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Editors office address:
Simon Kuznets Kharkiv National University of Economics
61166, 1-A Inzhenerny Ln., Kharkiv, Ukraine
E-mail: info@ecdev.com.ua
www: https://ecdev.com.ua/en

ЗМІСТ / CONTENTS

Vasyl Otenko*

Full Doctor in Economics, Professor
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0002-5979-1084

Lyudmyla Malyarets

Full Doctor in Economics, Professor
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0002-1684-9805

Igor Barannik

PhD in Economics, Doctoral Student
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0001-6364-4768

Oleksii Budarin

Postgraduate Student
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0001-9399-9914

Determining the economic sustainability reserve of economic entities in modern operating conditions

■ **Abstract.** In complex socio-economic and political conditions, economic entities must have a sufficient level of economic stability and its reserve for normal life activities. Therefore, the problems of assessment and analysis of economic stability and its reserve are urgent and require immediate solution. The purpose of the article was to study the determination of economic sustainability of economic entities, its reserve, substantiation of the logic of the stages of this determination, and the formation of an appropriate analytical tool. In the research process, general scientific and special research methods were used: abstract-logical method, systematic approach, methods of analysis and synthesis, graphic method, method of building an integral taxonomic indicator of development, multi-criteria optimisation, multi-factor regression analysis, genetic algorithm, marginal utility method, cluster analysis. The article presents the selection of a system of economic sustainability indicators for economic entities of the state sector of Ukraine across regions from the point of view of their legislative basis. In order to determine the reserve of economic sustainability of public sector economic entities across the regions, an economic-mathematical model of multi-criteria optimisation of economic sustainability indicators was developed and solved using a genetic algorithm, which is a new analytical support in economics in solving this problem. A new result in economic-mathematical modelling is the method of forming partial criteria in multi-criteria regression dependency optimisation. The article provides a procedure for implementing the marginal utility method for

*Corresponding author

justifying the final single optimal solution of the multi-criteria optimal problem of determining the optimal values of economic sustainability indicators. It has been proven that it is advisable to determine the absolute value of economic sustainability reserve for economic entities in the regions by their clusters, which were obtained on the basis of the system of indicators of economic sustainability and regional gross product per person. The practical significance lies in the fact that such a scientific-methodical approach to determining economic sustainability and its reserve allows for the objective development of management decisions at industrial enterprises to ensure their normal life activities in difficult war and post-war conditions

■ INTRODUCTION

Wars, Covid-19 and other force majeure circumstances that have been taking place recently in the world and in Ukraine prompted the need to generalise and consider the conditions that limit the activities of business entities. Currently, the conditions that limit the activity of business entities include such conditions as war, post-war, natural disasters, social disasters (Covid-19), global world crises. In such conditions, the management of enterprises does not have time to react in time to the unexpected changes that are taking place and to immediately adapt to them. In this regard, the economic sustainability of economic entities, namely its reserve, ensures life activity, and constant monitoring provides the opportunity to maintain these values.

Various aspects of the problem of economic entities sustainability for all levels of management have been reflected in the works of many scientists both in the world and in Ukraine. Foreign scientists pay particular attention to ecological and economic sustainability. So famous scientist R.B. Howarth (2012), who addresses the challenges of ecological economics in his report, argued that accepting significant reductions in future economic growth rates may not be necessary to protect and sustain the biophysical systems that provide the basis and foundation for human existence and well-being. In the long run, growth in material production and consumption is constrained by natural resource constraints, and achieving a sustainable future will require policies and institutions that support the economy within the framework set by nature (Howarth, 2012). The concept of sustainability is closely related to the basic concepts of macroeconomics such as development and growth. This is very well and thoroughly substantiated in the fundamental monograph of V. Draskovic *et al.* (2017). This monograph contains recommendations for solving many conceptual problems, namely: the relationship between economic and environmental crises; contradictions of economic development and ecology; institutionalisation of relations between economy and ecology, interpretation of sustainable development; the importance of knowledge in sustainable development; the importance of social responsibility in ensuring sustainable development. This monograph is of great importance in the formation of the modern theory of sustainable development.

Regarding the determination of economic sustainability, the authors E. Stockhammer *et al.* (1997) in their work recommend using the index of sustainable economic well-being as an addition to GDP (Gross Domestic Product). They believe that a holistic reporting system for measuring economic sustainability should be developed. An interesting approach to modelling the sustainability of the corporation's activity is proposed by P. Ahi *et al.* (2018). They substantiated the sustainability model based on a probabilistic approach, taking into account environmental issues. L. Hassani *et al.* (2019) supports the idea of multi-criteria in the assessment of sustainability, connecting the process of its determination with the solution of optimisation problems. The problems of determining industrial sustainability remain relevant in many countries, as evidenced by the results of A. Trianni *et al.* (2019) research. J. Wang (2022) in his work used a regression model of Difference in differences (DID) to assess the impact on the sustainable development of resource cities, while he recommends measuring economic growth by the annual growth rate of GDP.

Thus, the existing current conditions of business entities and the numerous works of scientists, their studies, which differ in their approaches to the interpretation and definition of economic sustainability, testify to the need to determine the reserve of this sustainability. The purpose of this study was to justify a new approach to the interpretation of the reserve of economic stability to ensure the normal life of business entities in force majeure circumstances, its new analytical definition using recommended mathematical tools.

■ LITERATURE REVIEW

L. Zapata-Cantu & F. González (2021) analysed sustainable development in great detail as one of the vital challenges of the 21st century for humanity. They explored how mission-oriented policies have influenced sustainable regional development and innovation in Latin America, and argued for opportunities that could support the improvement of the national innovation system and, as a result, the development of sustainability.

Ukrainian scientists, such as P.P. Zakorko & V.E. Breus (2017), paid a lot of attention to solving the problems of economic stability. They considered the essence of understanding the economic sustainability of an enterprise as an adaptive response that would return the system to one of the acceptable stages, propose components, methods of ensuring and methods of evaluating economic sustainability. S. Kozlovskyi & G. Mazur (2017) considered the essence of the category "sustainability of the economic system", its types and proposed a definition of the stability of the economic system, analysed the importance of assessing economic stability, defined approaches to managing economic stability. T.V. Ponomarenko (2016) substantiated the methodical approach to the assessment of economic sustainability based on a value model, which is defined as an ana-

lytical innovation and will allow formalising the levels and states of economic sustainability in accordance with the needs of modern economic diagnostics and real business, which is oriented towards long-term economic growth. A.O. Kasych *et al.* (2019) justified the procedures for determining the type of sustainability, as well as modifying the algorithm of the main components of the method, which allows comparing the positions of companies in relation to competitors and quantifying achievements in the field of sustainable development. E.V. Mishuk (2018) investigated the relationship between economic sustainability and economic security of the enterprise in the conditions of multivariate external and internal environments. He gives definitions of economic security containing the term "sustainability" and its derivatives and, based on the comparison of definitions of economic sustainability with similar definitions of economic security, revealed their common characteristics. S. Dombrovska & M. Horbachenko (2021) in the study of the economic essence gives priority to financial sustainability; in the analysis and assessment of financial sustainability, they focus on influencing factors. The institutional basis of economic sustainability was substantiated by the members of the Council for the Study of Productive Forces of Ukraine of the National Academy of Sciences of Ukraine, State Institution "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine", National Institute for Strategic Studies, etc.

For a detailed study of economic sustainability, its structure should be analysed. A socio-economic system has economic sustainability if its appropriate structure is preserved during the period of operation or flexibly changes under the influence of factors. But each state of the system is characterised by some separate structural norm, which is a ranked system of rates of changes in indicators that reflect meaningful economic sustainability. This structural dynamic standard takes into account the patterns of development of processes, phenomena and characteristics of socio-economic systems and reflects their current state (Malyarets *et al.*, 2019).

Despite the significant development of the theoretical and practical principles of economic sustainability and its management, a number of unresolved problems remain. In particular, the informational-analytical, scientific-methodological support of the economic sustainability of industrial enterprises in modern conditions of limited activity, determination of the optimal levels of the criteria for this sustainability, and the size of its reserve need to be improved.

■ MATERIALS AND METHODS
The study considered the analytical task of determining the economic sustainability of economic entities of the state sector of the economy across the regions for 2021. In accordance with the Methodological recommendations for the application of criteria for determining the efficiency of state-owned objects' management, approved by the order of the Ministry of Economy and Development dated 15.03.2013 No. 253 (Order of the Ministry…, 2013), it is said that the evaluation of the results of the financial and economic activity of economic entities must be done according to the criteria, namely: the absence or reduction of arrears from the payment of wages, the rate of change in the size of the average monthly wage, the implementation

of the financial plan, the degree depreciation of fixed assets, change in the size of net profit/loss, coverage ratio, financial stability ratio, solvency ratio, and the results of the audit opinion. Thus, the economic stability of economic entities of the state sector of the economy in the regional division was determined on the basis of the main indicators of their financial and economic activity, namely: net income (x_1, million UAH), net financial result (x_2, million UAH); receivables (x_3, million UAH), payables (x_4, million UAH), total value of assets (x_5, million UAH), equity (x_6, million UAH), average number of employees (x_7, thousands of people), arrears from the payment of wages (x_8, million UAH). In order to determine the level of economic sustainability of economic entities of the state sector of the economy in the regional section, the entire system of indicators was collapsed into one value, which is an integral indicator. Based on the advantages of calculating the integral indicator using the taxonomic indicator of development, namely the simplicity of the calculation algorithm of the method, the clear interpretation of the value of the integral indicator, it is recommended for determining the level of economic sustainability of entities of the economy state sector in a regional context. The graphic method was used to visualise the integral performance indicators of economic entities. Cluster analysis was used to calculate the values of the stock of economic sustainability of business entities in the studied regions.

■ RESULTS AND DISCUSSION
The analysis of the economic sustainability of economic entities of the economy state sector across the regions for 2021 shows that the highest level was observed in the Kyiv region, Kharkiv region, Odesa region, and Mykolaiv region; the lowest levels are in Kirovohrad, Luhansk, Kherson, and Chernivtsi regions. Figure 1 shows the calculated values of the integral indicator of economic sustainability of economic entities of the state sector of the economy across the regions.

In regions where there is a low level of economic entities' sustainability of the economy state sector, it is necessary to develop programs that would systematically solve the problems of their life activities. An important criteria of the economic sustainability of business entities in the region is the gross regional product per capita. Figure 2 shows the value of the GRP (Gross Regional Product) per capita in 2021.

According to Figure 2, the highest value of gross regional product per capita is in Poltava, Kyiv, and Dnipropetrovsk regions, and the lowest is in Luhansk region. But the analysis of the level of economic entities' sustainability of the state economy sector across the regions on the basis of the integral indicator of the efficiency of their activity or the gross regional product calculated per capita in the regions does not provide an opportunity to objectively talk about the reserve of this sustainability; a multi-criteria optimisation problem should be solved. But here it should also be noted that after obtaining a set of Pareto-optimal solutions in solving a multi-criteria optimisation problem, an important stage is the adoption of a final single solution. Many methods have been developed to determine the single optimal solution, but many of them have the disadvantage of requiring additional information and significant calculations.
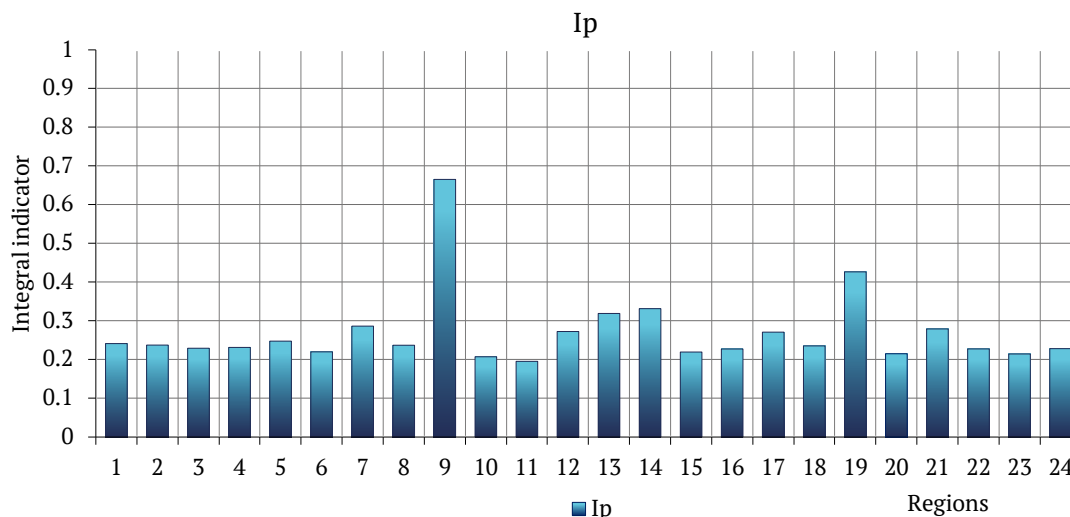
Figure 1. Integrated indicator of the efficiency of economic entities
of the state sector of the economy across the regions for 2021

Note: 1 – Vinnytsia region; 2 – Volyn region; 3 – Dnipropetrovsk region; 4 – Donetsk region; 5 – Zhytomyr region;
6 – Zakarpattia region; 7 – Zaporizhzhia region; 8 – Ivano-Frankivsk region; 9 – Kyiv region; 10 – Kirovohrad region;
11 – Luhansk region; 12 – Lviv region; 13 – Mykolaiv region; 14 – Odesa region; 15 – Poltava region; 16 – Rivne region;
17 – Sumy region; 18 – Ternopil region; 19 – Kharkiv region; 20 – Kherson region; 21 – Khmelnytskyi region; 22 – Cherkasy
region; 23 – Chernivtsi region; 24 – Chernihiv region
Source: compiled by the authors based on O.S. Budarin (2022)
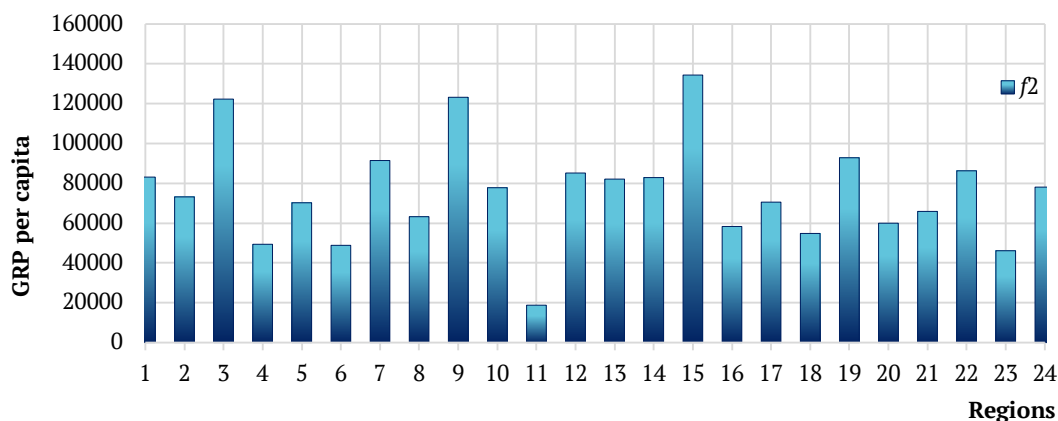
Figure 2. Gross regional product per capita in Ukraine in 2021
Source: compiled by the authors based on Regional Statistics (2022)

These methods include the method of decision-making based on the analysis of hierarchies, the method of decision-making based on network analysis (Saaty, 2008), the method of the best and worst criteria (Rezaei, 2015) and others. However, they all reflect the so-called fundamental paradox of the theory of decision-making based on multiple criteria, namely, when using different methods to solve the same problem, different solutions can be obtained (Triantaphyllou, 1989). One of the methods that is not affected by the stated paradox is the method of marginal utility (Zhao *et al.*, 2006), according to which the optimal final solution is obtained based on the determination of the smallest value of affinity between the nearest vectors in the space of values of the objective vectors of the solutions. In the task of determining the optimal level of economic sustainability of business entities, which contains

two partial criteria, it is necessary to analyse all vectors in terms of their affinity with the two nearest neighbouring solution vectors (Butko *et al.*, 2018). It should also be noted that solving the multi-criteria optimisation problem of determining the optimal values of indicators of economic entities' sustainability using a genetic algorithm is expedient in the MatLab software environment.

The approaches of scientists and practitioners allow us to outline the principles of ensuring economic sustainability: 1) the principle of multidimensionality and multicriteria – economic sustainability is a system that has a structure and elements, their properties, which are expressed through features and criteria; 2) the principle of dynamism – economic sustainability as a system changes over time; 3) the principle of institutionality – the obligation of business entities in the process of ensuring economic

stability to comply with the current legislation. Most often, sustainability is understood as a certain "state" of the enterprise, during which its stable functioning is ensured. Less often, sustainability is highlighted as the ability or capacity of the enterprise to resist the influence of negative factors of the external environment. In this study, economic sustainability is considered as a complex integral characteristic of business entities to maintain homeostasis with the external environment in various conditions of their activity, in particular, in conditions of its limitations, to counteract the negative impact of destabilising force majeure factors. According to the types of activities, financial, production, marketing, investment and innovation, as well as market, organisational sustainability are distinguished.

In a multi-criteria optimisation problem, the comparison of solutions based on their merits is not carried out directly, but with the help of set of X numerical functions f_1, $f_2, ..., f_k$, which are called criteria that form a vector criterion $f = (f_1, f_2, ..., f_k)$. The set of criteria can be presented in the form of a vector objective function: $F(X) = \{f_1(X), ..., f_k(X)\}$, where $X = \{x_1, ..., x_n\}$ $(i = \overline{1,n})$ is a vector of variables, usually $X \geqslant 0$. The functional interrelationship between variables is established by relations, on which restrictions $g_i(X) \leqslant b_i$ $(i = \overline{1,m})$) are imposed.

Since there are many methods of solving multi-criteria optimisation problems, the problem lies in its choice. Multi-criteria problems are classified according to many features: according to optimisation options, according to the number of criteria, according to types of criteria, according to the ratio between criteria, according to the level of structuring, according to the presence of the uncertainty factor (Voronin, 2018). It is believed that the most important of the classification features of multi-criteria optimisation methods is the feature based on the functions of the person who makes the decision, namely: 1) methods of finding the optimal solution without the participation of decision maker; 2) a posteriori methods; 3) a priori methods; 4) interactive methods.

To compile the objective function of the multi-criteria optimisation problem, we will use the dependence of the levels of economic sustainability of business entities and the gross regional product per person on the main indicators of financial and economic activity:

$$F(X) = \{f_1(X), f_2(X)\}, \quad (1)$$

where $f_1(X)$ is the criterion of the gross regional product level per capita; $f_2(X)$ is the criterion of the level of economic sustainability of economic entities of the state sector of the economy; $X = \{x_1, ..., x_8\}$ is a vector of variables, which are the main indicators of financial and economic activity.

At the same time, the limitations in the problem are the numerical characteristics of variables X, which are defined for the totality of regions in 2021.

As a result of the calculations performed in the MatLab environment, the economic-mathematical model of the multi-criteria optimisation problem of determining the optimal values of indicators of economic stability of economic entities of the public sector of the economy has the form:

$$f_1 = 71.9842 - 10.0189x_1 + 26.6956x_2 + 17.0093x_3 - 0.5111x_4 - 1.2117x_5 + 2.382x_6 + 3.9764x_7 + 0.42x_8 \to \max;$$

$$f_2 = 0.2075 - 0.0038x_1 + 0.016x_2 + 0.024x_3 - 0.0042x_4 + 0.0025x_5 + 0.0063x_7 - 0.0004x_8 \to \max.$$

subject to restrictions:

$$0.5818 \leqslant x_1 \leqslant 47.2707; \; -3.358 \leqslant x_2 \leqslant 10.9404;$$
$$0.0328 \leqslant x_3 \leqslant 8.7242; \; 0.1269 \leqslant x_4 \leqslant 59.0309;$$
$$0.9583 \leqslant x_5 \leqslant 126.8385; \; -11.145 \leqslant x_6 \leqslant 61.1503;$$
$$1.6 \leqslant x_7 \leqslant 29.6; \; 0.0 \leqslant x_8 \leqslant 248.0.$$

To solve this multi-criteria problem, it is recommended to use a genetic algorithm, which is based on the principles of the evolutionary theory of living organisms. Evolutionary methods are new methods of solving multi-criteria optimisation problems, which are successfully applied in various fields of science and practice. The essence of multi-criteria optimisation problems and their practical implementation in the MatLab environment are detailed in the work of L.M. Malyarets *et al.* (2013). This paper not only describes well the capabilities of the Matlab environment for solving optimisation problems, but also demonstrates examples of solving different types of optimisation problems, especially multi-criteria ones.

Therefore, solving the multi-criteria optimisation problem of determining the optimal values of indicators of economic entities' sustainability of the state sector of the economy across the regions for 2021, based on the genetic algorithm, is recommended to be carried out in the following logic of its stages (Malyarets & Minenkova, 2017): 1) form non-dominant vectors X_j $j \in [1:s]$ on the set D_X of admissible values; 2) make an initial population; 3) find the fitness function for the individuals of the population (estimates); 4) calculate the fitness of each individual in the population, and then the average fitness of the entire population; 5) make a choice of individuals from the current population as two parents for the implementation of the crossing over operator; 6) form the genotype of offspring; 7) implement a mutation operator with given probabilities and obtain the offspring genotype; 8) determine the number of individuals to exclude them from the population so that its size remains constant; 9) determine fitness (estimate the value of the objective function) and list the average fitness (calculate the value of the corresponding vector optimality criterion $f_j = f(X_j)$, $j \in [1:s]$; 10) to analyse the obtained solutions. If they satisfy the decision maker, then the process should be stopped and thus the optimal solution of the problem should be obtained. If it does not satisfy, then you should continue the computational algorithm and return to stage 3 (if the stopping conditions are met, the loop ends, otherwise you should go to the beginning of the loop, that is, to stage 3).

So, in order to find a set of Pareto solutions, it is necessary to use the MatLab software environment, namely, to implement the procedure Multiobjective optimisation using Genetic Algorithm. The genetic algorithm does not put forward any requirements for the form of the objective function and restrictions.

The calculation procedure takes into account the population type as a double vector with a population size of 120, and the selection function is implemented as a random selection of two people with reproduction parameters of 0.3 and 0.5. The mutation function depends on the

restrictions, and the crossing is average, the direction of migration is forward, that is, along the last subpopulation and every 20 generations. Figure 3 shows the results of the calculations described above.
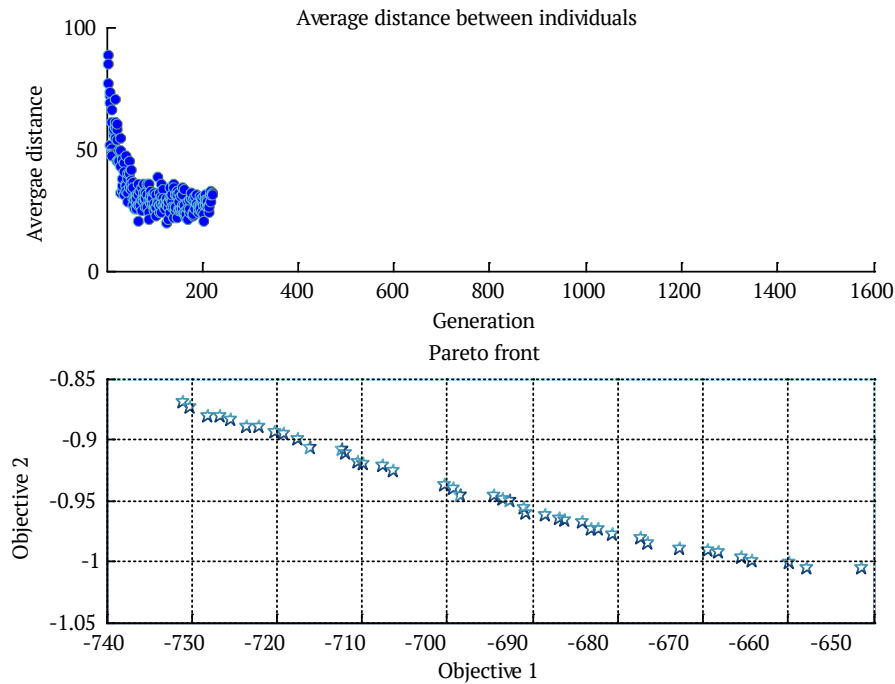
Figure 3. Results of calculations of Pareto-optimal solutions using genetic algorithm
Source: developed by the authors

The idea of the method of analysis of all vectors regarding their relationship with the two nearest neighboring solution vectors in the marginal utility method (Butko *et al.*, 2018) is as follows: consider an arbitrary vector V^0 belonging to the set of Pareto-optimal non-dominated solution vectors and whose coordinates are the values of the target functions $(\overline{f_1^0, f_2^0})$. First, it is necessary to determine two nearest neighboring vectors V^1 and V^2, and with coordinates $(\overline{f_1^2, f_2^2})$ and $(\overline{f_1^2, f_2^2})$ such that $f_1^1 \leqslant f_1^0 \leqslant f_1^2$ and $f_2^1 \geqslant f_2^0 \geqslant f_2^2$. These vectors are defined as those that are the least distant from the centroids of the k nearest vectors, the first coordinate of which is first less than and then greater than f_1^0. After defining these vectors for each V^0 vector, the affinity function is determined:

$$A_{V^0} = max\left(\frac{f_1^0 - f_1^1}{f_2^1 - f_2^0}, \frac{f_1^2 - f_1^0}{f_2^0 - f_2^2}\right). \qquad (2)$$

The value of the affinity function is determined for all vectors, but for k extreme vectors at both ends of the Pareto front, it may not be determined because it is considered that for these vectors it is a priori the smallest. The value k represents the resolution at which the affinity function is calculated and the compromise solution is determined. It can be taken depending on the power of the Pareto set or based on other considerations. In this study, the value $k=2$. The optimal compromise solution according to the marginal utility method is the solution corresponding to the target vector with the minimum value of the affinity function. Calculation data are summarised in Table 1.

Table 1. Calculations in the selection of a compromise solution
from a set of Pareto-optimal solutions of a two-criteria optimisation problem using the marginal utility method

№	f_1^0	f_2^0	f_1^1	f_2^1	f_1^2	f_2^2	$\frac{f_1^0 - f_1^1}{f_2^1 - f_2^0}$	$\frac{f_1^2 - f_1^0}{f_2^0 - f_2^2}$	A_{V^0}
1	651.4317	1.0056							
2	657.7353	1.0054							
3	659.8921	1.0015							
4	664.2009	1.0005	651.4317	1.0056	669.3590	0.9913	2530.0879	558.6891	2530.0879
5	665.4446	0.9971	657.7353	1.0054	672.6504	0.9902	936.0701	1044.6900	1044.6900
6	668.1918	0.9934	659.8921	1.0015	676.3993	0.9860	1024.6586	1117.5453	1117.5453
7	669.3590	0.9913	664.2009	1.0005	677.2780	0.9814	558.6891	799.0367	799.0367
8	672.6504	0.9902	665.4446	0.9971	680.5138	0.9781	1044.6900	649.0885	1044.6900

Table 1. Continued

9	676.3993	0.9860	668.1918	0.9934	682.3406	0.9739	1117.5453	488.3715	1117.5453
10	677.2780	0.9814	669.3590	0.9913	683.0007	0.9733	799.0367	705.0897	799.0367
11	680.5138	0.9781	672.6504	0.9902	684.1725	0.9677	649.0885	350.5624	649.0885
12	682.3406	0.9739	676.3993	0.9860	686.1608	0.9667	488.3715	533.7049	533.7049
13	683.0007	0.9733	677.2780	0.9814	686.8695	0.9645	705.0897	443.6640	705.0897
14	684.1725	0.9677	680.5138	0.9781	688.4105	0.9617	350.5624	705.5195	705.5195
15	686.1608	0.9667	682.3406	0.9739	690.8516	0.9610	533.7049	816.4393	816.4393
16	686.8695	0.9645	683.0007	0.9733	691.0280	0.9562	443.6640	496.7672	496.7672
17	688.4105	0.9617	684.1725	0.9677	692.5800	0.9514	705.5195	407.6462	705.5195
18	690.8516	0.9610	686.1608	0.9667	693.4751	0.9486	816.4393	212.7469	816.4393
19	691.0280	0.9562	686.8695	0.9645	694.4002	0.9465	496.7672	350.2855	496.7672
20	692.5800	0.9514	688.4105	0.9617	698.3822	0.9457	407.6462	1013.2754	1013.2754
21	693.4751	0.9486	690.8516	0.9610	699.3173	0.9403	212.7469	704.2144	704.2144
22	694.4002	0.9465	691.0280	0.9562	700.2764	0.9375	350.2855	650.9500	650.9500
23	698.3822	0.9457	692.5800	0.9514	706.2697	0.9266	1013.2754	413.8178	1013.2754
24	699.3173	0.9403	693.4751	0.9486	707.5909	0.9216	704.2144	442.5537	704.2144
25	700.2764	0.9375	694.4002	0.9465	709.8845	0.9202	650.9500	554.5301	650.9500
26	706.2697	0.9266	698.3822	0.9457	710.4499	0.9184	413.8178	505.3807	505.3807
27	**707.5909**	**0.9216**	**699.3173**	**0.9403**	**711.9941**	**0.9119**	**442.5537**	**451.4612**	**451.4612**
28	709.8845	0.9202	700.2764	0.9375	712.2732	0.9093	554.5301	220.1037	554.5301
29	710.4499	0.9184	706.2697	0.9266	715.9753	0.9078	505.3807	520.7159	520.7159
30	711.9941	0.9119	707.5909	0.9216	717.5621	0.9007	451.4612	496.0977	496.0977
31	712.2732	0.9093	709.8845	0.9202	719.2526	0.8961	220.1037	525.9404	525.9404
32	715.9753	0.9078	710.4499	0.9184	720.2399	0.8941	520.7159	311.6084	520.7159
33	717.5621	0.9007	711.9941	0.9119	722.0964	0.8902	496.0977	435.2888	496.0977
34	719.2526	0.8961	712.2732	0.9093	723.5078	0.8892	525.9404	617.3222	617.3222
35	720.2399	0.8941	715.9753	0.9078	725.3999	0.8843	311.6084	529.3199	529.3199
36	722.0964	0.8902	717.5621	0.9007	726.6732	0.8816	435.2888	526.1333	526.1333
37	723.5078	0.8892	719.2526	0.8961	728.0760	0.8806	617.3222	530.6680	617.3222
38	725.3999	0.8843	720.2399	0.8941	730.0688	0.8736	529.3199	434.3125	529.3199
39	726.6732	0.8816	722.0964	0.8902	730.9788	0.8689	526.1333	340.3245	526.1333
40	728.0760	0.8806							
41	730.0688	0.8736							
42	730.9788	0.8689							

Source: developed by the authors

Thus, the minimum value of the affinity function is equal to 451.4612 for point number 27, which corresponds to the value of the first criterion – the gross regional product per capita – 707.5909 UAH/person, and the second criterion – the level of economic entities' sustainability of public sector economy -0.921643, which is taken as the final compromise solution. At the same time, the optimal values of the indicators: net income 611.25 million UAH, net financial result 10834.34 million UAH, receivables 8713.881 million UAH, payables 4825.442 million UAH, total value of assets UAH 92,527.6 million, equity capi-

tal UAH 56,546.94 million, average number of employees 29,576 thousand, salary arrears UAH 158.4911 million. To determine the reserve of economic sustainability of economic entities of the regions, it is necessary to distinguish clusters according to its system of indicators and gross regional product per person (Fig. 4).

It is appropriate to distinguish 7 clusters of economic entities of the regions of Ukraine according to the system of indicators of economic sustainability and gross regional product per person and then calculate the average values of all these indicators in each cluster (Table 2).
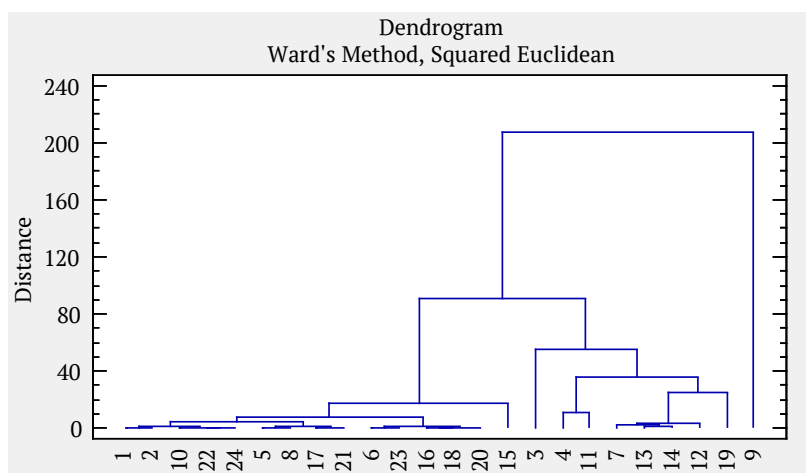
Figure 4. Dendrogram of clustering of economic entities of the regions of Ukraine in 2021 according to the system of indicators of economic sustainability and gross regional product per capita
Source: developed by the authors

Table 2. Average values of indicators of economic sustainability and gross regional product per capita in each cluster of economic entities of the regions

Cluster	x1	x2	x3	x4	x5	x6	x7	x8	Y1
1	2615.94	41.06	267.96	960.55	2647.72	1040.44	4.66	3.66	66.89
2	7233.70	-3358.00	3041.10	19976.90	34831.20	10823.80	20.30	248.00	122.30
3	3896.15	-1776.25	1476.75	17516.20	9420.50	-10688.30	14.35	63.35	34.09
4	7251.62	-27.83	2078.57	12108.60	13703.50	142.68	15.25	20.93	85.41
5	47270.70	10940.40	8724.20	59030.90	126839.00	61150.30	29.60	14.30	123.22
6	1023.40	19.20	32.80	1914.40	2621.80	666.20	2.60	1.40	134.38
7	19504.40	-126.70	7887.10	11230.90	27398.30	13778.70	17.60	66.00	92.84

Source: developed by the authors

The final determination of the reserve of economic sustainability of economic entities of the regions in each cluster is determined by the deviation of each achieved average value of the indicator (x_i) from the optimal value (x_o), i.e; $\Delta_i = x_i - x_o$. If $\Delta_i \geqslant 0$, there is a reserve of economic sus-tainability according to this indicator; if $\Delta_i < 0$, there is no reserve of sustainability and urgent measures should be taken to increase it. Table 3 shows the calculated values of the reserve of economic sustainability of economic entities across the regions in each cluster.

Table 3. Values of the reserve of economic sustainability of business entities across the regions in each cluster

Cluster	x1	x2	x3	x4	x5	x6	x7	x8	Y1
1	2004.6900	-10793.28	-8445.92	-3864.89	-95175.32	-55506.50	-24.91	-154.83	-640.70
2	6622.4500	-14192.34	-5672.78	15151.46	-127358.80	-45723.14	-9.28	89.51	-585.29
3	3284.9000	-12610.59	-7237.13	12690.76	-101948.10	-67235.24	-15.23	-95.14	-673.50
4	6640.3700	-10862.17	-6635.31	7283.16	-106231.10	-56404.27	-14.33	-137.57	-622.18
5	46659.4500	106.06	10.32	54205.46	-219366.60	4603.36	0.02	-144.19	-584.37
6	412.1500	-10815.14	-8681.08	-2911.04	-95149.40	-55880.74	-26.98	-157.09	-573.21
7	18893.1500	-10961.04	-826.78	6405.46	-119925.90	-42768.24	-11.98	-92.49	-614.75

Source: developed by the authors

The analysis of Table 3 shows that only economic en-tities of region 5 of the cluster, which is the Kyiv region, have positive deviations on 6 indicators of economic sus-tainability, for economic entities of the rest of the regions, programs of urgent management measures to strengthen their sustainability should be developed.

As it was already mentioned above, in order to de-termine the real parameters of the reserve of economic

sustainability of economic entities in the regions, it is necessary to find the optimal values of the indicators that characterise it by solving a multi-criteria optimisation problem. L. Hassani *et al.* (2019), A. Trianni *et al.* (2019), J. Wang (2022) talked about this in their works, but they did not state the problem itself, and even more so did not say how to solve it.

N.E. Kondruk & M.M. Malyar (2019) in their work discuss in sufficient detail the problem of methods of constructing and solving multi-criteria optimisation problems, but they do not indicate the disadvantages and advantages of each of the methods, and consider the implementation of these methods on simplified problems, not on real data.

Authors fully agree with J. Branke *et al.* (2008) that research and application of multi-objective optimisation require optimisation experience, as well as decision support, and it can also be added that knowledge of the research object, laws and regularities of its functioning and development is needed as well.

The well-known scientist M. Ehrgott (2005) speaking on the problems of multi-criteria optimisation admits that there is a lot of heuristics in the formulation of the most multi-criteria problems and methods of solving them, and this, in our opinion, does not reduce their value, but increases the effectiveness of both the methods themselves and their usefulness tasks in practical activity.

Modern multi-criteria optimisation methods in various spheres of human activity are interactive methods, in particular genetic algorithms; this is described in detail in the work of L.M. Malyarets *et al.* (2013). But the listed methods of multi-criteria optimisation were not used in determining the economic sustainability reserve of business entities; these methods were used to solve other problems in the economics.

Many scientists, including S.C. Chiam *et al.* (2008), talk about the unconditional advantage of such iterative methods for solving multi-criteria optimisation problems due to their computational algorithm in dialog mode and constant control of the calculation parameters by the person who makes the decision.

As for the logic of the stages of the genetic algorithm, it is described in the works of many scientists, in particular K.V. Kolesnikov *et al.* (2013), which not only provides the content of these stages, but also establishes that the convergence time of these algorithms depends on the accuracy and dynamics of the network change.

So, from the analysis of the works, it can be concluded that the topic of estimating the reserve of economic sustainability has been studied by many scientists. However, certain aspects, such as the application of certain methods to determine the reserve of economic sustainability in practice, the advantages and disadvantages of problem-solving methods, and specific ways of solving problems, have not been sufficiently considered.

◼ CONCLUSIONS

Summarising the presented results of the study, it is necessary to emphasise once again on the specified new approach in the study of economic sustainability of economic entities, which involves not only determining its level according to the appropriate system of partial indicators, but also its reserve. The study recommends an improved logic of the analysis stages of the economic entities' sustainability across the regions. The novelty of the research results is the formalisation of the economic-mathematical model of multi-criteria optimisation of indicators of economic entities' sustainability, which involves the formation of partial criteria in multi-criteria optimisation based on regression dependencies. To solve the multi-criteria optimisation problem of determining the reserve of economic sustainability of economic entities, the feasibility of using the genetic algorithm and the marginal utility method, which increases the efficiency and objectivity of the obtained optimal solution, is substantiated.

Further research of the authors will be the formulation and solution of the problem of the sensitivity of the reserve of economic sustainability of economic entities, which allows to determine the intervals of permissible change of economic sustainability and its reserve.

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◼ CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Василь Іванович Отенко

Доктор економічних наук, професор
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0002-5979-1084

Людмила Михайлівна Малярець

Доктор економічних наук, професор
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0002-1684-9805

Ігор Олексійович Бараннік

Кандидат економічних наук, докторант
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0001-6364-4768

Олексій Сергійович Бударін

Аспірант
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0001-9399-9914

Визначення запасу економічної стійкості суб'єктів господарювання в сучасних умовах діяльності

■ **Анотація.** В складних соціально-економічних, політичних умовах для нормальної життєдіяльності суб'єкти господарювання повинні мати достатній рівень економічної стійкості та її запасу. Тому проблеми оцінки та аналізу економічної стійкості, її запасу є актуальними й потребують свого негайного вирішення. Метою статті було дослідження визначення економічної стійкості суб'єктів господарювання, її запасу, обґрунтування логіки етапів цього визначення, формування відповідного аналітичного інструменту. В процесі дослідження були використані загальнонаукові та спеціальні методи дослідження: абстрактно-логічний метод, системний підхід, методи аналізу і синтезу, графічний метод, метод побудови інтегрального таксономічного показника розвитку, багатокритеріальна оптимізація, багатофакторний регресійний аналіз, генетичний алгоритм, метод граничної корисності, кластерний аналіз. В статті наводиться вибір системи показників економічної стійкості суб'єктів господарювання державного сектору України в регіональному розрізі з огляду їх законодавчої основи. Для визначення запасу економічної стійкості суб'єктів господарювання державного сектору в регіональному розрізі була розроблена та вирішена економіко-математична модель багатокритеріальної оптимізації показників економічної стійкості з використанням генетичного алгоритму, що є новим аналітичним забезпеченням в економіці у вирішенні цієї проблеми. Новим результатом в економіко-математичному моделюванні є метод формування частинних критеріїв в багатокритеріальній оптимізації на основі регресійних залежностей. В статті наводиться процедура реалізації методу граничної корисності для обґрунтування кінцевого єдиного оптимального розв'язку багатокритеріальної оптимальної задачі визначення оптимальних значень показників економічної стійкості. Доведено, що визначення абсолютної величини запасу економічної стійкості суб'єктів господарювання в регіонах доцільно зробити за їх кластерами, які були отримані на основі системи показників економічної стійкості та валового регіонального продукту розрахунку на одну особу. Практичне значення полягає в тому, що такий науково-методичний підхід визначення економічної стійкості та її запасу дозволяє об'єктивно розробляти управлінські рішення на промислових підприємствах щодо забезпечення нормальної їх життєдіяльності в складних воєнних та повоєнних умовах

■ **Ключові слова:** система показників; запас економічної стійкості; багатокритеріальна оптимізація; генетичний алгоритм; кластери регіонів; відхилення показників

Tatyana Shtal

Doctor of Economics, Professor
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0003-1256-9854

Tetiana Pliekhanova*

PhD in Economics
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0002-2054-4545

Kyrylo Kravets

Postgraduate Student
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0002-3470-1919

Nataliia Ohiienko

Master's Degree
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0009-0007-0179-5932

Risk factors determination of enterprise external and internal environment during project implementation

■ **Abstract.** A significant part of new enterprises of various forms of ownership and in different sectors of the economy ceases to exist within the first five years. This tendency to close enterprises indicates the need for strategic planning of enterprise development and the implementation of a risk factor identification, evaluation, and management process in the strategic management of enterprise development. The purpose of the research is to develop a methodological approach that would allow identifying the risk factors that may have the greatest impact at each life cycle stage of analysed project. To achieve the goal set within the framework of the research, structural and logical analysis, methods of systematisation, generalisation, scientific abstraction and hierarchy analysis were used. The article proposes methodological approach to determining the risk factors of enterprise external and internal environment, which makes it possible to identify the risk factors that have the greatest impact at each stage of the project life cycle. Mathematical models have been obtained which allow for the identification of those risk factors that can have the most negative impact (both in terms of frequency of occurrence and potential losses), which will enable the enterprise to increase the efficiency of managing these risks at all stages of project implementation. The impact of risk factors has been assessed in conditions of incomplete certainty and lack of sufficient statistical information. The practical significance of the results obtained lies in the possibility of increasing the efficiency of using available resources in risk management

*Corresponding author

processes. The proposed methodological approach can be used to assess the impact of project risks in a certain industry, which will increase the accuracy of the results obtained

■ **Keywords:** life cycle; method of expert assessments; method of hierarchy analysis; mathematical model; concordance coefficient

■ INTRODUCTION

In modern economic conditions, enterprises operate in conditions of incomplete certainty, caused by the rapid change in the influence of factors of the external and internal environment. In order to ensure competitive development, enterprises should systematically monitor changes in their macro- and microenvironment and quickly adapt to them, as well as take into account available resources and prospects for further development.

The implementation of strategic planning in enterprise activities will ensure the enterprise development in a strategic perspective and the effective use of available opportunities and resources through constant monitoring of the impact of risk factors of the external and internal environment, as well as enable the enterprise to pay sufficient attention to the stage of identifying and assessing risks, which will allow expanding the feasibility criteria and the possibility of implementing certain strategic decisions (Fedulova, 2019).

The process of strategic planning of enterprise development is often associated with the development and implementation of certain ideas, activities, projects, etc. (Shtal *et al.*, 2020). For the most efficient use of available resources, it is advisable for the enterprise to choose the most promising ones, taking into account the current situation, strategic goals and available internal resources. It is also advisable to allow for the possibility of implementing the planned measures in a certain perspective, i.e., to take into account the possibility of change in the influence of enterprise external and internal environment. That is why the possibility of assessing the influence of factors (measure and degree) at different stages of the idea, project, event implementation is relevant both among scientists and business executives.

T. Shtal *et al.* (2018), A. Spoiala *et al.* (2020) dedicated their works to assessing the risks of the external and internal environment of enterprises.

In their work, S. Ogunlana & P. Kumar Dey (2019) consider modern tools for assessing the risks of the enterprise external and internal environment in project implementation, however, insufficient attention is paid to the peculiarities of using certain methods depending on the stage of the project life cycle. N.R. Chakim *et al.* (2021) analyse 24 risk factors of the enterprise external and internal environment, suggest using the residual risk map for its assessment, as well as the introduction of risk management into the organisational structure of enterprise, but no attention is paid to the quantitative assessment of risks. H. Bolat *et al.* (2022) pay attention to technological (technical) start-ups and the analysis of the risk of failure of such projects using a fuzzy failure mode and effect analysis (FMEA), which makes it possible to identify the main reasons for the failure of start-up projects, however, this study focuses on the research and development stage and does not consider the impact of risk factors after the project enters the market.

K. Verhal & I. Ishchenko (2020) investigate the stages of risk management of an investment project, where for each of the selected stages (risk identification, risk assessment, risk response planning, risk monitoring) they propose a certain set of methods that can be used, however, practical recommendations for choosing the most effective method depending on the peculiarities of the project or enterprise are not considered. I. Riepina *et al.* (2019) consider the possibility of choosing an investment project based on NPV (Net present value), PI (Profitability index), PBP (Payback period) indicators and define the risk modelling method as the most universal for quantitative risk assessment, however, the specified approach cannot be used in conditions of uncertainty of enterprise business environment and lack of sufficient statistical or analytical information. S. Illiashenko *et al.* (2022) proposed an approach to quantifying the risks of innovative projects in the context of COVID-19, which excludes the double risk of calculations, and the fuzzy logic apparatus makes it possible to assess risk factors and their combinations, which allows justifying decisions in conditions of inaccurate, incomplete or contradictory information. In her article, N. Shandova (2018) proposed the main stages of anticipatory analysis of risk factors, however, most attention was paid to risk factors of the external environment.

The purpose of the research was to develop a methodological approach to assessing the impact of risk factors on the enterprise external and internal environment.

To achieve the goal, the following tasks were identified: to determine the list of risk factors and stages of the project life cycle for which calculations will be made; conduct an expert survey to assess the impact of enterprise risk factors on the probability of project implementation, taking into account the stages of the project life cycle; identify the most risk-generating factors at each of the selected stages of the project life cycle.

■ MATERIALS AND METHODS

As a basis for research, scientific works of Ukrainian and foreign scientists on the assessment of the impact of risk factors of the enterprise external and internal environment in project implementation were used. To achieve the goal set within the framework of the research and the solution of the tasks set, the following methods of scientific knowledge were used in the research: structural and logical analysis – in order to determine the logic and structure of the research; systematisation, generalisation, grouping – to identify types and groups of risk factors, depending on the life cycle of the analysed project; systems analysis and scientific abstraction – to identify risk factors of the enterprise external and internal environment, depending on the stage of the life cycle of the analysed project; method of hierarchy analysis – to increase the level of objectivity of assessing the impact of risk factors depending on the appropriate

stage of the project life cycle. To solve the tasks set in the research, the Microsoft Excel application package was used.

The proposed methodological approach to the assessment of enterprise risk factors at each stage of the project life cycle consists in performing the following sequence of actions:

1. Selection of project life cycle stages. At this stage, the stages of the life cycle that are characteristic of the analysed projects are selected. Also, the enterprise can make appropriate calculations for all stages of the life cycle that may occur in the future, since these risks primarily reveal the peculiarities of the enterprise economic conditions.

2. Identification of the main risk factors of the enterprise external environment. Considering the available resources and goals of an enterprise, it is possible to choose a different number of factors, because on the one hand, the more factors, the more detailed analysis can be conducted and relevant risks can be identified, and on the other hand, it can significantly increase the complexity of assessing the data obtained.

3. Determination of the main constituent factors of the enterprise internal environment. The list of factors should also be formed based on the current state of the enterprise and the complexity of processing further results.

4. Selection of a group of experts. Depending on the field of operation, it is necessary to form groups of experts so that there are enough experts to make further conclusions and their qualifications enable them to assess the impact of the selected factors on a particular project.

5. Conducting a survey through a pairwise comparison of the impact of risks of the enterprise external and internal environment at each of stage of the analysed project.

The survey was conducted in 2019. With the help of Google Forms software, an anonymous questionnaire was developed, which was then sent to the e-mail addresses of more than 400 enterprises engaged in the development and implementation of projects at the research stages. Based on the results obtained, the coefficients of the model were determined. This survey was conducted in order to show the possibility of using the proposed methodological approach.

Suppose that $C_1, C^2 ... C_n$ is a set of objects (in this case – risk factors of the enterprise external and internal environment). Then the quantification of the pair of objects (C_i, C_j) can be represented by constructing an n×n matrix.

$$A = (a_{ij}), (i, j = 1, 2...n). \qquad (1)$$

At the same time, it should be noted that the following rules apply to elements a_{ij}:

1) If $a_{ij} = \alpha$, then $a_{ij} = \frac{1}{\alpha}$, $\alpha \neq 0$.

2) If the experts established the same importance of judgments C_i and C_j, then $a_{ij} = 1$, $a_{ji} = 1$, $a_{ii} = 1$ for all i.

Matrix A will generally look as follows (Pasichnyk *et al.*, 2022):

$$A = \begin{bmatrix} 1 & \alpha_{12} & ... & \alpha_{1n} \\ 1/\alpha_{12} & 1 & ... & \alpha_{2n} \\ ... & ... & ... & ... \\ 1/\alpha_{1n} & 1/\alpha_{2n} & ... & 1 \end{bmatrix}. \qquad (2)$$

In order to conduct and evaluate the results of pairwise comparisons of experts, the Saaty's scale was used to increase the objectivity of subjective judgments (Pasichnyk *et al.*, 2022; Moore & Weatherford, 2001).

To use the matrix of pairwise comparisons for further calculations, it must be normalised.

6. Calculation of weight coefficients of risk factors of the external and internal environment based on the survey of each expert at each stage of the project life cycle using the method of hierarchy analysis, as well as checking the consistency coefficient for each of the calculations in order to assess the consistency of the expert's response and the possibility of using the obtained results in further research.

The consistency coefficient is calculated in three stages (Moore & Weatherford, 2001):

1) first, the consistency measure is calculated for each analysed criterion (CC);

2) the consistency index (*CI*) is calculated according to the formula:

$$CI = \frac{\overline{CC} - n}{n - 1}, \qquad (3)$$

where ($\overline{CC}$) is the average measure of consistency of all criteria; n is the number of considered criteria.

3) the consistency ratio (*CR*) is calculated according to the formula:

$$CR = \frac{CI}{RI}, \qquad (4)$$

where *CI* is the consistency index; *RI* is the randomisation index.

7. Calculation of the concordance coefficient for each of the analysed groups of risk factors (including macroenvironment, microenvironment and internal environment of the enterprise) at each of the analysed stages of the project life cycle. Consistency of expert opinions is calculated using the formula (Traskovetska *et al.*, 2013):

$$w = \frac{S}{\frac{1}{12}(m^2(n^3 - n) - m \sum_{j=1}^{m} T_j}, \qquad (5)$$

where S is the sum of squared deviations of all rank estimates of each examination object from the average value; n is the number of examination objects; m is the number of experts; T_j is an indicator that takes into account the coincidence of ranks and is calculated according to the formula (Traskovetska *et al.*, 2013):

$$T_j = \sum_{k=1}^{n}(t_k^3 - t_k), \qquad (6)$$

where t_k is the number of repetitions of rank k when ranking factors by the j expert.

The analysis of this indicator will make it possible to determine the degree of consistency of expert opinions, as well as identify the expert responses that differ significantly, which will allow identifying the causes of a significant deviation and exclude them.

8. Calculation of the arithmetic mean of the received values of weights of each factor of each expert in order to determine the total weights of groups of risk factors, as well as each risk factor of the enterprise external and internal environment at each of the analysed stages of the project life cycle.

9. Obtaining mathematical models to identify the influence of groups of risk factors and risk factors of the enterprise external and internal environment at each stage of the project life cycle.

The general form of the objective function can be represented as:

$$R = \sum_{i=1}^{n} w_i \times R_i, \qquad (7)$$

where w_i is the weight of the i-factor; $w_i > 0$; R_i is value of the i-factor; n is the number of factors.

It is advisable to present the mathematical model of the overall risk assessment of the enterprise as follows:

$$R = K_{1s} \times R_{1s} + K_{2s} \times R_{2s} + K_{3s} \times R_{3s} \qquad (8)$$

where R_{1s} is the risk of the enterprise macroenvironment; R_{2s} is the risk of enterprise microenvironment; R_{3s} is the risk of enterprise internal environment; K_{1s}, K_{2s}, K_{3s} are corresponding weights of each risk group, calculated by using the method of hierarchy analysis; s is the corresponding stage of the project life cycle.

10. Identification of risk factors of the macroenvironment, microenvironment and internal environment of the enterprise, which have the greatest impact on the project at the appropriate stage of the project life cycle in order to effectively manage them and evaluate the implementation of the project as a whole.

Identification of risk factors that have the most negative impact will increase the effectiveness of risk management and will also increase the probability of the analysed project implementation at all planned stages of its life cycle.

■ RESULTS AND DISCUSSION

Much attention was paid to the issue of the project life cycle in the works of Ukrainian and foreign scientists (Kotler, 1984; Chorna & Glukhova, 2012; Fedorovych, 2012). Summarising different approaches, it is possible to distinguish the stages of market entry, growth/improvement, maturity, slowdown, decline and exit from the market. However, the authors consider it expedient to additionally consider the life cycle stages of the innovation stage of the project, since the enterprise may try to introduce innovations to ensure its development and maintain competitive position. In their works, some scientists involved in life cycle research of innovative projects (Ilyashenko, 2008; Kyzim & Ivanov, 2007) additionally distinguish basic research, applied research, development work and market launch. Summarising these approaches, the authors propose to distinguish the following 10 stages within the framework of the research: basic research, applied research, R&D work, implementation, market entry, growth/improvement, maturity, slowdown, decline, and exit from the market (Vereshchahina & Pliekhanova, 2020). This does not mean that every project will go through all the stages, since it depends on its features and goals, but such a division makes it possible to fully consider the existing stages of life cycle of projects, including innovative ones.

Ukrainian and foreign scientists pay a lot of attention to the study of risk factors of the enterprise internal and external environment. In addition, many scientists distinguish microenvironmental risk factors (risk factors of direct influence) and macroenvironmental factors (risk factors of indirect influence) within the external environment of the enterprise (Kovbatyuk & Benyk, 2016; Porter, 2020). On the basis of the analysis of approaches to identifying enterprise risk factors, the authors selected for further analysis

factors of the macroenvironment (socio-cultural, scientific and technological, demographic, economic, political and legal, international, ecological, natural and geographical), microenvironment (clients, competitors, suppliers, intermediaries, contact audiences) and the internal environment (marketing, production, information, innovation, financial, time, labour, technological, spatial, management) of the enterprise (Pliekhanova, 2017a; Pliekhanova, 2017b). These risk factors (or the most significant for each analysed project, depending on the industry and set goals) can be used in the future when conducting an expert assessment using the method of hierarchy analysis to obtain appropriate mathematical models.

The risk factors of the macroenvironment have the greatest uncertainty due to the impossibility for the enterprise to influence them directly. The following model is proposed for risk assessment of the enterprise macroenvironment:

$$R_{1s} = H_{1s} \times V_{1s} + H_{2s} \times V_{2s} + H_{3s} \times V_{3s} + H_{4s} \times V_{4s} + \\ + H_{5s} \times V_{5s} + H_{6s} \times V_{6s} + H_{7s} \times V_{7s} + H_{8s} \times V_{8s}, \qquad (9)$$

where V_{1s} are socio-cultural risk factors; V_{2s} are scientific and technological risk factors; V_{3s} are demographic risk factors; V_{4s} are economic risk factors; V_{5s} are political and legal risk factors; V_{6s} are international risk factors; V_{7s} are environmental risk factors; V_{8s} are natural and geographical risk factors; $H_{1s}, H_{2s}, H_{3s}, H_{4s}, H_{5s}, H_{6s}, H_{7s}, H_{8s}$ are weights of the risk factor of the macro- environment of the enterprise, obtained on the basis of hierarchy analysis; s is the stage of project life cycle.

The following model is proposed for risk assessment of the enterprise microenvironment:

$$R_{2s} = G_{1s} \times Y_{1s} + G_{2s} \times Y_{2s} + G_{3s} \times Y_{3s} + G_{4s} \times Y_{4s} + G_{5s} \times Y_{5s}, \qquad (10)$$

where Y_{1s} are risk factors of customers; Y_{2s} are risk factors of competitors; Y_{3s} are risk factors of suppliers; Y_{4s} are risk factors of intermediaries; Y_{5s} are risk factors of contact audiences; $G_{1s}, G_{2s}, G_{3s}, G_{4s}, G_{5s}$ are weights of the risk factor of the macroenvironment of the enterprise, obtained on the basis of hierarchy analysis; s is the stage of project life cycle.

The following model is proposed for risk assessment of the enterprise internal environment:

$$R_{3s} = O_{1s} \times Z_{1s} + O_{2s} \times Z_{2s} + O_{3s} \times Z_{3s} + O_{4s} \times Z_{4s} + O_{5s} \times Z_{5s} + O_{6s} \times \\ \times Z_{6s} + O_{=7s} \times Z_{7s} + O_{8s} \times Z_{8s} + O_{9s} \times Z_{9s} + O_{10s} \times Z_{10s}, \qquad (11)$$

where Z_{1s} are marketing risk factors; Z_{2s} are production risk factors; Z_{3s} are informational risk factors; Z_{4s} are innovative risk factors; Z_{5s} are financial risk factors; Z_{6s} are time risk factors; Z_{7s} are labour risk factors; Z_{8s} are technological risk factors; Z_{9s} are spatial risk factors; Z_{10s} are management risk factors; $O_{1s}, O_{2s}, O_{3s}, O_{4s}, O_{5s}, O_{6s}, O_{7s}, O_{8s}, O_{9s}, O_{10s}$ are weights of the risk factor of the enterprise macroenvironment, obtained on the basis of hierarchy analysis; s is the stage of project life cycle.

In order to obtain substantiated results, it is necessary to determine the minimum number of experts who should be involved in the research with the corresponding error of results. For this, it is advisable to use formula 9 (Geets, 2005):

$$n_{min} = 0{,}5 \times \left(\frac{3}{E} + 5\right),$$ (12)

where E is the selected average error when including (excluding) an expert from the survey process.

It was determined that to ensure the validity of the results with an error of 5%, the minimum number of experts with agreed answers is 33 people. The study received agreed answers from 34-42 experts, depending on the stage of the project life cycle. An example of calculations is presented based on the results of a survey of one of the experts regarding the stage of fundamental research. The results of making a matrix of pairwise comparisons for risk groups are presented in Table 1.

The next step is matrix normalisation, the results of which are presented in Table 2.

Table 1. Comparison of groups of risk factors at the stage of fundamental research by an expert

	Macroenvironment	Microenvironment	Internal environment
Macroenvironment	1	4	0.2
Microenvironment	0.25	1	0.125
Internal environment	5	8	1

Source: made by the author

Table 2. Standardised data of groups of risk factors at the stage of fundamental research of one of the experts

	Macro-environment	Micro-environment	Internal environment	Average	Consistency measure
Macroenvironment	0.160	0.308	0.151	0.206	3.068
Microenvironment	0.040	0.077	0.094	0.070	3.016
Internal environment	0.800	0.615	0.755	0.724	3.204
$CI = 0.048$					
$RI = 0.580$					
$CR = 0.083$					

Source: made by the author

According to the results of the calculations, the consistency index is 0.048. The calculated consistency ratio is 0.083, which is less than the normative value of 0.10. From the obtained calculations, it can be concluded that the expert is consistent in their answers and there are no contradictions when filling out the table of pairwise comparisons.

According to the results of the calculations given in Table 2, it can be concluded that at the stage of fundamental research, according to one of the experts, the risk factors of the enterprise internal environment play the most important role.

Thus, the mathematical model of the overall risk assessment of the enterprise activity based on the results of the survey of one of the experts can be presented in the following form:

$$R = 0.206 \times R_{11} + 0.070 \times R_{21} + 0.724 \times R_{31}.$$ (13)

One of the experts proposes to calculate the influence of factors of macroenvironment, microenvironment and internal environment of the enterprise at the stage of fundamental research using a similar sequence of actions.

Thus, a mathematical model based on the results of the survey of one of the experts at the stage of fundamental research can be presented in the following form:

- the risk of the macroenvironment of the enterprise:

$$R_{11} = 0.023 \times V_{11} + 0.325 \times V_{21} + 0.033 \times V_{31} + \\ + 0.226 \times V_{41} + 0.160 \times V_{51} + 0.073 \times V_{61} + \\ + 0.049 \times V_{71} + 0.111 \times V_{81}$$ (14)

- the risk of the microenvironment of the enterprise:

$$R_{21} = 0.281 \times Y_{11} + 0.433 \times Y_{21} + 0.110 \times Y_{31} + \\ + 0.066 \times Y_{41} + 0.110 \times Y_{51}$$ (15)

- the risk of the internal environment of the enterprise:

$$R_{31} = 0.064 \times Z_{11} + 0.113 \times Z_{21} + 0.041 \times Z_{31} + \\ + 0.135 \times Z_{41} + 0.064 \times Z_{51} + 0.044 \times Z_{61} + 0.293 \times Z_{71} + \\ + 0.203 \times Z_{81} + 0.025 \times Z_{91} + 0.018 \times Z_{101}.$$ (16)

Thus, according to one of the experts, scientific and technological risk factors, economic risk factors, and political and legal risk factors can be identified as the most influential factors of the macroenvironment at the stage of fundamental research; risk factors of competitors and customers can be identified as the most influential factors of the microenvironment; labour, technological, innovation and production risk factors can be identified as the most influential factors of the internal environment.

The mathematical model of the overall risk assessment of the enterprise (taking into account all factors of influence) based on the results of the survey of one of the experts can be presented in the following form:

$$R = 0.004 \times V_{11} + 0.067 \times V_{21} + 0.007 \times V_{31} + 0.047 \times V_{41} + \\ + 0.033 \times V_{51} + 0.015 \times V_{61} + 0.010 \times V_{71} + 0.023 \times V_{81} + \\ + 0.020 \times Y_{11} + 0.030 \times Y_{21} + 0.008 \times Y_{31} + 0.004 \times Y_{41} + \\ + 0.008 \times Y_{51} + 0.046 \times Z_{11} + 0.082 \times Z_{21} + 0.030 \times Z_{31} + \\ + 0.098 \times Z_{41} + 0.046 \times Z_{51} + 0.032 \times Z_{61} + 0.212 \times Z_{71} + \\ + 0.147 \times Z_{81} + 0.018 \times Z_{91} + 0.013 \times Z_{101}.$$ (17)

According to the results of the mathematical model of general risk, built on the basis of the answers of the 1st expert at the stage of fundamental research, it is possible to distinguish labour, technological, production and scientific and technological risk factors.

After all calculations have been carried out at each stage of the project life cycle, it is necessary to check the consistency of expert opinions using the concordance co-efficient. The concordance coefficient of the research is in the range of 70.91%-85.38%, depending on the group of factors for which this indicator was calculated, as well as the corresponding stage of the project life cycle. The obtained calculations indicate a significant consistency of expert opinions and the possibility of using the obtained results for further generalisation.

The results of the survey can be presented in Table 3.

Table 3. Key risk factors at the stages of project life cycle

Project life cycle stage	Key risk factors
Fundamental research stage	labour, technological, production, innovation and economic risk-generating factors
Applied research stage	customer-related risk factors, as well as technological and labour risk factors
Research and development stage	risk factors related to customers, competitors and contact audiences, as well as labour and technological risk-generating factors
Implementation stage	risk factors related to customers, competitors and contact audiences, as well as marketing and managerial risk-generating factors
The initial stage of market entry	risk factors related to customers, competitors and contact audiences, as well as marketing and managerial risk-generating factors
Growth/improvement stage	risk factors related to customers, as well as scientific and technological and socio-cultural risk-generating factors
Maturity stage	socio-cultural, economic and international risk factors
Slowdown stage	risk factors related to customers, competitors and contact audiences, as well as marketing and innovation risk factors
Decline stage	risk factors related to customers, competitors, as well as marketing and managerial risk factors
Exit from market stage	financial, managerial, production and labour risk factors

Source: made by the author

A large number of methods are used for risk assessment, which V. Lukyanova & T. Golovach (2007) combined into 4 groups: expert methods, economic and statistical methods, calculation and analytical methods, and analogue methods. Each of these groups has its advantages and disadvantages. The use of economic and statistical and calculation and analytical methods requires a significant amount of statistical information, but there is often a lack of relevant information for a detailed study of not only the risk measure, but also the assessment of each of its components. For analogue methods, it is necessary to have examples of the implementation of relevant projects, but this information is not always freely available if the enterprise failed to implement the project. On the other hand, if the relevant information is available, the presented methods are quite easy to use. Expert methods are most widely used in the absence of sufficient statistical and analytical information, but they are mostly subjective in nature. That is why the methodological approach proposed by the authors using the method of hierarchy analysis makes it possible to increase the objectivity of the results obtained and use it in conditions of limited information.

Many scientists propose different approaches to risk assessment in different areas of business, because in the conditions of rapid changes and the lack of sufficient statistical information, it is increasingly difficult to use standard approaches to risk assessment. In their article, B. Bakhtawar *et al*. (2022) consider the possibility of using the Monte Carlo modelling method for public-private partnership projects using financial, social and environmental sustainability indicators to ensure risk management in conditions of sustainable development. In their article, Yu. Kolyada *et al*.

(2020) consider the possibility of using the system of Volterra-Lotka equations to quantify the risk behaviour of the decision-making subject. T. Bielialov (2022), in his article, investigates the risk management system of innovative products, and also identifies the sequence of actions for making managerial decisions while implementing the strategy of promoting innovative products. These works also consider the possibility of risk assessment in conditions of insufficient information, however, the approach proposed by the authors makes it possible to consider in more detail the constituent factors of risk at each stage of the project life cycle.

In their work, I. Berezyuk-Rybak & N. Ilchenko (2019) proposed to use NPV and IRR indicators to evaluate the effectiveness of innovative projects, and consider the risk from the standpoint of deviation of actual data from the calculated ones. However, it is advisable to use this approach with available information on the implementation of previous projects, as well as the ability to estimate the total costs of the entire project, which is quite difficult to accurately estimate, taking into account the uncertainty of the economic conditions of the enterprise and the project implementation. In the proposed project risk assessment model, O. Halytskyi *et al*. (2021) also use the NPV indicator, but vector algebra and fuzzy logic methods are additionally used to estimate the probability of each selected risk indicator. However, this approach does not provide an opportunity to analyse the impact of various risk factors depending on the peculiarities of the project. The NPV indicator is also used in the article by O. Tsesliv & A. Kolomiiets (2020) as the basis of the proposed methodology, which presents fuzzy indicators in the form of a triangular membership function for profit. This methodology makes it possible to

evaluate the project step by step and terminate its implementation if the efficiency criterion falls below the established limit norms, but the result is closely related to the definition of indicators of possible profit, which is quite difficult to assess in conditions of incomplete certainty.

In their article, I. Babii *et al*. (2022) proposed the use of an expert method with a point score to assess risk groups related to the external environment, marketing activity, use of financial resources, strategic development and competencies of enterprise specialists. This approach makes it possible to determine the risks with the greatest impact, however, unlike the approach proposed by the previous authors, it does not provide an opportunity to check the correctness and consistency of the expert assessments, but only the degree of consistency in opinions of experts with each other.

■ CONCLUSIONS

Within the framework of the research, a methodological approach has been proposed to identify internal and external risk factors that most affect projects of the analysed enterprise. The list of risk factors of the macro- and microenvironment, and internal environment of the enterprise is summarised, which will allow further use of the proposed methodological approach with the possibility of studying exactly those risk factors that correspond to the specifics of enterprise activity or the field of its operation. An extended list of the stages of the project life cycle is given (so that it could be used for innovative projects as for the most promising), and besides, the project can start and end its life cycle at any stage, depending on the specifics of the project and the set goals. Identifying the riskiness of each stage will give an opportunity to consider the chances of reducing risks of these stages by inviting relevant experts or outsourcing some work (in the absence of the necessary personnel qualifications or capacities / capabilities of equipment). The process of building a mathematical model of general risk assessment based on the example of the expert answers at the stage of fundamental research is considered in detail. The possibility of assessing the consistency of expert answers to identify their sequence and the possibility of using them in the further construction of mathematical models, as well as the calculation of the concordance coefficient for assessing the consistency of expert answers are considered. The proposed sequence of actions will make it possible to build a mathematical model at any stage and for any group of risk factors, depending on the enterprise goals. In further studies, it is planned to consider the possibility of applying the specified methodological approach to calculate the overall project risk in order to compare projects with each other and to make the most effective use of the enterprise available resources in the strategic planning of its development, as well as to use this approach to calculate the risk factors at different stages of the project life cycle in various fields of enterprise operation in order to increase the accuracy of the obtained mathematical models.

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■ CONFLICT OF INTEREST
The authors declare no conflict of interest.

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Тетяна Валеріївна Шталь

Доктор економічних наук, професор
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0003-1256-9854

Тетяна Євгенівна Плєханова

Кандидат економічних наук
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0002-2054-4545

Кирило Олександрович Кравець

Аспірант
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0002-3470-1919

Наталія Сергіївна Огієнко

Магістр
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0009-0007-0179-5932

Визначення факторів ризику зовнішнього і внутрішнього середовища підприємства при реалізації проєктів

■ **Анотація.** Значна частка нових підприємств різних форм власності та у різних сферах господарювання припиняє своє існування протягом перших п'яти років. Така тенденція до закриття підприємств свідчить про необхідність стратегічного планування розвитку підприємства та імплементації процесу виявлення факторів ризику, їх оцінювання та управління ними в процесі стратегічного управління розвитком підприємства. Мета дослідження полягала в розробці методичного підходу, що дозволить виявити фактори ризику, які можуть мати найбільший вплив, на кожному з етапів життєвого циклу аналізованого проєкту. Для досягнення поставленої в рамках дослідження мети було використано структурно-логічний аналіз, методи систематизації, узагальнення, наукової абстракції та аналізу ієрархій. У статті було запропоновано методичний підхід до визначення факторів ризику зовнішнього та внутрішнього середовища підприємства, що дає змогу виявити фактори ризику, які мають найбільший вплив, на кожному етапі життєвого циклу проєкту. Отримано математичні моделі, які дають змогу виділити саме ті фактори ризику, які можуть мати найбільш негативний вплив (як по частоті виникнення, так і по величині можливих збитків), що дасть змогу підприємству підвищити ефективність управління саме цими ризиками впродовж усіх етапів реалізації відповідного проєкту. Було оцінено вплив факторів ризику в умовах неповної визначеності та відсутності необхідної кількості статистичної інформації. Практичне значення отриманих результатів полягає у можливості підвищення ефективності використання наявних ресурсів в процесі управління ризиками. Запропонований методичний підхід може бути використаний для оцінювання впливу ризиків проєктів певної галузі, що підвищить точність отриманих результатів

■ **Ключові слова:** життєвий цикл; метод експертних оцінок; метод аналізу ієрархій; математична модель; коефіцієнт конкордації

Ivanna Pererva[*]

PhD in Economics, Associate Professor
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0002-8119-7022

Olga Myronova

PhD in Economics, Associate Professor
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0002-3188-2881

Use of creative marketing in the implementation of enterprise strategy

■ **Abstract.** The relevance of the research problem is determined by the need to increase the competitiveness of enterprises in the conditions of increased competition in the global market. The purpose of the article was to conduct a theoretical analysis and develop methodological support for the search for effective marketing tools during the implementation of a creative marketing strategy. To achieve the goal, the following methods were used: logical generalisation; comparative analysis; statistical analysis; analytic hierarchy process; expert survey method; graphical and tabular method. As a result of the study, the following results were obtained: the essence of the concept of "creativity" is determined and the importance of using creative marketing tools during the implementation of the company's strategy is substantiated; it has been proven that when choosing strategic directions, it is necessary to develop and implement a creative marketing mix model; it is substantiated that for the application of creative marketing, the personnel of the enterprise must be of a creative type; it was determined that during the development of a creative marketing strategy in the conditions of global digitalisation, an important stage is the choice of social networks; it has been proven that in conditions of the consequences of the COVID-19 pandemic and military aggression in Ukraine, the most significant creative marketing tool is Internet marketing; it has been proven that among creative Internet marketing tools, the most effective are Social Media Marketing, Search engine optimisation, Event marketing and contextual advertising. The practical significance of the obtained results lies in the formation of practical recommendations for the selection of effective creative marketing tools during the development and implementation of the company's strategy aimed at increasing its competitive advantages. Formulated conclusions and recommendations can be used by the management of modern enterprises that are looking for ways to increase competitiveness through the implementation of a creative marketing strategy

■ **Keywords:** creative approach; strategic directions; set of promotion measures; competitive advantages; promotion tools; Internet promotion

■ INTRODUCTION

In today's fast-changing conditions, in conditions of globalisation, there are a large number of competitors in all spheres of economic activity on the market. Therefore, the search for new ways of ensuring competitiveness and obtaining significant competitive advantages is becoming urgent for an increasing number of enterprises. It is in the conditions of global market relations that the leading place is occupied by marketing activities, which are carried

*Corresponding author

out in all spheres of the economy and are aimed at creating goods and services for consumers. For a long time, the concept of marketing has changed – from marketing aimed at production, product to social marketing. Currently, the literature describes a large number of possible marketing tools, which can be quite effective when used successfully. However, it is the focus on the end consumer, which became the basis for building effective business processes in companies, that forces them to implement the principle of customer orientation in their activities, which causes the need to search for new marketing tools and approaches.

One of the areas of improvement of the enterprise's marketing activity is the introduction of information technologies. In recent years, "digital" marketing principles have been successfully used by foreign and domestic companies. But the introduction of digital marketing tools also does not fully satisfy the needs of the modern market. Therefore, companies are looking for other areas of development of their marketing activities.

Creative marketing technologies should be highlighted among new marketing approaches. K. Mazerant *et al.* (2021), investigating creative biases and their influence on consumer response, note that creative dimensions (characteristics) of information are of primary importance for obtaining a better understanding of the patterns and mechanisms operating in the "creative space". In his work, N.M. Hurzhij (2011) claims that a feature of the creative marketing approach is that the managers and marketers of the enterprise need to "make the decision shock", evoke emotions, and not just formulate the right decisions. The key task of modern management is to increase the competitiveness of the product in comparison with others. The modern consumer is very "oversaturated" with a variety of goods and services, he often does not understand what he wants, he needs something non-standard, not as it was before, interesting, creative. Therefore, creative marketing is exactly the approach that will satisfy the most demanding consumers. I. Saukh & O. Vikarchuk (2021), studying the role of management as a driving force in ensuring the competitive position of developing countries, pay special attention to the place of creativity in management and the features of creative management and emphasise that "creative management" is a component of the system enterprise management. O.I. Pushkar & Yu.L. Tataryntseva (2018) discussed the implementation and use of a creative approach in marketing, which will allow effective management of marketing activities by establishing an emotional connection with the client and forming positive impressions. N. Zadorozhniuk (2018) claims that creativity in thinking is important not only for the work process, but also has a direct impact on motivation.

R.T. Rust *et al.* (2004) established that the development of new creative directions and approaches pushes enterprises to focus more attention on the strategic level of management, and not only on the tactical level. The implementation of a creative approach to marketing activity requires a review of all elements of the strategy – mission, goals, values, tools, etc. All of them should be based on the principle of "creativity" and be significantly different from the existing ones. The main feature of creative marketing is an emphasis on the assessment of hidden demand and its transformation into a real one by creating new effective goods and services that will be attractive and attractive to the population, investors and the state, taking into account their value for the consumer and market needs. Therefore, it is expedient for the management of modern companies to understand what creative marketing technologies are, how to develop them and implement them in the company's activities.

Based on the above, the purpose of the research was theoretical substantiation and practical recommendations regarding the choice of creative marketing tools when developing a creative marketing strategy. To achieve the goal, the following scientific and applied tasks were set and solved: to investigate the essence of creative marketing and determine its role in business strategy; to investigate the relationship between creative marketing tools and the company's competitive advantages; formulate the main strategic directions and develop an innovative algorithm for choosing tools for marketing activities based on a creative approach.

◼ LITERATURE REVIEW

The concept of creativity in modern management is found in many aspects (Saukh & Vikarchuk, 2021). Today, there is even such a field of activity as creative industries. The M.O. Proskurina (2015) explores the concept of creative industries and analyses the potential of creative industries in Ukraine. In addition, the M.O. Proskurina (2015) pays special attention to the culture and art sector as a special environment for entrepreneurial activities and the influence of the state on their development. She notes that creative industries are a full-fledged sphere of modern economic activity. K. Mazerant *et al.* (2021) in their scientific work also note that in order to obtain an effective response from consumers, especially in the conditions of the development of the use of social networks, it is necessary to introduce a creative approach.

As it was mentioned earlier, effective marketing activity is the key to high competitiveness of the company (Rust *et al.*, 2004) and requires a creative approach. An organisation's need for creative marketing is driven by its ability to communicate with its customers and satisfy their needs through its current products or by developing new products that are constantly improved to meet changing customer tastes.

The creative component in the marketing of various companies was studied by such scientists as S.H. Ang *et al.* (2004), N.V. Bezrukova & V.O. Gunchenko (2015) and O.I. Pushkar & Yu.L. Tataryntseva (2018). O.I. Klipkova (2015) argues that creative marketing is the most visible tool used to achieve success in the production and marketing of high-quality goods and to facilitate the creation of new opportunities and markets.

The problems of introducing creative marketing into the activities of enterprises, as mentioned earlier, are occupied by various scientists, in particular, the place of creative marketing in the strategic marketing system is considered in the work of N.M. Hurzhij (2011). This author also investigated the peculiarities of the creative approach to the formation of the company's marketing strategy. The positive relationship between the creativity of the marketing strategy and the effectiveness of the implementation of the organisation's strategy was proven by researchers in (Azimpour *et al.*, 2015).

A significant number of scientific works are devoted to the issue of development and implementation of creative marketing strategies that are adapted to client-oriented enterprises in various spheres of economic activity. D. Dabrowski *et al*. (2019) proved that creativity and novelty in marketing strategies directly affects the effectiveness of the organisation. The role of creative strategies is considered in the literature in many aspects. Most often, the principle of creativity is considered in the context of advertising. S.H. Ang *et al*. (2004) substantiated the special importance of using the principle of creativity during the development and implementation of an advertising strategy. Research (Ngai *et al*., 2015) addresses the role of creativity when using social media as a tool to influence the customer. Today, the special role of using digital tools in marketing activities is also emphasised (Papetti *et al*., 2018), which allow to increase the level of creativity and innovation in it.

Taking into account the fact that these studies are more concerned with the role of creative marketing and the essence of marketing strategy separately, as well as the introduction of the principle of creativity in various aspects of marketing activity, it is advisable to pay more attention to their combination when developing a creative marketing strategy. The research attempts to determine the role of creative marketing in achieving competitive advantages of the company, since constant creation protects the company from risky competition.

■ MATERIALS AND METHODS

Using the method of logical generalisation, the concepts of "creative" and "creativity" were formulated, and the differences between creativity and creative work were justified. In order to determine the essence of the concept of "creative marketing", the author's approaches to the description of marketing as a whole and its creative component were considered and analysed. Similarities and differences are determined and the essence of creative marketing as a tool for achieving competitive advantages of the enterprise is substantiated.

For the study of strategic directions and tools of marketing activity, the method of comparative analysis was used, with the help of which a comparison of existing sources on the topic was carried out, which made it possible to form a set of methods, tools and possible areas of use for different directions of strategic marketing activity, taking into account creative orientation. Also, the use of this method made it possible to characterise personnel that can be effectively used in the framework of strategic creative marketing, to formulate the main advantages and disadvantages of creative type employees during marketing activities. With the help of the modelling method, models of the relationship between classic marketing tools – elements of the marketing mix, but using the principle of creativity, and the improvement of the competitive advantages of the organisation were built.

For the selection of tools of marketing activity in the context of Internet marketing, the method of analysis of hierarchies was used, which made it possible to build a decomposition for the selection of alternative options for using marketing tools. The analysis made it possible to identify such alternatives as SMM (Social media marketing),

SEO (Search engine optimisation), contextual advertising, SMS (Short Message Service) marketing, E-mail marketing, blogging and event marketing. The following criteria were selected for decision-making: consumer loyalty, return on investment, costs, breadth of audience coverage, and the level of creativity of the tool. The proposed criteria were identified using a theoretical analysis of literary sources. The evaluation of alternatives of marketing tools according to the relevant criteria was carried out using the basic method of pairwise comparisons.

Experts were involved to determine the criteria for evaluating alternatives and to evaluate alternative options for marketing tools. Since group methods are characterised by greater accuracy of the obtained results, the group work of experts based on absentee surveys was used during the study. The survey of experts was conducted by the authors of the study in the city of Kharkiv (Ukraine) in October 2022 using means of communication, taking into account the security situation in the country. During the survey, ethical norms were observed when working with people (American Psychological ..., 2017). Representatives of the expert group hold various positions and qualifications, which have creative work. Since the management sector develops strategies for the enterprise, representatives of management positions are also included in the expert group. Thus, a sample of experts was formed in the number of 5 people:

E 1 – a marketer, brand and SMM strategist;
E 2 – a marketer of social networks;
E 3 – an Internet marketer;
E 4 – a specialist in marketing and advertising;
E 5 – a brand marketer.

The calculation of priority vectors for criteria and alternatives involves filling in the matrices of pairwise comparisons, calculating the components of the eigenvector of the matrices, the normalised vector of the matrices, the consistency index and the consistency coefficient according to the formulas (Tavana *et al*., 2021):

$$W_i = (a_{i1} \times a_{i2} \times a_{i3} \dots a_{in})^{(1/n)} \quad (1)$$

$$W_n = \frac{W_i}{\sum_{i=1}^{n} W_i} \quad (2)$$

$$\lambda_{\max} = \sum_{j=1}^{n} a_{ij} \times W_{nj} \; \lambda_{\max} = \sum_{i=1}^{n}\left(\sum_{i=1}^{n} E_{ij} \times W_i\right) \quad (3)$$

$$CI = \frac{(\lambda_{\max} - n)}{n-1} \leq 0.2 \quad (4)$$

$$CR = {CI}/{RC}, \quad (5)$$

where W – the component of the eigenvector of the matrix; W_n – the normalised vector of the matrix of pairwise comparisons; $\lambda_{\max}$ – the maximum eigenvalue of the matrix; CI – consistency index; RC – the average value of the consistency indicator; CR – the consistency coefficient.

The method of analysing hierarchies allows you to compare inconsistent data with consistent data. If the value of the consistency index is less than 0.2, and the relative consistency (inconsistency) value does not exceed 0.1, it indicates the consistency of expert opinions. Otherwise, experts should revise their assessments.

The results of the expert evaluation are considered significant and suitable for further research in case of consensus of experts' opinions. Therefore, the calculation of the

concordance coefficient was used, which is the most common method for assessing the agreement of the opinions of a group of experts.

Since the evaluations of alternative marketing tools are repeated, there are standardised ranks, formulas (6)-(8) were used to calculate the concordance coefficient (Hrabovetskyj, 2010).

$$W = \frac{12 \sum_{j=1}^{m} d_j^2}{n^2(m^2 - m)} \qquad (6)$$

$$d_j = S_j - \frac{\sum_{j=1}^{m} S_j}{m} \qquad (7)$$

$$S_j = \sum_{i=1}^{n} R_{ij} \qquad (8)$$

where W – the concordance coefficient; n – number of experts; m – the number of criteria; d_j – deviation of the sum of ranks according to the -th criterion from the average sum of ranks according to the sample; S_j – sum of ranks according to the -th criterion; R_{ij} – the rank matrix.

Using the algorithm of calculations based on the method of analysis of hierarchies, indicators of average integrated advantages for various marketing tools were calculated, and also the global priority of alternatives was calculated, which allowed to make a final decision on the choice of tools during the development of the implementation of a creative marketing strategy.

Graphical and tabular data presentation methods were used to visualise the research results.

■ RESULTS AND DISCUSSION
Relationship between creativity and marketing activity

The process of development and transformation of the economy is happening so fast that marketing concepts, strategies, tools and approaches that showed good results when used a few years ago become ineffective in the modern economy (Petrova & Loiko, 2022). Today, there are several advanced strategic directions of marketing activities of Ukrainian enterprises, namely: neuromarketing, event marketing, emotional marketing, content marketing, Internet marketing (Petrova & Loiko, 2022). As we can see, companies actively use a creative component in their marketing policy, which would lead to success in sales of their products and services. Thus, marketing is an integral tool driving the innovative development of the economy. According to the results of the practice of applying marketing tools in the economy in recent decades, the importance of the presence in all spheres of marketing of methods and tools, which are also based on a creative component, is rapidly increasing (Mazerant *et al.*, 2021).

Creativity is one of the essential components of production. Creative work is an imaginative process, and imagination is often more important than knowledge (Papetti *et al.*, 2018).

Usually, creativity is associated with innovative, creative activity, which manifests itself through the creative abilities of a person to generate fundamentally new ideas. Creativity is both a component of talent and at the same time an independent element.

The essence of the concept of "creativity" is at the centre of scientific discussions of foreign and domestic scientists. J.P. Guilford (1950) argued that creativity includes risk-taking, intuition, the ability to quickly react

and switch between objects, quickly find solutions for multifaceted tasks, both economic and social.

A.H. Maslow (1954) considered creativity as a creative component that is inherent in everyone from birth, but is lost under the influence of the system of upbringing, education and social practice. According to C.W. Taylor (1988), creativity combines a set of abilities, each of which manifests itself to a different extent during the solving of tasks. J.S. Renzulli (1977) interprets creativity as a feature of behaviour that manifests itself in unique ways of obtaining a product. At the same time, S.A. Mednick (1962) interprets creativity as the process of reproducing elements in new combinations, which provides the purchasing needs and desires of consumers.

The difference between creative work and creativity is that creativity aims to bring an idea to a specific end result, while creative work is the process of creating something. The field of marks marketing is considered as sales growth, brand recognition and the formation of new markets (Khrupovych & Ivanechko, 2020). In this regard, creativity should be considered an important component of marketing activity, without which it is impossible to do. The connection between creative marketing strategies and business performance is intuitive and compelling.

In order to generate more profits, organisations must identify creative marketing strategies and be able to implement them effectively. Due to competition for resources, an uncertain environment and cultural tensions, it is often difficult to achieve both goals (Slater *et al.*, 2010; Ishaq, 2013).

Creativity should be understood as the ability to be creative, in the form of the desire and ability to create fundamentally new unconventional ideas and solve problems using non-standard approaches.

As for the essence of the concept of "creative marketing", it is appropriate to consider it as a non-standard approach to marketing solutions, which is based on the generation of new, extraordinary and effective creative ideas that lead to the implementation of marketing complex solutions (Pushkar & Tataryntseva, 2018). Creative marketing is aimed at a significant change of the product, the use of advanced methods of promotion and sales, the formation of effective pricing, the use of leading marketing research methods, the development of a creative marketing strategy, product repositioning, consolidation of the company's brand, etc.

According to the scientific views of S. Khrupovych & N. Ivanechko (2020), creative marketing is an effective marketing tool that contributes to increasing business efficiency through the implementation of non-standard solutions generated on the basis of creative ideas. However, this tool requires the use of new non-standard methods and management principles. The basic tools of creative marketing are considered to be a sharp reduction in prices, intensification of advertising and other methods of rapid promotion of the product (Bezrukova & Gunchenko, 2015).

The lack of creative marketing in the elements of the marketing mix (7Ps) or focusing on one of these elements can lead to the neglect of other elements, which negatively affects the competitive advantages and opportunities of the organisation. Creative marketing is a permanent competitive advantage of any organisation that has strategic value and is a flexible resource (Al-zoubi, 2017). Creative

marketing can be considered a valuable, unique resource for any organisation. The relationship between the creative component of the marketing mix and competitive advantages and opportunities is depicted in Figure 1.

Creative Marketing 7P	Competitive advantages
Price Product Place Promotion People Process Physical evidence	Brand recognition Increasing profitability Sales growth Expansion of the client base Expansion of the supplier base Reducing the threat of substitute products Reducing the threat of competitors Productivity growth Product differentiation Cost reduction

Figure 1. Model of the relationship between the creative 7Ps marketing mix
and competitive advantages and opportunities
Source: developed by the authors based on A.F. Al-zoubi (2017)

Creative marketing improves operations that affect customers through elements of the marketing mix. Creativity in the marketing mix, as in any field, is the creation and implementation of new, non-standard marketing tools in order to cause the desired reaction from the target market and at the same time introduce new unfamiliar methods and ideas to the elements of the marketing mix (product, price, promotion and placement).

Pricing is considered to be the most challenging task for managers in any organisation because it depends on a number of factors that are constantly changing and beyond the organisation's control. Based on pricing methods based on demand, cost, competition and product formation (Khrupovych & Ivanechko, 2020), it is advisable to apply creative pricing.

Creative product (Product) means the generation of new ideas to present a new product or to constantly improve the characteristics of a given product in order to meet new needs and expectations of customers and bring them to life. Creative products are new products that have pronounced functional features. Product creativity involves making significant changes to product design, adding new value that attracts more customers. Product creativity includes changes in product characteristics that make them more special and unique.

Creativity in sales (distribution – Place) is based on the introduction of new methods and methods in the distribution of products. The process of bringing a product to market goes through a series of distribution channels before it is delivered to customers. The role of the organisation is to create new sales channels instead of the usual ones.

Creativity in the promotion of the product to the market (Promotion) is to convey the message of the brand and make the target audience believe in the idea. Since the brand lives in the customer's imagination, advertising creative works with human vision: associations, desires, feelings, etc. Advertising creativity penetrates our consciousness, forcing us to dream, rejoice, be ashamed, deceive ourselves, believe. At the same time, creativity in advertising is aimed not only at brand promotion, but also has social significance.

The implementation of strategy and decisions at various levels depends to a greater extent on the personnel of the enterprise. That is why creative personnel (People) are labour resources that generate new solutions, are sensitive to new ideas, have internal incentives for creative work and are oriented towards the performance of functions and the achievement of goals for the long-term development of the organisation (Kharun, 2017).

In order to maintain the creativity of the staff, a favourable environment is formed at the enterprise, thanks to which the necessary conditions are provided. The goal of creating a favourable creative environment is to support talent and promote the development of employees' potential. A creative environment develops the current intellectual potential, supports the need for self-development and self-improvement, aims at the acquisition and application of creative ideas, skills and abilities (Dragan & Rudova, 2021).

The term creative process (Process) means the process of interaction between the consumer and the company, as it is the basis for buying on the market and forming customer loyalty to the brand.

Physical evidence of the process of service provision (Physical evidence) describes what surrounds the consumer at the time of ordering the service. The environment shapes the image of the company, and at the same time, the ability to approach creatively and highlight the special characteristics of the product allows you to maintain a competitive position on the market.

The "7Ps" marketing complex, which includes "product", "place", "price", "promotion", "people", "process", "physical evidence", requires a combination of creative marketing policy and rational solutions that will realise the goals enterprises and take into account the needs, requests and wishes of customers, that is why the usual marketing activities in terms of 7Ps must be supplemented with specific creative methods.

Creativity in marketing activities is manifested in various areas of marketing, namely during the development of non-standard methods of researching the markets of goods and services, creating and introducing products to the market, pricing, improving sales policy processes, promoting products to the market and managing the marketing of the enterprise in general. Often it is the lack of a creative marketing approach that is the cause of inefficient implementation of management decisions. Marketing as one of

the subsystems of enterprise management is focused on ensuring the implementation of marketing goals by using marketing mix strategies (Khrupovych & Ivanechko, 2020).

Creative marketing aims to change marketing communications. When using creative marketing, its creative component must fully correspond to the strategy of the enterprise's marketing activities in general. Improper use of creative can lead to the loss of not only money, but also harm the brand awareness and worsen the competitive position. The company's strategy should be formed not only on the entrepreneurship of the management, but also on the entire team. In this regard, it is necessary to pay special attention to the use of potential opportunities (especially creative abilities) of all personnel. That is why management should reveal and develop creativity in employees who occupy management positions, and thereby form and consolidate a creative type of thinking in all employees. The specifics of work using creative methods and approaches allow us to highlight the advantages and disadvantages of creative type employees (Table 1).

Table 1. Advantages and disadvantages of creative type employees

Benefits	Drawbacks
▪ flexibility of thinking (the ability to go beyond the obvious); ▪ tolerance for ambiguity (restraint in conflict situations); ▪ realisation of creative potential (new achievements); ▪ detailing (the ability to get into the details of the task); ▪ curiosity (acquaintance with different areas and directions); ▪ orientation to actions and achievements (possibility of going beyond standard thinking); ▪ independence of thinking; ▪ participation in solving the problem; ▪ sensitivity to the interests of colleagues (understanding the needs of others); ▪ concentration on the problem (systematic work); ▪ persistence in defending an opinion (despite obstacles); ▪ a sense of humour (the ability to accept some truth at a certain distance from reality).	▪ psychological stress; ▪ solutions to complex and non-standard situations; ▪ search for ways to achieve agreement between employees; ▪ lack of ability to focus on one task for a long time, as new requests and needs constantly appear; ▪ the complexity of forecasting work results and the high cost of erroneous decisions; ▪ the need for continuous training in management, coaching, presentation skills, etc.

Source: developed by authors based on O.I. Klipkova (2015), O.A. Kharun (2017), N. Zadorozhniuk (2018)

It can be noted that the main negative and demotivating factors of creative employees are a high level of stress and anxiety, fatigue, as well as the likelihood of emotional burnout syndrome (Zadorozhniuk, 2018).

However, not all categories of workers can be classified as creative. In most cases, creative workers include: heads of enterprises, managers, coordinators, heads of specialised departments, project managers, experts, idea generators (innovators), facilitating engineers (Kharun, 2017).

Creativity in all its manifestations relies on intelligence, ingenuity, practical vision and self-organisation. In their research, D. Leonard *et al*. (2014) identified the main elements of creativity that are still relevant today.

1. Competence (covers knowledge, skills and experience).

2. Creative thinking (includes flexibility, ingenuity and persistence in finding a solution, creative thinking).

3. Motivation: internal – personal interest, striving for self-realisation; external – material incentives and career growth. In this case, the internal motivation of the employee plays a more important role for creativity. It is important for the staff to be motivated to creative activity and in turn it is necessary to support the discovery of individuality, to apply creative thinking and creative work. The development of positive creative thinking is influenced by a number of factors that can be projected onto any employee of the enterprise (Kharun, 2017).

Development of a creative marketing strategy

In turn, when forming a creative marketing strategy, special attention should be paid to the strategic directions of marketing activities and their corresponding marketing tools and areas of their use (Table 2).

Table 2. Strategic directions and tools of marketing activity

Areas of marketing activity	Methods	Instruments	Field of application
Neuromarketing	Eye tracking, EEG (electroencephalography), heart rate monitoring, facial expression analysis, SGR (skin galvanic response)	Measurement of brain activity, visualisation, tracking reaction on advertising and products, services for the purpose of creating products and their promotion based on research on subconscious brain reactions of the target audience of consumers	Advertising studies; e-commerce; branding; offline points of sale; shopping; cinema; bank branches, etc.
Event marketing	Creating and conducting special events	Focusing attention on the promotion of products or services through various events	Festivals, symposiums, concerts, corporate events, presentations, conferences, exhibitions, seminars, etc.

Areas of marketing activity	Methods	Instruments	Field of application
Emotional marketing	Tracking the emotions and feelings of customers	Emotional analysis – demonstrating the behaviour of happiness as a counterpoint to economic decline and stagnation	Creating a strong emotional connection with customers through the use of various tools
Internet marketing	Attracting targeted traffic, improving conversion	SMM – Social Media Marketing; SEO – search engine optimisation; Contextual advertising (SEA (Search Engine Advertising), PPC (Pay per click) advertising); Banner advertising; SMS marketing; E-mail marketing; Blogging; Event marketing	Attracting and retaining potential customers on social networks and the Internet
Digital marketing	Using digital technologies and channels to attract potential customers and retain them as consumers	Content creation; Advertising blocks; App store; SMS advertising; Network search activities using SEO and SEM (Search Engine Marketing); Affiliates (advertising networks, webmasters); Teaser, banner and contextual advertising; Marketing channels, etc.	Promotion in blogs and social networks, creation of special Internet sites, viral advertising, contextual advertising, television, etc
Content marketing	Diversification of content, repetition of content with a high rating, amplification of hits, maintenance of content with a low rating, entertainment content	Author content; Guides; Reviews; Cases – examples of completed works; Analytics; White paper – a collection of useful information on a single issue; Visual content; Video; Live broadcasts; Posts in social networks; Presentations; Podcasts (audio content)	Social media, articles, sites, photos, videos, blogs, SMS mailing, e-books, printed products, gamification; content products; presentations; coaching programs; knowledge bases, Internet forums; reference resources, etc.

Source: compiled by authors based on J. Harris *et al.* (2018), O. Kitchenko & Ye. Prykhodko (2020), I. Petrova & Y. Loiko (2022)

When forming a marketing policy, enterprises introduce incentives that would increase sales of products and services. Since traditional marketing strategies do not always guarantee success in sales and promotion of goods and services, marketing strategies based on innovation are used (Petrova & Loiko, 2022).

Today's realities force enterprises to apply a mix of marketing strategies, depending on the situation, and the tasks that need to be solved, and at the same time, these strategies must include a creative component. According to scientific research by O.I. Pushkar & Yu.L. Tataryntseva (2018) the process of developing a creative marketing strategy can be divided into a number of stages.

The first stage. One of the first stages in the development of a creative marketing strategy of an enterprise is the generation and formation of an idea. The generation of ideas takes place using creative methods. The application of ideas lies in the field of complex marketing and must be consistent with the goals of the entire enterprise.

The second stage. Selection of the best idea and its implementation. At this stage, special attention should be paid to the implementation of creative ideas in marketing. Implementation of ideas should evoke emotions in consumers. When developing a product, you should consistently focus creative actions on the elements of the marketing mix and monitor the reaction to changes. The simultaneous use of creative for all elements of the marketing mix can overload the target audience with content and not be perceived.

The third stage. Selection of content transmission channels in online and offline environments. At this stage, an analysis of the preferences of the target audience regarding content transmission channels is carried out. Since the realities of life interpret their conditions, the role of online channels for promotion and distribution of products increases: social networks, messengers for exchanging messages, search engines, mobile television, etc.

The type of target audience and the product being promoted directly affect the choice of social networks that are better to use (Bezrukova & Gunchenko, 2015). The most popular social networks in Ukraine in 2021, according to the Research & Branding Group survey and other studies, include: Facebook, YouTube, Instagram, Telegram, Twitter, VK, Odnoklassniki and LinkedIn (Kurenkova, 2021; Rating…, 2021).

The analysis of scientists' views on determining the stages of the process of developing a creative marketing strategy for an organisation allowed us to determine that one of the most important stages is the choice of content

transmission channels both online and offline. Since the use of a client-oriented approach to the development of a creative marketing strategy was justified, as well as taking into account the total digitalisation of society, it was considered appropriate to use the method of statistical analysis to study the use of social networks in Ukraine. For this, information was obtained from open sources regarding the frequency and amount of use of various most popular social networks. The resulting indicators were determined with the help of appropriate calculations.

Analysis of social networks of Ukraine and the world for 2021 is presented in Table 3.

Table 3. Analysis of social networks of Ukraine for 2021

Network	Place in the rating		Million people		Age	Gender	Type of content
	World	Ukraine	World	Ukraine	World and Ukraine	World and Ukraine	
Facebook	1	1	2 910	16.8	25-34 years old. The number of over 65s is increasing	No gender differences	Tests, text posts, life hacks, videos, conferences, quizzes, infographics, humour, news, weather, communications, discussions
YouTube	2	2	2 291	23.6	14-34 years	More male audience (about 65%)	90% entertainment content: life hacks, reviews, technologies, children's content, humour, music, sports, computer games, funny animals, product reviews, funny videos, shopping, unboxing, educational videos, parodies, pranks, celebrity gossip
Instagram	5	3	1 287	15.8	18-34 years	More female audience	Photos, pictures, videos: fashion, beauty, health, family, children, decor and interior, art; provocation posts, polls, contests, raffles, quests, marathons, promotions, reviews, etc.
Telegram	9	4	600	3.9	25-34 years	No differences by gender	Conversational texts, podcasts and voice messages, videos, links, surveys, case studies, reviews of the latest news, stories from personal experiences and more
Twitter	16	5	463	1.71	45-50 years	More male audience	Sports, vegetarianism, success, psychology, news, society and politics
LinkedIn	18	8	310	0.3	25-45 years	No differences by gender	Professional content, career work, expert reviews, lessons, resumes, trends, tips, articles, surveys, videos, stories
TikTok	8	17	1 000	12	18-24 years	More female audience (60%)	Challenges, lip sync videos, duet, reactions, tricks, funny videos, social videos, beauty, reviews and streams

Source: compiled by the authors based on O.I. Pushkar & Yu.L. Tataryntseva (2018), Instagram surpassed Facebook... (2022), Media Consumption in Ukraine... (2022)

The fourth stage. At the stage of content promotion, it is necessary to form a content strategy and determine methods of promotion. The selected promotion channel affects the choice of promotion methods. The main methods of content promotion include: site optimisation, e-mail distribution, contextual advertising and advertising in social networks, blog, Social Media Marketing, mailing, viral advertising, hidden advertising, Push-messages, etc.

When developing content, it is recommended to apply H. Gardner's theory of multiple intelligences (Pushkar & Tataryntseva, 2018), that is, to match the type of product to be promoted with the type of intelligence of the target audience.

Tools of creative marketing activity

During the study of strategic directions and tools of marketing activity, it was found that in the conditions of the global crisis caused by the COVID-19 pandemic and military actions in Ukraine, Internet marketing is increasingly used. Thus, in 2021, e-commerce in the USA increased by 14.2% (Young, 2022). Therefore, in order to research which of the tools is better to use for content promotion, it was decided to narrow the scope of research to the analysis of Internet marketing itself, as the leading direction of marketing activity in crisis conditions. It is advisable to choose alternative options for using tools using an analytical-hierarchical process. In the condi-

tions of intensifying competition, the use of traditional methods does not give high results, so only the strategic management system can ensure long-term success in the environment of the growing dynamism of the external environment and the pandemic crisis and the related need for the development of innovative activities. To increase the rationality of decision-making and expand the possibilities of information processing, a decomposition procedure was used, which is also the focus of the analytical-hierarchical process (AHP).

An innovative algorithm for choosing marketing activity tools for Internet marketing depending on the goals of the advertising company, criteria and alternatives is presented in Figure 2.

According to the presented hierarchy, it is necessary to choose a marketing tool for the implementation of the company's creative advertising strategy, taking into account such criteria as costs, return on investment, customer loyalty, the breadth of audience coverage, and the level of creativity. Alternatives include the main Internet marketing tools used today: SMM; SEO – search optimisation; contextual advertising (SEA, PPC advertising); banner advertising; SMS marketing; e-mail marketing; blogging; event marketing.

With the help of the expert survey method, evaluations were obtained regarding the effectiveness of using certain

tools of creative marketing activity. All obtained estimates are checked for the degree of agreement of experts' opinions, since only agreed opinions can be considered significant and used for further research. With the help of appropriate calculations (coefficient of concordance), the possibility of using the constructed hierarchy of alternatives for choosing strategic directions of creative marketing activity has been proved.
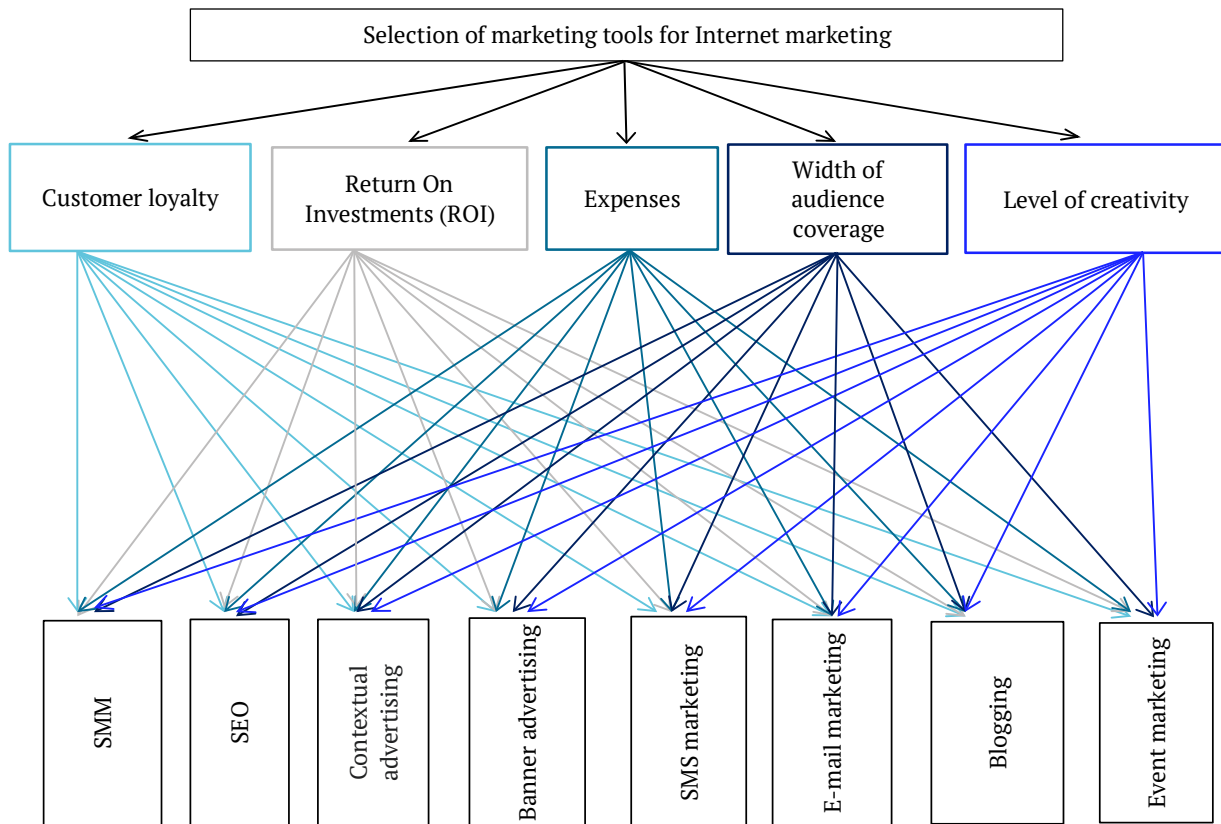
Figure 2. Hierarchy of the decomposition of the choice of marketing tools for Internet marketing
Source: developed by the authors

Score matrices are converted into rank matrices to calculate the concordance coefficient. The matrix of the ranks of the assessment of the degree of agreement of experts' opinions regarding the criteria is shown in Table 4.

Table 4. Assessment of the degree of consistency of experts' opinions regarding the criteria

Criteria	Expert					Sum of ranks S_j	$d_i = r_j\text{-dcp}$	d^2
	E 1	**E 2**	**E 3**	**E 4**	**E 5**			
Customer loyalty	2	2	2	2	2	10	–5	25
Return on Investment (ROI)	1	1	1	1	1	5	–10	100
Expenses	3	3	3	3	4	16	1	1
Width of audience coverage	5	5	5	5	5	25	10	100
Level of creativity	4	4	4	4	3	19	4	16
$S = \Sigma d^2$	242							
Concordance coefficient $W = 12*S/(N^2*(m^3-m)) =$	0.97							
$x_p^2 = N*(m-1)*W =$	33.9							

Source: calculated by the authors

The concordance coefficient can take values from 0 to 1. The lower the value of the concordance coefficient, the lower the degree of consistency of experts' opinions. At there is almost no agreement, and at there is complete agreement of opinion (Hrabovetskyj, 2010).

According to the results obtained during the expert evaluation of the criteria, we can see that the concord-ance coefficient is equal to 0.97 and is close to 1, and the calculated value of the Pearson criterion exceeds the table value (9.5), which indicates a high consistency of the experts' opinions.

Based on experts' assessments, a matrix of average integral advantages for alternative marketing tools was constructed (Table 5).

Table 5. Evaluation of the degree of average integral advantages of alternatives

Alternatives	Customer Loyalty	Return on Investment (ROI)	Expenses	Audience reach	Creativity level	Integral benefits
SMM – Social Media Marketing	0.3	0.3	0.35	0.18	0.24	0.29
SEO – Search Engine Optimisation	0.17	0.22	0.04	0.08	0.05	0.17
Contextual advertising	0.1	0.14	0.15	0.09	0.05	0.12
Banner advertising	0.05	0.06	0.06	0.24	0.13	0.07
SMS-marketing	0.05	0.04	0.11	0.22	0.03	0.06
E-mail marketing	0.04	0.03	0.1	0.09	0.05	0.04
Blogging	0.2	0.06	0.05	0.05	0.13	0.09
Event marketing	0.08	0.16	0.13	0.04	0.32	0.15
Criterion importance	0.21	0.56	0.09	0.05	0.09	1

Source: calculated by the authors

The results of the calculations show that the following criteria are decisive when choosing marketing tools for the implementation of the company's creative advertising strategy: return on investment and customer loyalty. Taking into account the available estimates, a hierarchy of alternatives can be determined (Fig. 3).
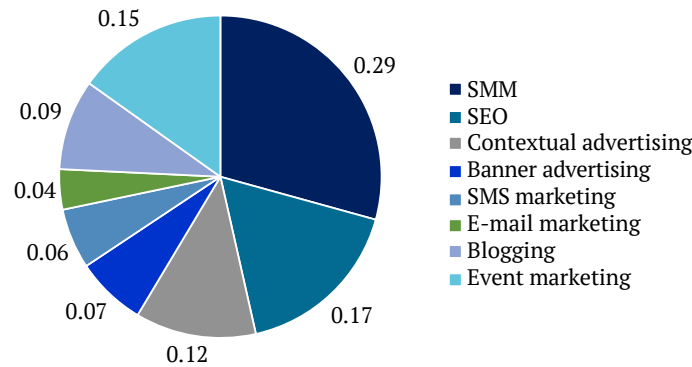
Figure 3. The importance of evaluating the global priority of alternatives
Source: developed by the authors

The results of the calculations show that Social Media Marketing, SEO – search engine optimisation, Event marketing, and contextual advertising are the most appropriate for implementing a creative advertising strategy.

Drawing a parallel with other studies (Petrova & Loiko, 2022), authors agree that the rapid development of society shifts the emphasis from traditional marketing approaches and strategies to the implementation of marketing strategies that have a creative component and give preference to the promotion of goods and services through social networks and the Internet. Such methods make it possible to satisfy the needs of consumers and ensure progressive development. G. Azimpour *et al.* (2015) noted the exceptional role of a creative marketing strategy in the implementation of the company's strategy and emphasised the positive impact of the implementation of strategies in a creative way. Similar results were obtained in the studies of S.F. Slater *et al.* (2010), who noted that an effective creative marketing strategy directly affects the effectiveness of the implementation of the overall strategy of the enterprise. In

turn, A.F. Al-zoubi (2017) researching creative marketing as a strategic asset to fuel the organisation's competitive advantages obtained similar results and mathematically proved that marketing creativity in terms of product, price, promotion, distribution, people, physical environment and service delivery techniques contributes to the effective strengthening of competitive advantage organisations. C. Papetti *et al.* (2018), looking at the digital tools used by businesses for marketing purposes, identified key trends and the impact of digital technologies to improve their effectiveness in marketing and customer relationship management. D. Dabrowski *et al.* (2019) emphasised the indirect effect between market orientation and organisational performance through creative marketing programs and noted and emphasised the importance of such aspects of creative marketing programs as relevance and novelty. S. Khrupovych & N. Ivanechko (2020) noted the need to use creative approaches and tools in business processes to ensure competitive advantages and obtain better financial results. O.I. Pushkar & Yu.L. Tataryntseva (2018), researching the role of creative marketing in the economy of impressions, carried out a thorough analysis of creative methods of generating ideas, conducted an analysis of the audience of social networks, presented recommendations for the directions of content formation, taking into account the type of intelligence of the target audience, and proposed a methical approach to the implementation of creative marketing in the economy of impressions. As can be seen, most scientists focus on analysing the importance of using a creative marketing strategy, highlighting its features and developing recommendations for its implementation. Some, researching the role of creative marketing in the company's activities, pay attention to new strategic directions of marketing activities and corresponding marketing tools (Harris *et al.*, 2018; Kitchenko & Prykhodko, 2020; Petrova & Loiko, 2022). However, almost no scientist has considered the criteria that have an impact on the choice of tools for the implementation of a creative promotion strategy. There are no scientific theoretical studies and recommendations that will help the management personnel of the enterprise to choose the most effective tools for the Internet promotion of their products and services. Thus, although there are no preliminary conclusions regarding the effectiveness of using a specific marketing tool, the authors believe that SEO, Social Media Marketing, Event marketing and contextual advertising are the most effective in this case.

■ CONCLUSIONS

In the course of the study, the importance of creative marketing in the formation of the company's strategy was substantiated. The analysis of strategic directions and tools of marketing activity showed that in the conditions of the global crisis caused by the COVID-19 pandemic and military operations in Ukraine, Internet marketing is increasingly used. Since the type of target audience and the product that is the object of marketing activity directly affect the choice of social networks, an analysis of the effectiveness of using social networks was conducted. The conducted analysis showed that in the world as a whole, and in Ukraine in particular, Facebook and YouTube are the most popular and effective. Certain criteria and alternatives were determined to make a decision regarding the choice of marketing tools for the implementation of the company's creative advertising strategy. With the help of an analytical and hierarchical process, a selection of alternative options for using marketing tools was made, taking into account the creative component. Consumer loyalty, return on investment, costs, breadth of audience coverage and level of creativity of the marketing tool were determined as criteria for selection. In order to obtain qualitative and objective research results, a group of experts was formed in the work, who evaluated the identified alternatives and criteria. The expert group included specialists whose professional activities are related to creativity – a marketer, a brand and SMM strategist; social network marketer; Internet marketer; marketing and advertising specialist; brand marketer. With the help of calculations of the concordance coefficient, an assessment of the consistency of the experts' opinions was carried out, which allowed us to draw a conclusion about the possibility of using their opinions to determine the hierarchy of alternatives regarding the use of a set of marketing measures during the implementation of the company's creative advertising strategy.

The results of the calculations show that Social Media Marketing, Search Engine Optimisation, Event marketing, and contextual advertising are the most appropriate for implementing a creative advertising strategy. Further research in this direction will be focused on the study of the level of effectiveness of the application of these tools.

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The authors declare no conflict of interest.

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Іванна Миколаївна Перерва

Кандидат економічних наук, доцент
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0002-8119-7022

Ольга Миколаївна Миронова

Кандидат економічних наук, доцент
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0002-3188-2881

Використання креативного маркетингу при реалізації стратегії підприємства

■ **Анотація.** Актуальність дослідження обумовлена необхідністю підвищення конкурентоспроможності підприємств в умовах збільшення конкуренції на глобальному ринку. Метою статті було проведення теоретичного аналізу та розробка методичного забезпечення пошуку дієвих маркетингових інструментів під час реалізації креативної маркетингової стратегії. Для досягнення мети використано методи: логічного узагальнення; порівняльний аналіз; метод моделювання, статистичний аналіз; метод аналізу ієрархій; метод експертного опитування; графічний та табличний метод. У результаті дослідження було визначено сутність поняття «креативності» та обґрунтовано важливість застосування креативних маркетингових інструментів під час реалізації стратегії підприємства; доведено, що потрібно розробляти та впроваджувати креативну модель маркетинг-міксу; обґрунтовано, що для застосування креативного маркетингу персонал підприємства повинен бути креативного типу; визначено, що під час розробки креативної маркетингової стратегії в умовах глобальної діджиталізації важливим етапом є вибір соціальних мереж; доведено, що в умовах наслідків пандемії COVID-19 та військової агресії в Україні, найбільш значимим інструментом є Інтернет маркетинг; доведено, що серед креативних інструментів Інтернет маркетингу найбільш ефективними є Social Media Marketing, Search engine optimisation, event marketing та контекстна реклама. Практична значущість отриманих результатів полягає у формуванні практичних рекомендації щодо вибору дієвих креативних маркетингових інструментів під час розробки та реалізації стратегії підприємства, спрямованої на підвищення його конкурентних переваг. Сформульовані висновки та рекомендації можуть бути використані менеджментом сучасних підприємств, які шукають шляхи підвищення конкурентоспроможності за рахунок впровадження креативної маркетингової стратегії

■ **Ключові слова:** творчий підхід; стратегічні напрямки; комплекс заходів просування; конкурентні переваги; інструменти просування; Інтернет просування

Svitlana Achkasova[*]

PhD in Economics, Associate Professor
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0001-7233-0189

Oleksandr Platukhin

Postgraduate Student
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0009-0003-2693-8881

Identifying patterns of interest in the topic of managing equity capital of the enterprise

■ **Abstract.** Increasing attention to the issues of finding tools to meet the defined needs and interests of investors determines the relevance of the development of the goals of managing equity capital of the enterprises. The goal of the study was to formulate recommendations for determining the patterns of interest in the management of equity capital of the enterprise. The research methodology is based on the use of theoretical and empirical methods, in particular methods of Internet resource analysis, forecasting, decision support system Decision Making Helper, etc. During the analysis of interest in the topic of managing equity capital of the enterprise in English, the tools of the Google Trends web application were used. On the basis of these data, predictive models of trend lines for the concepts of "equity capital of the company" and "equity capital of the enterprise" were built, which have a satisfactory approximation reliability value and can be used to identify patterns of interest in the topic of enterprise equity management. However, the frequency of search queries for these terms in the Ukrainian language in the world and in Ukraine, starting from 2015, was very low. The assessment of alternative key goals of financial management of equity capital of the enterprise was carried out using the decision support system Decision Making Helper. The priority of ensuring the effective structure of equity capital of the enterprise and the proper level of its capitalisation was determined as the top priority. The practical significance lies in the developed recommendations that can be applied in assessing the relevance among users of Internet resources of information related to equity capital of the enterprise, and in assessing the key goals of financial management of equity capital of the enterprise in order to improve their functioning

■ **Keywords:** business entity; company; search query; assessment; own funds

■ INTRODUCTION

There is no doubt about the actualisation of the issues of management of equity capital of enterprises as an element of structural transformation of national economies of all countries of the world, especially under the influence of crisis phenomena of international nature, the outbreak of SARS-CoV-2 (COVID-19) and other crisis manifestations.

Increasing attention to the issues of finding tools to meet the defined needs and interests of investors determines the relevance of the development of the goals of managing equity capital of enterprises.

The strengthening of the influence of crisis phenomena on various spheres of activity of enterprises determines

*Corresponding author

the need to study the issues of managing equity capital of the enterprise, as one of the key elements of the development of the country's economy, entrepreneurship and business activity.

The introduction of the goals of managing equity capital of enterprises and the development of the policy of managing equity capital of enterprises is a European integration vector, as it corresponds to the basic principles and implements them in accordance with the Directive of the European Parliament and the Council (EU) 2017/1132 of June 14, 2017 on some aspects of corporate law (codification) (Directive..., 2017).

Also, the issues of improving the process of assessing the level of interest and the degree of spread of the topic of the equity capital of the enterprise are being updated. The scientific works of scientists are devoted to the issue of the influence of equity capital of enterprises on business activity, development of the economy of countries and search for innovative solutions for its management in the conditions of global socio-economic changes.

The issue of studying the impact of various criteria on the financial decision-making process, in particular, the mobilisation of financial capital for sustainable development, was studied by J. Sandberg & D. Rönnegard (2020). P. Rao *et al*. (2019) in their work study the basic modern globalisation challenges and how they affect the study of factors that influence the capital structure decisions of small and medium-sized enterprises (SMEs) in India. In their research, M.I. Karlin *et al*. (2021) emphasise the need for a detailed and in-depth analysis of new threats and crises in functioning of small enterprises in the context of the systemic impact on their finances.

Foreign scientists A.J. Hibbert & C.J. Turnbull (2020) in their scientific activities pay considerable attention to the applied aspects of identifying and managing risks in the development of small enterprises. A. Bartik *et al*. (2020) and M. Belitski *et al*. (2022) study the impact of the COVID-19 pandemic on the financial performance of small businesses and recommend possible ways to overcome them.

It is advisable to pay attention to the scientific works of N.M. Vnukova (2020), which are based on the application of the innovative approach to the use of the automated decision support system (hereinafter – DSS) Decision Making Helper to assess the level of activation of expanding access to the means of financing the implementation of promising projects of small and medium-sized businesses.

However, given the considerable number of scientific developments, not enough attention is paid to assessing the level of interest and demand for information on managing equity capital among users, as well as improving practical ways of assessing the key goals of its management.

The object of the study is the equity capital of the enterprise. The ability and effectiveness of the management of equity capital of the enterprise depend on informational, normative, methodical, analytical and other support, which is the basis for determining its level. It is advisable to pay special attention to analytical support, in particular, to assess the degree of interest of users in the subject of equity capital of the enterprise using the Google Trends web application, which allows you to set current trends and DSS Decision Making Helper for assessing the

key goals of financial management of the equity capital of the enterprise.

The goal of the work is to provide recommendations for identifying patterns of interest in the topic of managing equity capital of the enterprise. In accordance with the set goal, the following tasks must be solved in the research process: determine the level of interest of users of Internet resources in information related to the concept of "equity capital of the company" and "equity capital of the enterprise" using Google Trends; use the DSS Decision Making Helper to make optimal decisions when assessing the level of importance of the key goals of financial management of equity capital of the enterprise.

The novelty is the improvement of the process of assessing the level of interest and the degree of spread of the topic of equity capital of the enterprise using the tools of the Google Trends search engine and the improvement of the decision-making process regarding the selection of key goals of the financial management of the equity capital of the enterprise using the DSS Decision Making Helper.

■ MATERIALS AND METHODS

The research methodology is based on the application of theoretical and empirical methods of scientific research.

Since it is important to pay enough attention to the research of the general trends of the level of interest of users in the topic of equity capital management, to assess the demand for this area according to the criteria of prevalence, the method of analysing Internet resources using the tools of the Google Trends public web application of Google was used for this purpose.

This public web application Google Trends has certain benefits to use. It is based on the Google search engine and shows how often a given term is searched for in relation to the total volume of queries in various regions of the world and in different languages (Kliuiev *et al*., 2022). However, the process of assessing the level of interest in Google Trends can be a bit laborious (Achkasova, 2020).

At the beginning of the study, Ukrainian and English languages were selected in order to analyse the interest of various stakeholders in the search for information related to the concept of "equity capital of the enterprise" and derived from this definition "equity capital of the company". The management function applied to equity capital of the enterprise did not yield search results for the studied concepts, as well as the use of queries in the Ukrainian language. Because the search queries were very small and did not show up in the public web application Google Trends. In the further stages of the research, only the English language was chosen. All operations for the formation of the statistical base were carried out as of November 2022. During the study of statistical data of user search queries for the analysed concepts "equity capital of the company" and "equity capital of the enterprise" in English, obtained in the web application Google Trends, the method of statistical analysis and generalisation was applied in order to establish patterns of interest in the subject of equity capital of the enterprise.

The use of the graphic method in combination with the method of forecasting based on the construction of trend lines (Achkasova *et al*., 2022) made it possible to build models of forecasting the level of interest of users in the

topic of equity capital of the enterprise. This made it possible to visualise the number of search queries according to the studied concepts. The built models for forecasting the level of interest of users in the subject of equity capital of the enterprise must be qualitative and reliable, which can be evidenced by trend lines with a satisfactory value of the coefficient of determination R².

The deduction method was used to collect information about the essence of equity capital and the goals of its management. The expert ranking method was used in the process of extrapolation of the influence of criteria in the process of making optimal decisions when assessing the level of importance of the key goals of financial management and the policy by equity capital of the enterprise.

For the automated selection of the best alternative for the key goals of the financial management of equity capital of the enterprise, the software product DSS Decision Making Helper was used.

According to the terms of DSS Decision Making Helper, determination of the level of importance of criteria and assessment of alternatives is carried out through the necessary ranking assessment: from (-5) "most unimportant" to (+5) "most important", 0 – neutral (Decision making helper, n.d).

The assessment of the most important goals of the enterprise equity capital management was carried out using the DSS Decision Making Helper. The following selection criteria are highlighted: timeliness; security; performance. The following were subject to assessment: block A – Ensuring an effective structure of the enterprise equity capital and the proper level of its capitalisation, block B – Increasing the market value of the enterprise, ensuring the financial stability and efficiency of the enterprise activity, block C – Creating protection against risks and managing the processes of mergers and/or takeovers of the enterprise-target.

This program is available to users of Internet resources and is automated in terms of calculations. It is based on determining coefficients of significance of the selected criteria and alternatives, as well as a comparison of experts' judgments, which greatly reduces the subjectivity of their opinions. This made it possible to obtain excellent results, among which the highest priority was chosen in the process of assessing the level of importance of the key goals of the financial management of the enterprise equity capital based on such criteria as timeliness, security and effectiveness.

▪ RESULTS AND DISCUSSION

Assessment of the level of interest of Internet resources users in the concept of "equity capital of the company" and "equity capital of the enterprise" using web application Google Trends

The development of the sphere of entrepreneurship and enterprises serves as the basis for the development of the economy of any country. The influence of globalisation changes is exercised on all spheres of activity, in particular on the policy of managing equity capital. The interest of shareholders in the effective management of equity capital of the enterprise under the influence of globalisation changes serves as the basis for the search of new tools and technologies for making appropriate decisions.

However, it is worth noting that any entrepreneurial activity is associated with risk. It acts as an element that, on the one hand, is characterised as an opportunity for development, and on the other, as a threat with the necessity to find solutions to avoid it (Kosovich & Dmitruk, 2020). And risks are inherent in the field of equity capital management. Therefore, in all spheres of enterprise activity, the topic of equity capital management is becoming more and more important, and therefore determining the degree of prevalence and interest of users in this direction can indicate its interest and prospects for further research among representatives of the scientific community and practitioners.

Currently, there is no single approach to defining the concept of financial capital, in particular equity capital, which is related to the process of its formation (Rao *et al.*, 2019). According to the authors, a fairly complete and meaningful interpretation of equity is that it is a set of elements that establish the system of financing the assets of a business entity, the functioning of which is determined by the degree of development of economic relations, property relations and the competitive environment and is characterised by the properties of self-increasing value (Dorosh & Snizhko, 2019). At the same time, modern financiers often deviate in their formulations from the stable characteristics of equity capital, which shows the part of the enterprise property that is financed by the owners' funds and by the equity capital of the enterprises (Koval & Bolekhivska, 2019).

The interest of various users in learning information related to the concepts of "equity capital of the company" and "equity capital of the enterprise" in English was analysed, considering their search queries in terms of countries with the highest frequency of search queries, starting from 2015 (Table 1).

Table 1. Search queries of users in the world regarding the terms "equity capital of the company" and "equity capital of the enterprise" in English across countries

Concept	"equity capital of the company", %	"equity capital of the enterprise", %
Country	Philippines – 100	Philippines – 100
	India – 72	India – 31
	Kenya – 63	United States of America – 12
	United States of America – 34	
	Malaysia – 29	
	Pakistan – 21	
	Canada – 15	

Source: developed by authors based on Google trends (n.d.)

The data obtained in Table 1 show that, taking into account the linguistic features of each country in the world, the concept of "equity capital of the enterprise" in English is of interest to 100% of users from the Philippines, 21% of users from India, and 12% of users from the United States of America. At this stage, it is appropriate to present the distribution of their search queries, which is carried out later in the research. Demand for information on the concept of "equity capital of the company" in English was found in the following countries: Philippines – 100%, India – 72%, Kenya – 63%, United States of America – 34%, Malaysia – 29%, Pakistan – 21%, Canada – 15%. When comparing the dynamics of the popularity of the term "enterprise's own risk" in the world in English using Google Trends tools, the demand of users in the search for information was established (Fig. 1).

In order to obtain a greater visualisation of user search queries in the world for the concepts under study "equity capital of the company" and "equity capital of the enterprise" in English, the distribution diagrams for each of the concepts are presented and the building of qualitative and reliable approximation functions are presented, Figures 1 and Figure 2 in accordance.

$$y = 0.0112x^2 - 0.4226x + 15.223$$
$$R^2 = 0.7325$$
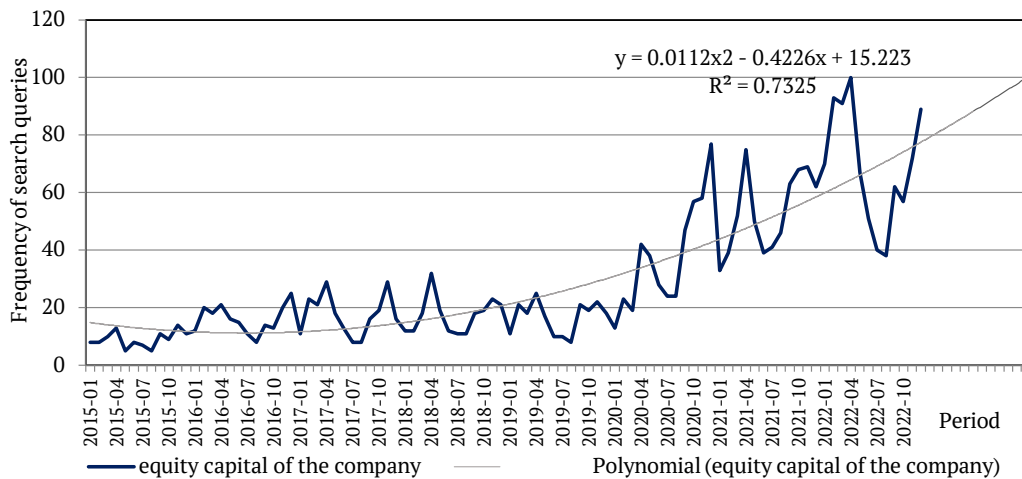
Figure 1. Predicting the degree of interest of users in the concept of "equity capital of the company" in the world in English, based on data from January 2015 to October 2022
Source: built by authors based on Google trends (n.d.)

$$y = 0.0112x^2 - 0.4226x + 15.223$$
$$R^2 = 0.7325$$
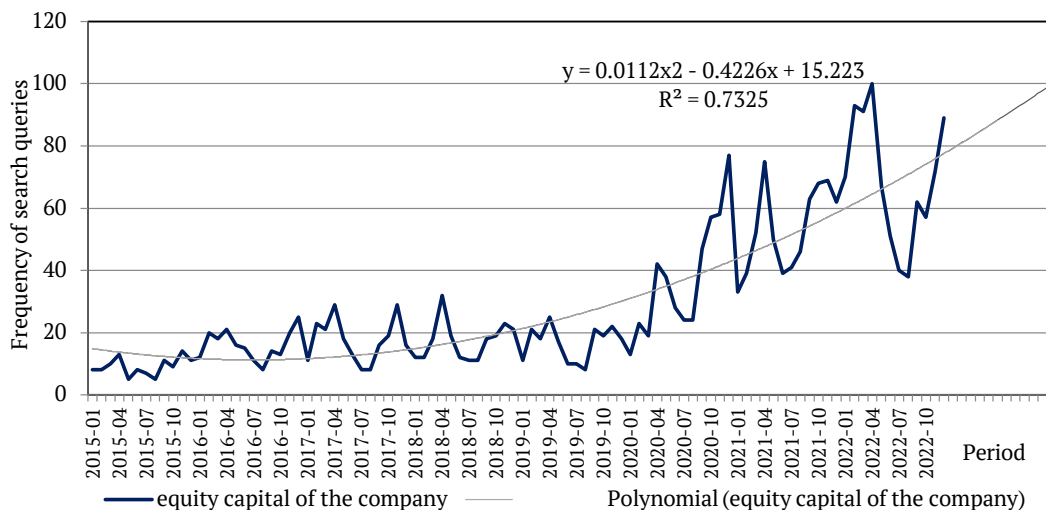
Figure 2. Predicting the degree of interest of users in the world to the concept of "equity capital of the enterprise" in the world in English, based on the data from 01.2015 to 10.2022
Source: built by authors based on Google trends (n.d.)

The trend lines with a 12-month forecast were added to the distribution charts to establish trends and model the degree of interest of users of Internet resources in the terms under study. However, both for the concept of "equity capital of the company" and for the concept of "equity capital of the enterprise" in Ukrainian in the world and in Ukraine, according to data based on search queries, since 2015, the frequency of search queries has been very low. This made it impossible to analyse the frequency of these search queries and build predictive models.

After considering the data in Figure 1, it can be noted that, taking into account the search queries of users from different countries, there is the special tendency towards a mostly continuous and stable increasing interest in

studying information related to the concept of "equity capital of the company". Starting from January 2015, more and more frequent searches for information related to this topic were carried out every month, and the number of searches did not reach zero. This is caused by a series of crisis phenomena in the world, which caused the need of users from countries around the world for a more detailed analysis of the issues of managing equity capital of the company.

The graph shows that the rapid growth of interest in the concept of "equity capital of the company" took place in October 2020, when the active spread of the SARS-CoV-2 (COVID-19) outbreak began and the economic condition of many companies was in a state of crisis.

The graph presented in Figure 2 shows a positive stable trend of search queries regarding the term "equity capital of the enterprise" since January 2015. This may be related to the understanding of English-speaking users, among whom we should distinguish academics, practitioners etc., of the relevance of issues of the equity capital of the enterprise in various spheres of activity. As per the data in Figure 2,

since April 2020, there has been an increase in the demand for research on equity capital of the enterprise in English, which can be explained by the spread of the corona crisis.

It should also be noted that starting from February 2022, the interest of users in searching for information regarding the category "equity capital of the enterprise" began to grow actively due to the unfolding of conflicts at the international level.

After analysing the built trend lines for the terms "equity capital of the company" and "equity capital of the enterprise" in Figures 1-2, it can be concluded that they are adequate and reliable, because the value of the coefficient of determination R^2 exceeds 0.70 and is 0.704 and 0.7325 respectively. This indicates that, based on the obtained models, it is possible to make a forecast of demand among users of information related to the studied concepts.

Approximation functions obtained from the built trend lines, which confirm the significance of the results of forecasting users' search queries in the world according to the analysed concepts in the English language, are shown in Table 2.

Table 2. Approximation functions of the studied concepts in English according to the search query data

Concept	Approximation function	Reliability of approximation
"equity capital of the company"	$y=0.0112x^2-0.4226x+15.223$	$R^2=0.7325$
"equity capital of the enterprise"	$y=0.0016x^2-0.0661x+1.1923$	$R^2=0.7040$

Source: built by authors based on Google trends (n.d.)

As it can be seen in Table 2, the built trend line models of the studied concepts based on the data of user queries in the world in the information and search system Google have a satisfactory value of the coefficient of determination R^2, which for the concept "equity capital of the company" is 0.7325, and for the term "equity capital of the enterprise" – 0.7040.

Thus, the distribution shown in Figures 1-2 demonstrates a consistent increase in interest in the topic of equity capital with growth since 2020, which may indicate a certain reassessment of the importance of a more thorough and detailed analysis of the causes, consequences and methods of managing equity capital of enterprises in various sectors of the economy.

Using DSS Decision Making Helper to make decisions in the field of making optimal decisions or assessing the level of importance of the key goals of financial management of equity capital of the enterprise
It is worth noting that the global trend is to increase the level

of interest of users in issues of equity capital of the enterprise, which is determined taking into account linguistic features.

Modern globalisation and integration processes expand their network of influence every year, forming new challenges and requirements, which causes entrepreneurs' concern as to increasing uncertainty and instability in the global business space (Karlin *et al.*, 2021).

Therefore, the successful adaptation of enterprises to modern realities of doing business on national and international markets requires effective regulatory mechanisms (Shapiro & Borie-Holtz, 2020). Taking into account the definition of the essence of equity capital of the enterprise through the prism of financing its assets, which is determined by the level of development of relations and the growth of the enterprise value, the blocks of goals of managing equity capital of the enterprise are proposed.

The results of determining the level of importance of the criteria when choosing the best among the specified alternatives, as well as assessing the key goals of financial management of equity capital of the enterprise, are given in Table 3.

Table 3. Determination of the level of importance of the key goals of financial management of equity capital of the enterprise

| Criterion/weight | Unit A | Unit B | Unit C |
	Ensuring the effective structure of equity capital of the enterprise and the appropriate level of its capitalisation	Increasing the market value of the enterprise, ensuring the financial stability and efficiency of the enterprise	Creation of risk protection and management of merger and/or takeover processes of the target enterprise
Term (+5)	+5	+4	+4
Security (+4)	+5	+4	+4
Effectiveness (+5)	+5	+4	+5

Source: developed by the authors using a Decision Making Helper (n.d.)

Based on the data given in Table 3, determined by the method of expert ranking, the data are entered in the DSS Decision Making Helper (Fig. 3).

Based on the data presented in Figure 3, the DSS Decision Making Helper provides final results for decision-making regarding the selection of the key goals of financial management of equity capital of the enterprise (Figures 4-6). It is worth noting that this software product automatically calculates the decision value for each regulatory mechanism in percentages from (-100%) to (+100%) and on the scale: "unsatisfactory / quite unsatisfactory / neutral / quite positive / positive" (Kliuiev *et al.*, 2022).
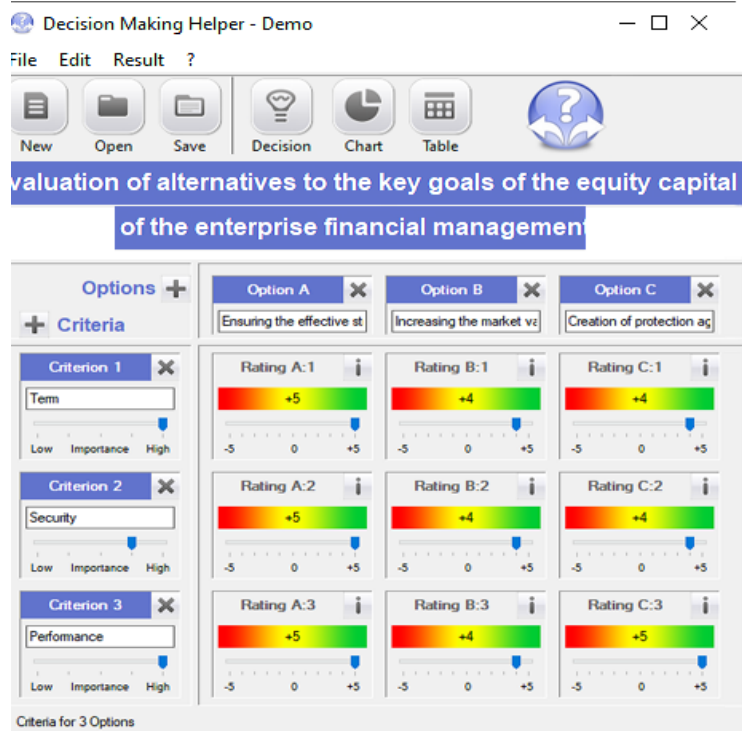
Figure 3. DSS Decision Making Helper dialog window with assessments of alternatives for the key goals of financial management of equity capital of the enterprise
Source: developed by the authors using a Decision Making Helper (n.d.)
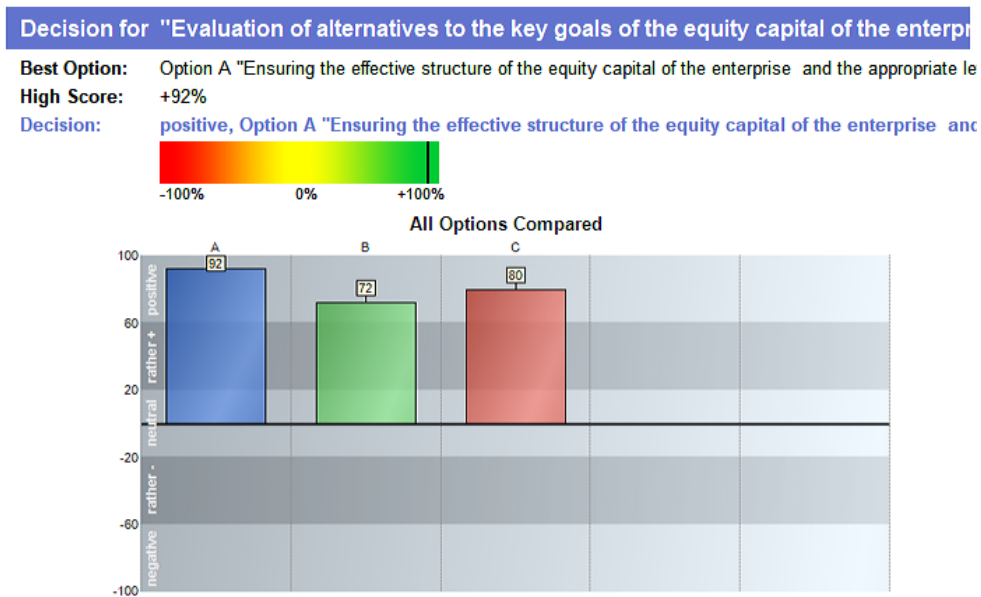
Figure 4. Dialog window of DSS Decision Making Helper with results regarding alternatives of key goals of financial management of equity capital of the enterprise
Source: developed by the authors using a Decision Making Helper (n.d.)
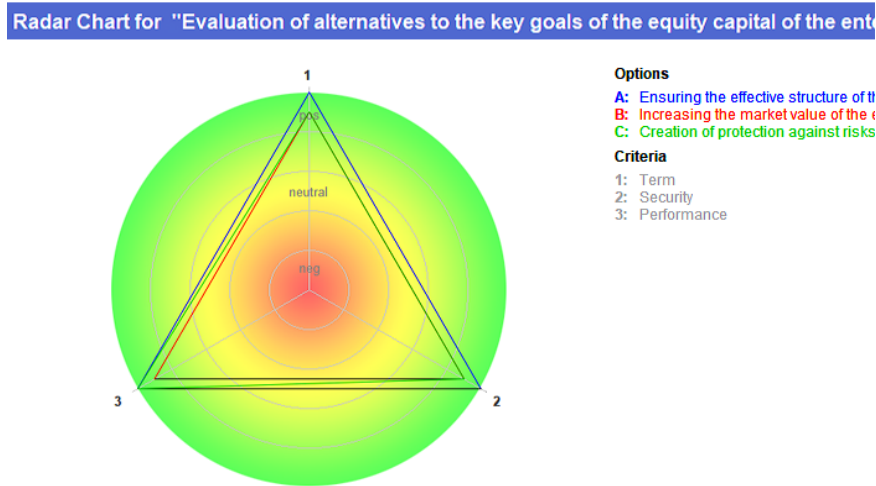
Figure 5. DSS Decision Making Helper dialog window with results regarding alternatives
of the key goals of financial management of equity capital of the enterprise (radar method)
Source: developed by the authors using a Decision Making Helper (n.d.)
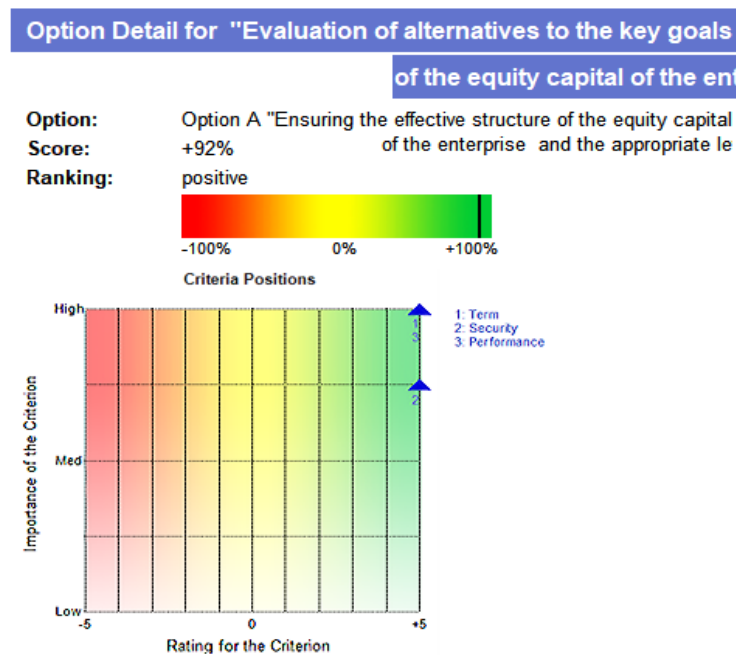
Figure 6. Results of the DSS Decision Making Helper assessment of alternatives of the key goals
of the financial management of equity capital of the enterprise in the context of the decision of Unit A "Ensuring
an effective structure of equity capital of the enterprise and the proper level of its capitalisation"
Source: developed by the authors using a Decision Making Helper (n.d.)

Using DSS Decision Making Helper provides such advantages as decision-making automation and the possibility of determining the priority of these decisions.

Based on the results of the analysis of the obtained results in Figures 3-6, it can be concluded that the most appropriate alternative, which would contribute to the realisation of the goals of financial management of equity capital of the enterprise, is Unit A "Ensuring an effective structure of equity capital of the enterprise and the proper level of its capitalisation". This is especially important, because the crisis phenomena in the Ukrainian economy caused a decline in the manufacturing industry. Due to the growth of competition on the Ukrainian and world markets, some enterprises do not have the proper pace of development (Kolodiziev, 2019; Kolodiziev *et al.*, 2021).

The results of the research (Abdullah & Tursoy, 2021), related to the empirical research of the interconnection between the efficiency of companies (non-financial) and their capital structure, confirm the positive connection between the company's performance and capital structure. Also, J. Ulbert *et al.* (2022) work established positive consequences of the capital structure based on the "golden section" on the financial indicators of companies, significant positive connections between the deviation from the capital

structure based on the "golden section" and deviations of data on revenues, earnings, share prices and market value of the companies from their all-time high. Therefore, it can be an effective instrument for companies to improve their efficiency. All these results testify to the importance of managing the capital structure, a part of which is equity capital.

The understanding of the importance of ensuring the capital's effective structure and the proper level of its capitalisation in the financial management of equity capital (Fig. 6), indicates the expediency of the development of this direction in the context of ensuring the profitability of the activity. The authors fully agree with the opinion of K. Bagatska *et al.* (2021) that for enterprises whose total amount of equity and current liabilities is stable and comparable in size to external borrowings, these enterprises show a decrease in the volume of losses. N. Qayyum & U. Noreen (2019) and H.T. Dinh & C.D. Pham (2020) had a similar point of view regarding the influence of the capital structure on financial indicators. Also, the influence of the amount of equity capital can affect the financial flexibility of the enterprise. According to the source C. Mari & M. Marra (2019), the weighted average cost of capital (WACC) method was used to assess the financial flexibility of the enterprise in crisis conditions. The results of the study show that ensuring an effective structure of equity capital will contribute to ensuring the efficiency of operations. So, they correlate with the study (Sumani & Roziq, 2020), according to which enterprises, that have an excellent corporate liquidity policy, form it due to the correct management of the capital structure and the capital structure with a share of debt that is balanced with its equity capital.

The authors are in complete agreement with the opinion of L. Pronko *et al.* (2021) that the deep economic crisis, the underdevelopment of the stock market and the high price of loan resources should draw attention to the real capitalisation of the enterprise, the process of accumulation of equity capital by business entities. Therefore, taking into account the information above, the target indicator of effective financial management of equity capital for each enterprise will be the provision of an effective structure of the enterprise equity capital and the appropriate level of its capitalisation.

■ CONCLUSIONS

Based on the search queries of Google Trends users, predictive trend models were built for the analysed concepts "equity capital of the company" and "equity capital of the enterprise" in English, which have satisfactory (0.7325 and 0.7040) approximation reliability values. These two predictive trend models are recommended for predicting the level of interest of users in the subject of equity capital of the enterprise. This provides such an advantage as the prospect of predicting the interest of Google Trends users in this topic. However, it should be noted that when research is conducted by other scientists, there may only be a discrepancy in time intervals.

It has been established that the introduction of the goals of enterprise equity capital management and the development of the policy of enterprise equity capital management is a European integration vector, as it corresponds to the basic principles and implements them in accordance with the Directive of the European Parliament and the Council (EU) 2017/1132 of June 14, 2017 on some aspects of corporate law (codification). It was determined, using the DSS Decision Making Helper, that decision A "Ensuring an effective structure of the enterprise equity capital and the proper level of its capitalisation" is the most prioritised in view of the recommendation of the decision as the most positive when assessing the goals of the enterprise equity capital management. Compared to the decision made in terms of the goal of block C "Creation of protection against risks and management of processes of merger and/or acquisition of the target enterprise" (+80%), its priority is +92% and is characterised as the most positive.

The successful functioning of enterprises at the national and international levels requires effective mechanisms of equity capital management and its assessment, which is the subject of further research.

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■ CONFLICT OF INTEREST
The authors declare no conflict of interest.

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Світлана Анатоліївна Ачкасова

Кандидат економічних наук, доцент
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0001-7233-0189

Олександр Георгійович Платухін

Аспірант
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0009-0003-2693-8881

Виявлення закономірностей щодо зацікавленості тематикою управління власним капіталом підприємства

■ **Анотація.** Посилення уваги до питань пошуку інструментів задоволення визначених потреб та інтересів інвесторів обумовлює актуальність розвитку цілей управління власним капіталом підприємств. Метою дослідження було формування рекомендацій щодо визначення закономірностей зацікавленості управління власним капіталом підприємства. Методика проведення дослідження базується на використанні теоретичних і емпіричних методів, зокрема методів аналізу Інтернет-ресурсів, прогнозування, системи підтримки прийняття рішень Decision Making Helper тощо. Під час аналізу зацікавленості тематикою управління власним капіталом підприємства англійською мовою застосовувалися інструменти веб-додатку Google Trends. На основі цих даних побудовано прогнозні моделі ліній трендів для понять «equity capital of the company» та «equity capital of the enterprise», які мають задовільну величину достовірності апроксимації та можуть бути використані для виявлення закономірностей щодо зацікавленості тематикою управління власним капіталом підприємства. Разом із тим, для цих понять українською мовою у світі та в Україні, починаючи з 2015 р., частота пошукових запитів була дуже мала. Із застосуванням системи підтримки прийняття рішень Decision Making Helper проведено оцінювання альтернативних ключових цілей фінансового управління власним капіталом підприємства. Визначено пріоритетність забезпечення ефективної структури власного капіталу підприємства та належного рівня його капіталізації як найбільш пріоритетного. Практичне значення полягає в розроблених рекомендаціях, що можуть застосовуватися при оцінці актуальності серед користувачів Інтернет-ресурсів інформації, пов'язаної з власним капіталом підприємства, та при оцінюванні ключових цілей фінансового управління власним капіталом підприємства з метою поліпшення їх функціонування

■ **Ключові слова:** суб'єкт господарювання; компанія; пошуковий запит; оцінювання; власні кошти

Andriy Krysovatyy*

Doctor of Economics, Professor
West Ukrainian National University
46009, 11 Lvivska Str., Ternopil, Ukraine
https://orcid.org/0000-0002-5850-8224

Olena Ptashchenko

Doctor of Economics, Professor
Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine
https://orcid.org/0000-0002-2413-7648

The mechanism of entrepreneurial innovation system in institutions of higher education

■ **Abstract.** The relevance of the research is determined by the fact that the development of modern society requires the acceleration of all economic processes. Therefore, in forming a scientific and educational space, paying more attention to the involvement of business structures and state authorities is essential. The research aimed to generalise the theoretical foundations of developing higher education institutions' entrepreneurial innovation system mechanism. General scientific and specific research methods were used in the article, in particular: comparative – to study the theoretical foundations of the development of the field of education and science and the formation of a categorical research apparatus; analysis and synthesis – in the process of identifying development trends in the field of education and science. It analysed research in the field of higher education and the formation of the main trends in the development of the educational and scientific spheres, which makes it possible to predict the primary vector of the development of the educational sector. The presented study considered the main features of the educational sphere from the point of view of the combination of three main components: education, business, and the state. With such a combination, the main features of the development of scientific and educational activities, as one of the main components of entrepreneurship development, have been determined. The conducted studies proved that, first of all, it is necessary to intensify efforts to improve and develop the regulatory and legal framework on a wide range of scientific and innovative activity issues to form a scientific and innovative activity infrastructure. The main elements and tools of entrepreneurial innovation systems that allow commercialising scientific projects and research are presented. The practical significance is that the proposed model of interaction between business, the state, and universities is an effective mechanism for solving the issue of forming a system of entrepreneurial innovation initiatives

■ **Keywords:** entrepreneurship; project activity; innovative projects; educational activity; commercialisation of projects

■ INTRODUCTION

The transition of the Ukrainian economy to an innovative path of development in the conditions of an increase in the number of new independent participants in economic activity that use non-state forms of ownership should, first of all, provide state support for their participation in scientific and innovative processes I.N. Krasovskiy *et al.* (2020) noted that in several developed countries, the primary vector of economic development has become the initiative of the

*Corresponding author

corporate sector. The typical features of such countries are that their state apparatus actively performs the functions of forming and regulating the infrastructure of innovative activity, supporting optimal mechanisms for creating, distributing, and using innovations (products, processes), i.e., their effective commercialisation.

O.V. Loginov (2016), in his studies, said that the activation of innovative activity is possible under the condition of combining the efforts of enterprises and institutions of higher education with the simultaneous distribution of responsibilities and risks between the participants of the integration process and the state to ensure the exit of complex organisational and technical systems to a competitive level, as well as the construction of a systemic state innovation policy in scientific-technological field. Closer contact of higher education institutions with production can stimulate innovation in the economy. N. Makhynia *et al.* (2021) proved that contract research for companies, informal consultations for businesses, and many other forms of cooperation could occur without undermining the institution's independence of higher education, mainly if cooperation occurs in an atmosphere of mutual understanding and respect.

O.B. Danchenko *et al.* (2018) demonstrated that since Ukraine has embarked on the path of socio-economic and political reform, the directions, forms, and methods of implementing the state policy of supporting the scientific activity of students must be adequate to the new conditions of society. First of all, this should manifest itself in establishing a system of partnership in relations between the state and the private sector, in which cooperation takes place based on taking into account the interests of both parties.

O.I. Zaklekta & O.P. Shimanska (2013), in their work, researched that the interests of the state lie in the comprehensive development of intellectual, spiritual, and economic potential through the development of a system of support for higher professional education and research and innovation activities. The state sees this as the most critical condition for its security and stability, economic, scientific, and technological progress, worthy of cooperation with the world community.

That is why the purpose of the current study was to study the basis for forming the mechanism of the entrepreneurial innovation system in higher education institutions. Such a study clearly illustrates the need to implement the trinity of cooperation between the state, business, science, and education.

A combination of general scientific and specialised research methods was utilised, including comparative analysis for examining the theoretical underpinnings of the development of education and science for creating a research framework, as well as analysis and synthesis for identifying trends in the development of education and science.

■ REVIEW OF LITERARY SOURCES ON THE TOPIC

The formation of the mechanism of the entrepreneurial innovation system in institutions of higher education becomes relevant and essential for the development of the modern economic system.

Due to the historical development of the management theory, innovative activity is assigned to a separate direction of the idea of innovation. To date, many works are

devoted to the theoretical study of the concepts of "innovation" and "innovative activity", based on what became classic for this direction in the studies of M. Kondratiev, J. Schumpeter (Hryshchenko, 2015) and were developed in the studies of V. Heyets (2006).

At the same time, little attention is paid to the definition of the innovative activity of the institution of higher education and its specificities. A. Romanovskii (2019) defined it as innovative educational programs, which is explained by the reasons, including the separation of education from science in institutions of higher education founded in the Soviet period, as well as the relative novelty of the task of carrying out innovative activities in institutions of higher education. Some authors, S. Ilyashenko (2010) and O.B. Danchenko *et al.* (2018), still consider it in the context of scientific research. The latter is reduced to defining it as scientific and innovative, which on the one hand, includes elements of tautology since the innovative activity consists of scientific activity. However, such a definition is fair given the specifics of such activity in educational organisations and the predominant position of the first group of scientists.

A new paradigm of higher education is also presented in the work of A. Krysovatyy (2015), where the involvement of entrepreneurial capital in the development of the educational and scientific sphere is indicated.

M. Uddin *et al.* (2022) explored entrepreneurial initiative from a subordinate moderation perspective involving educators and academics in collaborative engagement with business structures.

It is also possible to note that not only scientists raise questions about the development of cooperation according to the trinity of education and science – business – the state, but also state authorities. Many Erasmus projects have appeared in the European space involving scientific and educational institutions, public organisations, and business structures (Official website of Erasmus+, n.d.). Also, the Ministry of Education and Science of Ukraine (Official website of the Ministry…, 2021) will oversee grant and conceptual projects within the framework of such tripartite cooperation.

It is necessary to pay attention to the fact that despite the great interest in building an entrepreneurial innovation system among scientists and economists, there are still many unsolved questions regarding the attraction of business investments in terms of business interest and state support. Also in the centre of constant attention is the aspect of the motivation of scientists and educators in the same combination of the trinity for the development of educational and scientific projects.

The mechanism of coordination of interests in creating an entrepreneurial innovation alliance with the participation of a higher education institution should consider the peculiarities of regulation in higher education. T. Shtal *et al.* (2018) found that the main limiting subject concerning the institution of higher education is the founder, whose requirements are both formal and informal. That is why consideration in the presented study of the trinity of the state, business, education, and science acquires particular importance in ensuring entrepreneurial initiative. Thus, opening startup centres based on higher education institutions is a part of constructing an entrepreneurial innovation system.

ENTREPRENEURIAL INNOVATION SYSTEM

To achieve the global vector of reforming the scientific and educational sphere from the point of view of entrepreneurial initiatives at the state level, it is necessary to solve the following tasks presented in the works (Kopchenko, 2004; Geets, 2006; Hryshchenko, 2015): increasing the role of the scientific and innovative component in the system of priorities for the development of the higher education institution; formation of corporate culture in accordance with traditions and the accepted system of values, which ensure effective work of the labour team of the institution of higher education; expanding the range and development of fundamental and applied scientific research; accelerated formation of scientific work from the priority directions of scientific research of the institution of higher education, using the achievements of the institution of higher education in certain scientific areas; strengthening of existing and formation of new scientific schools and increasing their effectiveness; strengthening the influence of the higher education institution on the market of scientific and technical developments and innovations demanded by state customers, business structures and non-commercial organisations (this involves establishing and strengthening business contacts between departments and businesses); commercialisation of the results of research activities in the national economy and the educational process (this is not only the creation of small innovative enterprises, but also the development of consulting activities); accelerated implementation of the results of the Scientific research work in the educational process of the institution of higher education (this applies not only to the Scientific research work performed by the scientific and pedagogical staff during the main working hours of the departments, but also financed from the own funds of the higher education institution and Scientific research work financed on a competitive basis at the expense of the state funds budget); increasing the interest of scientific and pedagogical personnel in the growth and realisation of their scientific potential in the institution of higher education; active use of the potential of graduate students and students for the implementation of scientific and innovative projects.

Considering the current characteristics of the crisis conditions of the economy, instability, and the ever-increasing level of competition, an active policy is a primary condition for ensuring the regular activity of business entities and a high level of competitiveness and innovation and successful use of technology transfer.

Scientific achievements within the innovative activities of companies are no longer localised exclusively in the national economy of a single country but, with the help of technology, transfer mechanisms, go beyond its borders and dominate the international world market.

However, in Ukraine, the process of creating an innovative system is still at an initial stage, characterised by the need for more successful technology transfer mechanisms, and is an essential obstacle on the way to active interaction and entering the world market technological innovations.

This situation has a highly negative impact on the development of Ukrainian entrepreneurship and urgently needs a solution in terms of rationalisation and development of the scientific and methodological support system. The optimal direction for improving this direction is implementing foreign experience in the field of methodological recommendations for developing signs and indicators for measuring the efficiency of technology transfer to establish a set of measures and tools for their national implementation companies.

Considering the above, a necessary condition for developing Ukrainian higher education institutions is understanding the need to create an entrepreneurial innovation ecosystem. Therefore, to identify the latest trends and understand the situation in the scientific and educational environment, it is necessary to monitor the development of the entrepreneurial innovation ecosystem in higher education institutions of Ukraine.

A schematic representation of the entrepreneurial innovation system is presented in Figure 1.
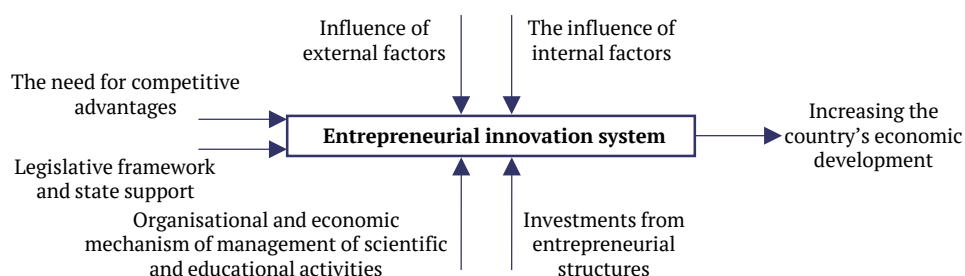
Figure 1. Schematic representation of the entrepreneurial innovation system
Source: authors' development

The state policy of Ukraine regarding the formation and development of scientific and innovative activities of higher education institutions is based on the following principles (Cunningham & Menter, 2021; Gupta, 2021):

▪ state support is provided by creating an environment for sustainable financing of higher education institutions at the expense of budget funds;

▪ an essential part of the state policy in the field of higher professional education is state support for the training of specialists in priority areas of fundamental and applied scientific research conducted in higher education institutions;

▪ the system of higher educational institutions in higher education institutions, in addition to enriching the content of the educational process, improving the quality of training specialists, and providing financial support to students, plays a vital role in the formation of future scientific-pedagogical and research personnel for higher

education institutions and other institutions, which is especially important in this period;

▪ the more attention paid by the management of higher education institutions to the creation of the infrastructure of scientific creativity, increasing the prestige of scientific activity, including the payment of special scholarships and grants, the higher the succession of generations of scientific and pedagogical personnel.

The state implements the policy of supporting scientific activity at the state, regional, and local levels, promoting the development of various ways, forms, and methods of its implementation (Kopchenko, 2004; Abhilash, 2021).

◼ DEVELOPMENT OF SCIENTIFIC ACTIVITY

In the conditions of economic reform (Geets, 2006; Allinson & Javorka, 2019; Cao, 2022), the process of development of the scientific activity of higher education institutions should include Figure 2.
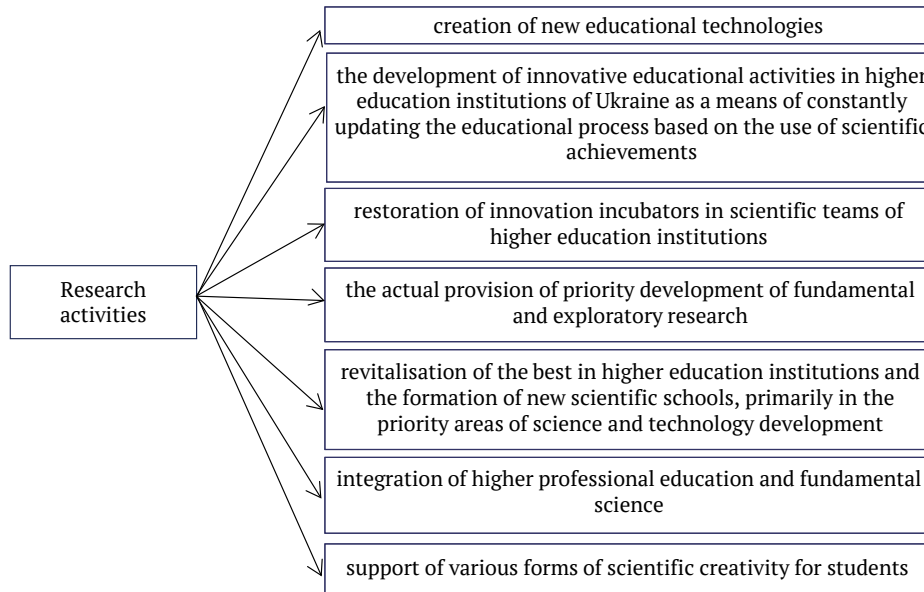

Figure 2. Components of the development of scientific activity
Source: developed by the authors based on T. Ambler (2004), P. Kotler *et al.* (2016), T.V. Shtal *et al.* (2018)

The selection of elements and forms of their interaction within the framework of the entrepreneurial innovation system in higher education institutions should comply with several principles: the innovative potential of the participants of the entrepreneurial innovation system of the higher education institution must meet the set goals and objectives; participants must be ready for entrepreneurial innovation risk, its redistribution between them, joint responsibility for the results of entrepreneurial innovation activity; information about completed projects should be available and open to all participants of the business innovation ecosystem; system participants must be entrepreneurial and innovative; legal conditions for entrepreneurial and innovative activities, observance of the interests of ecosystem participants and concentration of entrepreneurial and innovative potential in the most significant directions must be ensured.

These principles form the legal field of the entrepreneurial innovation system of the institution of higher education, within which specific structures are specified depending on the complexity and complexity of the tasks to be solved.

One of the effective forms of work organisation within the entrepreneurial innovation system is a strategic alliance in joint research and development. A strategic alliance is considered a soft organisational form of partnership based on a temporary agreement between the participants, which allows immediate termination if it becomes unprofitable (Kichuk *et al.*, 2021).

The following indicators can serve as a criterion for the effectiveness of coordination of interactions (Chaika *et al.*, 2019; Makhynia *et al.*, 2021; Bogatyreva *et al.*, 2022): for the enterprise – funds (resources, profit, development funds) remaining after settlement with the founders; for a higher education institution, it is, first of all, the improvement of performance indicators requested by the founder, and ultimately profit.

It should be noted that the construction of an innovative system should be started with the following elements:

1. It is advisable to start building partnership relations with those enterprises for which the institution of higher education prepares specialists (provides training and retraining of personnel on an ongoing basis).

2. Negotiations must be conducted between the heads of the higher education institution and the enterprise responsible for strategic development, including scientific activity, and have a real substantive nature.

The result of the development of the entrepreneurial innovation system within the framework of the strategic alliance may be a new structure that will be endowed with complete financial and legal independence necessary for the organisation of activities, including the selection, hiring, and firing of personnel, and the conclusion of contracts.

It is worth paying attention to the fact that only some of the roles in the construction of an entrepreneurial innovation system are played by the brand of the educational institution itself.

In 2014, the reform of general education started in Ukraine. On July 1, 2014, the Verkhovna Rada adopted the Law of Ukraine "On Higher Education" No. 1556-VII, which entered into force on September 6, 2014 (Law of Ukraine…, 2014). This law covered all elements of higher education – management, scientific and pedagogical personnel training, content, financing, and structure. This law creates the legal, organisational, and financial basis for the functioning of higher education and conditions for strengthening the interaction of state bodies with business and higher education institutions based on the autonomy of higher education. It combines education with science and production to create competitive human capital for the development of high and innovative technologies of the country, preparation for self-realisation of the individual, meeting the needs of society, the labour market, and the country in qualified specialists (Law of Ukraine…, 2006, Law of Ukraine…, 2011; Law of Ukraine…, 2015). The reform in education has chosen a strategic direction that can create a fundamentally new system of higher education that will allow everyone to save and update their knowledge during active work.

ASSORTMENT-PRICE APPROACH TO THE FORMATION OF HIGHER EDUCATION

Therefore, considering the above, it is advisable to apply the assortment-price approach to the formation of higher education institution activity strategies when promoting the market of educational services. The essence of this approach is that to manage the range of educational services effectively, it is necessary to take into account (Krasovskiy *et al.*, 2020; Lehmann *et al.*, 2020; Costa *et al.*, 2022):

1) types of educational organisations – state, private institutions of higher education, centres for advanced training, retraining of personnel, etc., which make up a particular share of the total range of educational services that enjoy the same demand; the cost of training one skilled worker;

2) groups of factors formed under the influence of market conditions – characterised by the average price for training and the maximum order volume, the "demand" of the specialty – characterised by high prices for training and the minimum order volume; state order – characterised by relatively low prices and an average volume of orders, regulating the volume of educational services;

3) level of income and consumption of educational services by households – high and medium levels of revenue and consumption.

The process of applying benchmarking in a higher education institution is based on a comparative assessment of the 4P subsystems of benchmarking management of the best universities: 1) personnel management (People); 2) partnership relations (Partnership); 3) process management (Processes); 4) (Products).

Thus, analysing the data presented above (Romanovskii, 2019; Bogatyreva *et al.*, 2022; Cao, 2022), it is possible to propose summarised indicators in Table 1 for the main processes and indicators in the institution of higher education during the benchmarking project.

Table 1. Key processes and indicators in a higher education institution during a benchmarking project

The process	The indicator
Student admission management	Adherence to the student admission management plan
Development of a scientific plan	Affirmation
Teaching	Evaluation of teachers and level of teaching by students
International cooperation	Number of students studying abroad
Research work	Number of publications
Communication with the regional community	Number of complaints
Informatisation	Number of computers per student
Long-term planning	Percentage of achieved goals
Hiring, personnel development	The percentage of people employed after the first application
Financing	The ratio of the volumes of requested finances to those received

Source: authors' development

The object of the benchmarking study is located in one of these four areas of activity of the institution of higher education. If several problem areas are identified due to the self-examination, their priority (order of problem-solving) can be determined using a rating. Thus, Table 2 presents the form of the general view of the rating table for the calculation of the benchmarking project.

The criteria for assessing the correctness of the selection of the issues of the benchmarking project were used in Table 2. The table is filled in by all working group members involved in developing the benchmarking project.

Each group member individually assigns to each criterion the appropriate, in their opinion, weight so that the sum of all weights gives 1.0 (one). The total weight for each criterion is obtained by summing up the weights assigned by all working group members. It would be possible to use the concept of "arithmetic mean" for each criterion, obtained as the sum of the weight of the given criterion for all group members concerning the number of group members. However, it is optional in this case since all comparative values will be divided by the same number of working group members.

Table 2. Key processes and indicators of a higher education institution when implementing a benchmarking project

The criteria	1 – Importance for the internal university audience (students, teachers, employees)	2 – Importance to the external university audience (parents, employers)	3 – What we want to achieve as a result, part of the strategic plan	4 – Probability of success	Total score
Weights assigned: 1 2 3 4 ... _____ Total Weights _____ Improvement area	 _____ _____	 _____ _____	 ... _____ _____	 ... _____ _____	1 1 1 1 ...
1. Educational activities (optimisation)	Assigned rank:				
2. Quality management system (implementation)	Assigned rank:				
3. Self-government system	Assigned rank:				

Source: compiled based on T. Ambler (2004), R.T. Syed *et al.* (2022), M. Uddin *et al.* (2022)

As a result of the collective discussion of each problem, a point (rank) is assigned: the fundamental problem receives as many points as the topics for discussion (in this case – 3), and the least important – 1. The assigned rank is multiplied by the total weight for each criterion, after which terms add up the results calculations of each column. Thus, each problem considered receives a total score depending on its importance to the working group members, after which it becomes clear in which sequence work should be started to improve the existing situation.

■ DEVELOPMENT OF BRANDS OF HIGHER EDUCATION INSTITUTIONS

One of the critical elements in developing the entrepreneurial innovation system is the brand of the higher educational institution itself. The determination of the stages of the analysis is presented in Figure 3.

In this way, a conditional object is determined, which is best assigned from the point of view of the analysed indicators and the purpose of the study, the value of the standardised data parameters.

After building the standard, at the sixth stage of calculating the taxonomic coefficient indicator, it is necessary to determine the distances between individual points characterising the objects of analysis and the standard point. The so-called Euclidean distance. The seventh stage consists in determining the values of taxonomic indicators of the condition of brands of higher education institutions. Thus, the value of taxonomic coefficients can take on values from 0 to 1 (one). It should be noted that the closer the value of the development coefficient is to 1, the higher the level of development of the object of research, in this case, the brand of a higher education institution.
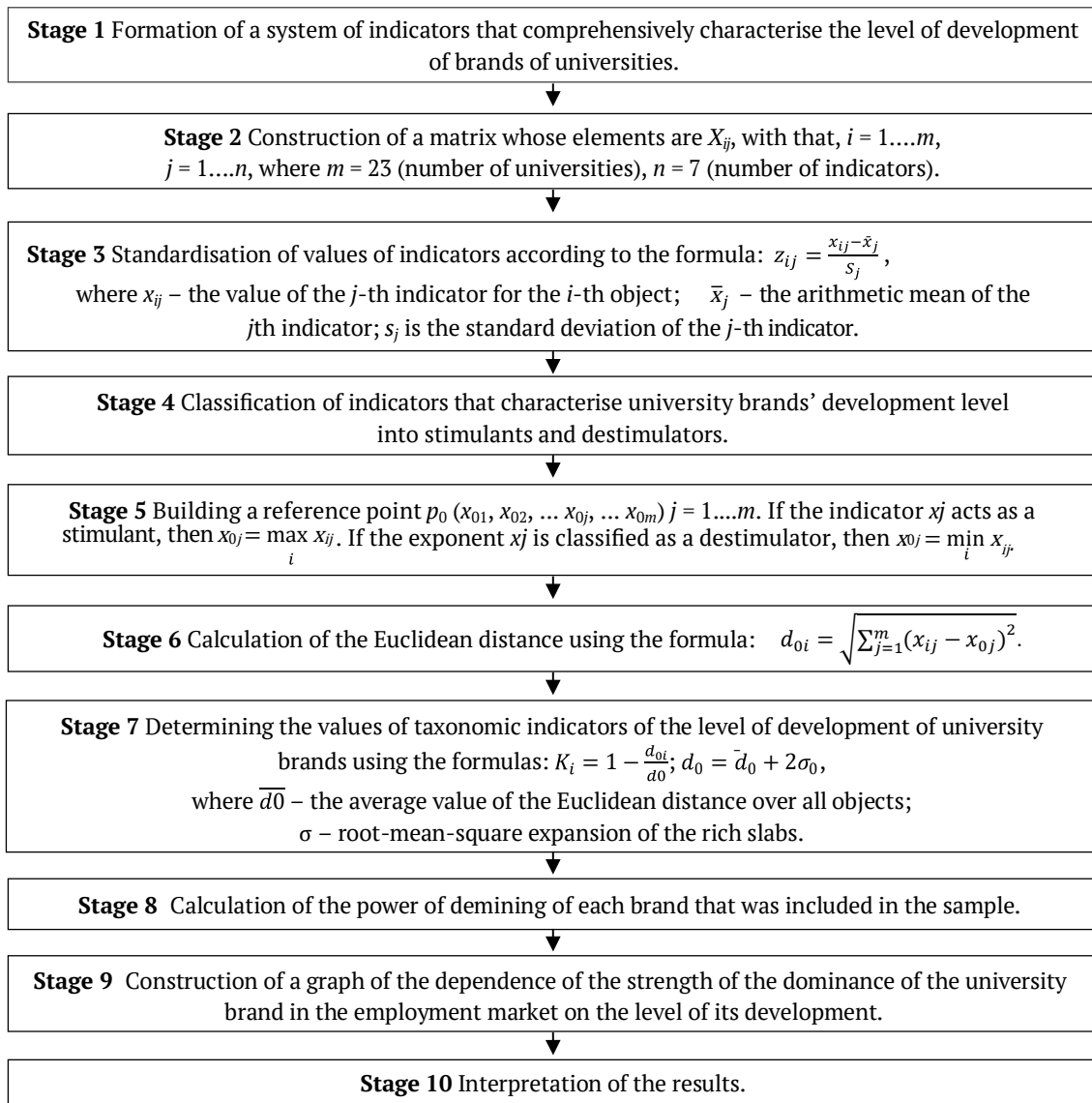
Approbation of the stages of conducting a comparative analysis of the level of development of brands of higher education institutions in terms of dominance in the employment market is presented in Figure 4, illustrated by calculations in Table 3, where the activities of leading universities of Ukraine are analysed. Thus, it can be concluded that the use of such an evaluation method as the method of taxonomic indicators for the comparative analysis of the brand of a higher education institution with competing brands allows to carry out a critical objective assessment of the level of development of the brand of a higher education institution, to compare the level of brand development of a particular institution with the level development of a competitor's higher education institution, to highlight higher education institutions that are leaders in the educational services market, to study and apply the positive experience of brand management as a system-forming factor of the entrepreneurial paradigm of higher education (Wei, 2022). Based on the established dependence between such indicators as the level of brand development and the power of brand dominance in the employment market, predict the strength of the authority of the institution's brand higher than a certain level of its development.

That is why it is possible to consider that the brand of a higher education institution is a guarantor of ensuring competitive advantages and an attractive investment for business structures.

Universities are central to creating knowledge in the post-industrial economies of the world's developed countries. The new role of universities is to find an increase in the relationship between education, science, business, and power in dynamic, innovative development. It is based on the awareness of the role of universities as multifactorial innovation networks. The business environment and governments see the university as an ideal springboard for finding common points of interaction because the activities of universities are impartial and are guided by the priority of innovative development and long-term perspectives rather than commercial interests and short-term goals. The critical functions of the university today are conducting scientific research and training future scientists and specialists, managers, and innovators (Fig. 4).

Stage 1 Formation of a system of indicators that comprehensively characterise the level of development of brands of universities.

$\downarrow$

Stage 2 Construction of a matrix whose elements are X_{ij}, with that, $i = 1....m$, $j = 1....n$, where $m = 23$ (number of universities), $n = 7$ (number of indicators).

$\downarrow$

Stage 3 Standardisation of values of indicators according to the formula: $z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}$, where x_{ij} – the value of the j-th indicator for the i-th object; $\bar{x}_j$ – the arithmetic mean of the jth indicator; s_j is the standard deviation of the j-th indicator.

$\downarrow$

Stage 4 Classification of indicators that characterise university brands' development level into stimulants and destimulators.

$\downarrow$

Stage 5 Building a reference point p_0 $(x_{01}, x_{02}, ... x_{0j}, ... x_{0m})$ $j = 1....m$. If the indicator xj acts as a stimulant, then $x_{0j} = \max_i x_{ij}$. If the exponent xj is classified as a destimulator, then $x_{0j} = \min_i x_{ij}$.

$\downarrow$

Stage 6 Calculation of the Euclidean distance using the formula: $d_{0i} = \sqrt{\sum_{j=1}^{m}(x_{ij} - x_{0j})^2}$.

$\downarrow$

Stage 7 Determining the values of taxonomic indicators of the level of development of university brands using the formulas: $K_i = 1 - \frac{d_{0i}}{d_0}$; $d_0 = \bar{d}_0 + 2\sigma_0$, where $\overline{d0}$ – the average value of the Euclidean distance over all objects; σ – root-mean-square expansion of the rich slabs.

$\downarrow$

Stage 8 Calculation of the power of demining of each brand that was included in the sample.

$\downarrow$

Stage 9 Construction of a graph of the dependence of the strength of the dominance of the university brand in the employment market on the level of its development.

$\downarrow$

Stage 10 Interpretation of the results.

Figure 3. Stages of conducting a comparative analysis of the level of development of brands of higher education institutions in terms of the power of dominance in the employment market

Source: authors' development

Table 3. Calculation results

Enterprises	Indicator value	Rating position
Taras Shevchenko National University of Kyiv	0.80427	1
Igor Sikorsky Kyiv Polytechnic Institute	0.710958	2
V. N. Karazin Kharkiv National University	0.706958	3
West Ukrainian National University (WUNU)	0.666747	4
Kyiv National Economic University, named after Vadym Hetman	0.662135	5
Kyiv National University of Technologies and Design	0.652134	6
Sumy State University (SumDU)	0.620164	7
Sumy National Agrarian University	0.598721	8
Kharkiv Polytechnic Institute	0.581004	9
Simon Kuznets Kharkiv National University of Economics	0.55937	10

Source: authors' development
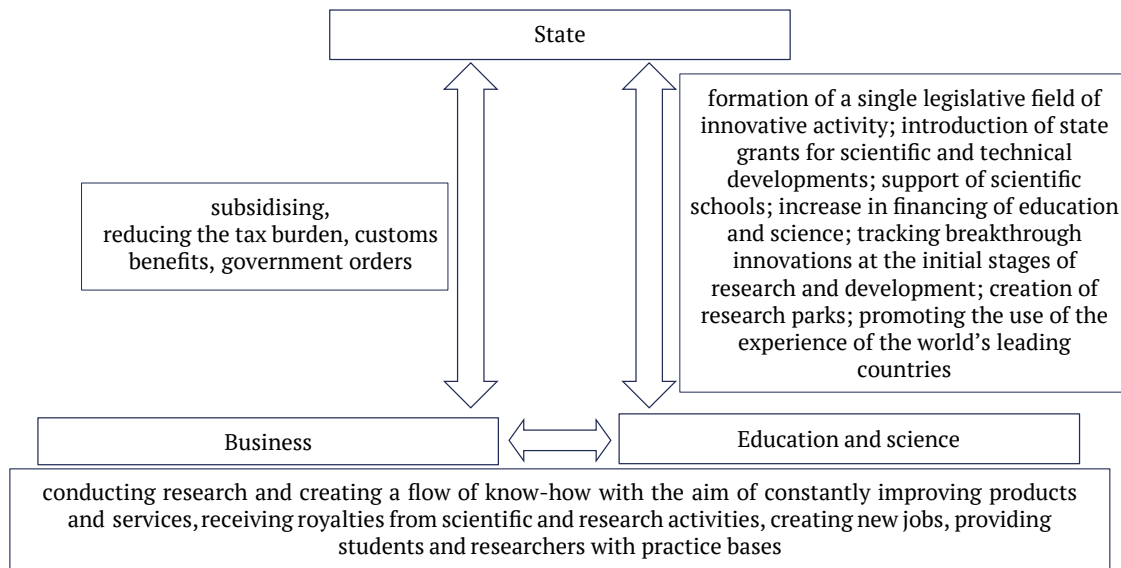
Figure 4. A generalised representation of the mechanism
of the entrepreneurial innovation system in higher education institutions
Source: author's development

The entrepreneurial innovation system of a higher education institution acts as one of the tools for forming a continuous chain of production of innovative goods and services. As one of the parties-organisers of interaction and a key participant in the entrepreneurial innovation process, the institution of higher education needs to develop provisions to form its entrepreneurial innovation system. As a result of using the mentioned provisions in the management practice of the institution of higher education, stable institutional forms of elements of the entrepreneurial innovation system should arise, which will significantly increase the effectiveness of its scientific and innovative activities.

■ CONCLUSIONS

To increase the effectiveness of a higher education institution's entrepreneurial scientific, and innovative activity, it is necessary to change all aspects of its activity, including organisational and management structure, scientific and innovative activity, educational process, marketing, and personnel. Today, higher education institutions can use various funding sources for their scientific research activities: state and non-state, their own and external organisations, domestic and foreign, etc.

External opportunities for attracting additional sources of funding for higher education institutions are: expanding cooperation with industrial enterprises, commercialisation of the results of scientific research, attracting funds from graduates and patrons, and use of scientific funds.

In the presented research, it was established that technical progress directly depends on the educational and professional level of specialists in integrating higher education with science and production. In the world's industrialised countries, new forms of such cooperation are constantly being improved and created, which leads to an increase in the practical significance of university scientific research, and creates conditions for the higher school

to obtain financial independence for conducting scientific research. Forms of direct stimulation of innovative activity during the state's implementation of special financial projects and programs can be significantly expanded. The development of university science and innovative activity is influenced at the state level and by industrial monopolies.

Thus, to create strategic alliances with the most significant foreign market operators both from the side of science and entrepreneurship, it is necessary to integrate Ukrainian market participants into the relevant European structures, which will make it possible to gain access to databases, stock exchanges, venture capital funds and to other informational and financial resources, will provide significant advantages for the registration of license contracts and international patents, to concentrate funds on the production of innovative products of the sixth technological order on the territory of Ukraine. Considering world experience, it is possible to expand the range of state instruments for stimulating innovations and mechanisms for their transfer. It was established that to improve the situation in, for example, the high-tech sphere of Ukraine, it is necessary to use the experience of developed countries to stimulate the development of the high-tech industry, innovative activity, and the implementation of its results in domestic production.

In the future, it is necessary to create an effective system of partnership relations regarding exchanging information and creating a single data bank to accelerate management and marketing decisions. Another form of cooperation between universities and industry is joint projects, in which the university's and industrial firms' scientific units participate. As a rule, such cooperation is based on long-term relations.

Further studies are planned to identify the main problems of the development of an innovative entrepreneurial system in the field of education and to determine which tools of the management and marketing unit can be used to overcome these obstacles; a promising direction is to

determine the main characteristics of the products of such a system, which are formed at each of the research stages, and in the presence of unsatisfactory characteristics, operative intervention in the process of creating and researching an innovative product is possible.

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Андрій Ігорович Крисоватий
Доктор економічних наук, професор
Західноукраїнський національний університет
46009, вул. Львівська, 11, м. Тернопіль, Україна
https://orcid.org/0000-0002-5850-8224

Олена Валеріївна Птащенко
Доктор економічних наук, професор
Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна
https://orcid.org/0000-0002-2413-7648

Механізм підприємницької інноваційної системи у закладах вищої освіти

■ **Анотація.** Актуальність дослідження зумовлена тим, що розвиток сучасного суспільства вимагає прискорення всіх господарських процесів. Тому для для формування наукового та освітнього простору необхідно приділяти більшу увагу залученню підприємницьких структур та органів державної влади до цього процесу. Мета дослідження – узагальнити теоретичні основи розробки механізму підприємницької інноваційної системи для закладів вищої освіти. У статті було використано загальнонаукові та специфічні методи дослідження, зокрема: порівняльний – для вивчення теоретичних засад розвитку галузі освіти та науки та формування категоріального апарату дослідження; аналіз і синтез – у процесі виявлення тенденцій розвитку у сфері освіти та науки. Були проаналізовані дослідження у сфері вищої освіти та сформульовані основні тенденції розвитку освітньої та наукової сфер, що дає змогу спрогнозувати основний вектор розвитку освітньої галузі. У представленому дослідженні було розглянуто основні особливості освітньої сфери з точки зору поєднання трьох основних складових: освіти, бізнесу та держави. При такому поєднанні визначено основні особливості розвитку науково-освітницької діяльності, як однієї з основних складових розвитку підприємництва. Проведені дослідження довели, що, перш за все, для формування інфраструктури науково-інноваційної діяльності необхідно активізувати зусилля на вдосконаленні та розробці нормативно-правової основи по широкому спектру питань науково-інноваційної діяльності. Представлено основні елементи та інструментарій підприємницької інноваційної системи, що дозволяють комерціалізовувати наукові проекти та дослідження. Практичне значення полягає в тому, що запропонована модель взаємодії бізнесу, держави та університетів є дієвим механізмом вирішення питання щодо формування системи підприємницької інноваційної ініціативи

■ **Ключові слова:** підприємництво; проєктна діяльність; інноваційні проєкти; освітня діяльність; комерціалізація проєктів