it possible to determine the level of enterprise development in the conditions of emergency situations as a whole and in terms of resource usage efficiency, optimality of financial support, and efficiency of activity. The proposed assessment of the level of enterprise development by calculating the taxonomic indicator has allowed making relevant conclusions about the existing and potential opportunities for improving the level of resource usage of the enterprise and its financial stability, and also it has served as the basis for the formation of information and analytical support for the management decision making concerning the prevention and liquidation of the consequences of emergencies.

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