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DETERMINING THE IMPACT OF VUCA-WORLD AND BANI-WORLD ON THE ACTIVITIES OF ENTERPRISES IN THE EXPERIENCE ECONOMY

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The relevance of the research is determined by the need to determine the basic models of functioning of the internal and external environment of enterprises both separately and in their interconnection and taking into account mutual influence. Since it is a recognized fact that the modern external environment is constantly transforming, becoming more complex and moving from one state to another, more complex, its main manifestations are VUCA-world and BANI-world, which is also typical for the Ukrainian economy. Therefore, the purpose of this study is to publish the developed methodology for determining the impact of VUCA-world and BANI-world on the activities of enterprises in the impression economy and to present the results of its practical testing. The object of the study is the course of influence of VUCA-world and BANI-world factors on the factors of the internal environment of domestic enterprises in the conditions of the experience economy. The subject of the study is to improve and further develop the theoretical, methodological and methodological support for the analysis of external environment factors according to the most common VUCA-world and BANI-world models and the factors of the internal environment of industrial enterprises in the context of the experience economy. The research methods used were analysis and synthesis, theoretical generalization, structural and logical analysis, systematic approach, multidimensional factor analysis, neural networks, and the method of additive convolution. The main results of the study are the developed methodology for determining the impact of VUCA-world and BANI-world on the activities of enterprises in the context of the impression economy and its practical testing, which includes the following stages: analysis and substantiation of factors and indicators of the internal and external environment of enterprises using the method of multivariate factor analysis; modeling of functional relationships between indicators of the internal and external environment separately and in their direct and inverse relationship using the method of neural networks; definition and p The conclusions of the study are as follows: proving the nonlinearity of the impact of VUCA-world and BANI-world on the activities of enterprises and vice versa through the built models of interconnection, which are nonlinear models of the multilevel perceptron; substantiation and rating of indicators of sensitivity of the internal and external environment of enterprises, selection of the top 3 from their composition; formation of proposals for managing the activities of enterprises in a complex nonlinear internal and external environment.

Introduction

Over the past 5 years, Ukraine has been experiencing 2 major economic and social crises, caused in 2019 by the COVID-19 pandemic and exacerbated in 2022 by a full-scale military invasion. These conditions pose a significant challenge to the

external environment for businesses. In order to successfully withstand these conditions, business entities must constantly improve and develop their activities, adapting to the impact of external factors, and adapt their internal state by increasing the level of innovation. This is confirmed by the practice of developed countries, where innovations are the main driving force of socio-economic development, and economic relations are developing according to the latest economic models. One of the most promising models is the impression economy model, which focuses on the formation of positive impressions of the achievements and capabilities of enterprises by their stakeholders. The difficulty of the impression economy model is to take into account the transformation that takes place in the external environment of enterprises. Changes in the influence of the external environment are caused by its characteristics – variability, uncertainty, nonlinearity and fragility. Such changes are inherent in the economic relations of all countries of the world due to the transformation of the external environment of enterprises in the international economic environment of the globalized world, as noted by scholars [1–10]. The stable, expected, simple and defined SPOD-world has become inherent only in certain industries in certain countries. In general, the external environment in most industries and countries is becoming volatile, unknown, confusing, unclear, i.e., it is turning into a VUCA-world, fragile, weak, anxious, disturbing, nonlinear, inexplicable, incomprehensible, which corresponds also to the BANI-world, economic relations are gradually plunging into disorder, chaos, self-centeredness, turbulence, i.e., the DEST-world is beginning to form [3, 4]. In order to be successful in such a situation, enterprises must use adequate methods, management models based on in-depth studies of the composition of external environment factors, their sensitivity to change, and the internal environment to determine the possibility of their adaptation to the transformation process, which should be based on innovative processes. These issues have been studied by many scientists [4–7], who proposed certain measures to counteract the manifestation of the troubles of these worlds. However, this issue still remains open, since all aspects of the impact of these unstable worlds in relation to the innovative development of enterprises in terms of their ability to use and manage internal factors and influence external ones in the context of the impression economy have not been clarified and studied.

Therefore, the relevance of the chosen topic is beyond doubt. In this regard, the aim of the study is to publish the developed methodology for determining the impact of VUCA-world and BANI-world on the activities of enterprises in the conditions of the impression economy and present the results of its practical testing.

The object of the study is the course of influence of VUCA-world and BANI-world factors on the factors of the internal environment of domestic enterprises in the conditions of the experience economy.

The subject of the study is to improve and further develop the theoretical, methodological and methodological support for the analysis of external environment factors according to the most common VUCA-world and BANI-world models and internal environment factors of industrial enterprises in the context of the experience economy.

The research methods used are general scientific and special methods of cognition: analysis and synthesis, theoretical generalization, structural and logical analysis, systematic approach, multidimensional factor analysis, neural networks, additive convolution method, graphical method.

1 VUCA-world and BANI-world: characteristics and research methodology

The modern world is unpredictable, risky, and fragile. Nowadays, more and more scientists are devoting their attention to researching and studying this world. In scientific and economic circles, it is common to call this world the VUCA-world and the BANI-world. These worlds are different, but many scientists consider them together, as no exact boundary for their separation has been proposed. Work [4] notes that the VUCA-world is focused on the unpredictability of external and internal circumstances of society's development.

VUCA is an abbreviation of the English words: Volatility; Uncertainty; Complexity and Ambiguity. In this world, everything is changing rapidly, it is difficult to predict the future, the level of confusion, tension and chaos is growing, and problems are being formed due to the difficulty of understanding various facts and causes. However, this difficult world is being replaced by the BANI world, which is even more unpredictable than the previous one. The beginning of the BANI-world is considered to be the beginning of the Covid-19 period, as noted by Professor J. Cascio of the University of California [5]. The BANI world consists of four English words: Brittle; Anxious; Nonlinear and Incomprehensible. This world reflects the instability of systems that can unexpectedly change the direction of their action, i.e. "break", characterizes the growing level of stress and anxiety due to the unpredictability of events, their nonlinear development, when even minor changes can have significant consequences and situations that are difficult to understand or explain due to their complexity. Such conditions of the described worlds are characteristic of certain industries, geographical areas, and enterprises.

It is impossible to assert that absolutely all economic relations have the characteristics described. There are certainly some parts of economic relations that still function in the SPOD world. Thus, economic relations are similar to certain unevenly arranged puzzles that seek to take their place in the world economy. However, most of these puzzles function in the VUCA world and the BANI world.

Global economic crises, pandemics, and wars have created new challenges that many countries, regions, and businesses have not been prepared for. Only those organizations that are able to change approaches to managing their activities, ensure high adaptability and flexibility can survive and continue to operate successfully in the market in the new conditions [3].

The presented results of the study on the behavior of enterprises in the process of functioning in unstable conditions of their work [6] are concentrated in a three-stage model that will help enterprises to be successful in the VUCA-world. In accordance with the model, it is advisable to define your VUCA-world, i.e., describe it, research it, identify factors; identify obstacles to ensuring adaptive behavior; implement practices that increase flexibility. The proposed three-stage model is indeed an interesting way to confront the changing and unexpected conditions of the external world. The first stage emphasizes the importance of managers understanding where their companies are in their development and where they stand. Only those who understand and correctly assess their advantages and disadvantages will be able to survive in VUCA-world. After identifying the weaknesses of their company, managers must assess what obstacles are preventing them from eliminating the shortcomings or will prevent them from eliminating them. And at the third stage, managers should not only make changes to eliminate the shortcomings, but also apply reasonable measures that will increase the flexibility and adaptability of the enterprise to unstable environmental conditions. In other words, it is advisable to model the behavior of the enterprise, identify the most sensitive indicators and influence changes in their values so that the enterprise follows a certain development trajectory.

There are also other models for adapting, taking into account or opposing the effects of the VUCA world and the BANI world. These models have the same names as their worlds and involve the use of appropriate methods. In order to reduce the negative impact of the VUCA-world, it is advisable to use the VUCA method [7], which means:

V – Vision forms an idea of where and why the company is moving, for what purpose, what risks it may face, values and business philosophy;

U – Understanding implies awareness of constant changes in business, which is the norm of existence, the reasons for which lie in the changing environment;

C – Clarity means eliminating unimportant things, focusing on strategic areas of activity, optimizing production and business processes;

A – Agility means rapid adaptation to environmental changes, formulating a list of alternatives for making operational and strategic decisions.

To reduce the negative impact of the BANI-world, it is proposed to use the BANI method, which focuses on the following:

B – Balancing is the search for balance in all processes of the enterprise. Managers are able to analyze changes in real time and make effective decisions. The company's management should stimulate effective interaction between structural units. Regular communication and information exchange help to ensure understanding and comfort with the purpose, scope, and expectations of the goals;

A – Adaptability – the ability to adapt quickly. The company's management should adapt and improve in accordance with changes and create new strategies, optimize the use of available resources, and employees should be ready to learn something new quickly;

N – Nous – the ability to use the principle of common sense, to look for optimal but creative ways to solve problems. Business units should be open to innovative ideas, look for new opportunities and be ready to introduce new products, services, methods, technologies, etc;

I – Intuitive – the ability to plan and predict in the face of uncertainty.

The unpredictability of the BANI world is accompanied by increased risks. Enterprise management should be focused on identifying and assessing the risks of its activities. Effective risk management will allow you to successfully perform work even in difficult economic and other conditions.

The worlds of VUCA and BANI intersect and create a certain symbiosis; it is impossible and inappropriate to consider them separately. Summarizing these two worlds, it can be concluded that the use of the VUCA method allows enterprises to be competitive in a changing business environment and ensure further development of their business activities. Over the past few years, the world has been characterized by turbulence and fragility, which are inherent in the BANI world. Thus, modern enterprises must respond quickly and invent new strategies and intensify innovation in a rapidly changing environment, while engaging intuition, emotional intelligence and developing creative thinking, which is inherent in such a model of economic relations as the experience economy [11].

In general, global economic relations are transforming into six models [11].

The first model is the exabyte economy, which combines devices, digital technologies, and human capital as its main components. After all, two-thirds of the world's population uses mobile phones, and more than half have access to the Internet. Under martial law in Ukraine, remote work has become widespread and is growing annually, new Internet services such as the Internet of Things are emerging, the speed of Internet networks is increasing due to 5G technology, and certain activities and services are practically moving into the online space, such as education, healthcare, trade, banking, financial settlements, office work, reference information, statistical data transmission, etc. Digitalization and digitalization trends are expanding to varying degrees to almost all types of activities.

The second model is the wellbeing economy, which is based on changes in the behavior of the population and its approaches to lifestyle, mental state, psychology of relationships, and physical health. Such changes affect the volume of production, provision of services by lifestyle-related industries, namely, healthy lifestyles, self-development, other psychological and organizational practices, behavioral changes that involve an increase in travel, namely, health, gastronomic, extreme, green, and educational tourism. In other words, due to changes in lifestyle and behavior, economic relations are undergoing transformations that expand opportunities and promote the development of service businesses, creative cultural industries, certain healthcare services, and sporting events, which expands not only individual national markets but also the global market for certain industries.

The third model of the economy is the carbon-neutral economy, characterized by environmental protection, which involves reducing CO2 emissions through the use of innovative products, technologies and investment models for the use of alternative energy sources and the latest types of energy resources.

The fourth model is the circular economy, which is based on consumerization, conscious consumption of products and use of services in an effort to extend their service life. The need for the formation and use of the circular economy is driven by the growth of the population and the need to provide it with food, goods, and services, the number of which is growing at a slower rate than the population growth rate. The functioning of a closed-loop economy or circular economy is aimed at reducing the negative impact on the external environment, lean production, and waste reduction.

The fifth model is the biogrowth economy, which involves limiting resources in an effort to ensure the welfare of the population and its comfortable living. Therefore, the biogrowth economy is aimed at the growth and introduction of genetic engineering achievements into production, the creation of new

biomaterials capable of self-destruction, which will be useful in the processing of certain types of products into others.

The sixth model of economic relations is embodied in the experience economy, which, in terms of development prospects and sectoral scope, has the best result of implementation and forecasting of its development prospects. This is confirmed by the thesis that decision makers in both the production and service sectors are guided not only by rational information but also by subjective impressions, motives and expectations, since a management decision is objective and subjective in nature, as it is based on rational and emotional expected values and benefits. It is the essence of the decision-making motives that plays a leading role in this model. Industry affiliation determines the predominance of rational or emotional motives. In other words, in the impression economy, the positioning of business entities on the rational-emotional continuum varies depending on their industry affiliation, factors of influence, motivation, specifics of relations with partners and aspirations of partners, consumers and certain segments of the market and society interested in the functioning of business entities from the standpoint of their material value, social profitability and capacity. The social and emotional play a significant role in the impressions economy, while technological innovations fill them with new content and opportunities. This applies to the milestones of the national economy and involves the use of such achievements as artificial intelligence, 3D reality technologies, biogenic engineering, etc.

Thus, the experience economy is becoming a new promising model of economic relations in any sphere of production and services, based on the solvency of partners and consumers, their conscious consumption based on rational management decisions, and at the same time paying attention to greening with care for the environment, obtaining additional social, cultural, psychological, and experiential pleasures through the formation of experiences. That is, in the chain "raw materials – products – services – impressions", the value and added value increases with each element, i.e., it migrates from raw materials to impressions.

The impression economy is able to mitigate the challenges of the VUSA and BANI worlds to some extent by identifying factors and indicators that can convey positive impressions to consumers and partners of enterprises about the performance of enterprises and their future opportunities. In other words, the impression economy is the model that will allow to rebuild the national economy in the postwar period, so it is advisable to pay significant attention to its development and use it to achieve the success of enterprises.

In the current difficult conditions of martial law, Ukraine has a BANI world, which was not only caused by COVID-19 but also reinforced by the event that took place on February 24, 2022. A full-scale war in real time demonstrates the fragility and anxiety of the outside world. Considering these worlds, the authors of the study proposed a methodology consisting of a sequence of stages and methods that should be used by enterprises to ensure the success of their activities in the worlds under consideration, which are characteristic of the external environment in the current conditions of the impression economy model:

– analysis of external and internal environment factors, determination of the most relevant factors of priority importance, for this purpose it is advisable to use the method of modeling by multivariate factor analysis;

– determination of adequate models of the relationship between these factors; as a method of determining the relationship, it is advisable to use neural networks that are close in their algorithm to the process of human thinking, it is possible to hypothesize that such models and relationships between the factors of the internal and external environments of enterprises will be non-linear;

– in accordance with the selected and substantiated models, to forecast the values of indicators of the internal and external environment and to determine the most sensitive indicators characterizing the factors of the internal and external environment by rating;

– to make management decisions on changing the values of selected sensitive indicators, the impact of which will allow enterprises to adapt to the relevant changing world as soon as possible in the process of functioning of the impression economy model;

– to use change-sensitive indicators as a basis for forming positive impressions of the enterprise (according to the impression economy model), which are characteristic and necessary for the growth of their added value and profit at a faster rate compared to other models of economic relations development to start and continue productive cooperation with partners and relationships with consumers.

The proposed methodology can be applied to both the VUCA world and the BANI world, which proves its universality. The difference lies in the indicators selected to characterize these two worlds. It is the justification of the indicators that will take into account their peculiarities, while the process of managerial influence can be carried out according to the same algorithms and procedures.

Common to the life of enterprises in these two worlds is the proposal to intensify innovation activities, increase the level of innovation, which can significantly affect the formation of positive impressions of the enterprise among

consumers and partners, its performance and opportunities. Thus, innovative development is the key to the success of enterprises, as noted by many scientists in their works [14, 21–30].

Any socio-economic system succeeds in its activities if it is in a state of consistent and steady development. Innovative development of an enterprise as an economic category is a set of relations that arise in the course of a targeted increase in the economic efficiency and competitiveness of an enterprise on the basis of qualitative changes that provide innovation [22].

The competitiveness of the national economy is one of the determining factors in ensuring sustainable development and well-being of the country, stability of the national economy in the context of global economic crises and a factor in raising social standards. In order to ensure the competitiveness of the national economy, both large and medium-sized and small enterprises must intensify their innovation activities [25].

The intensification of innovation is the main condition that ensures the development and improvement of production efficiency of enterprises, and thus contributes to their competitiveness. Implementation of innovative changes should take place on an ongoing basis, which requires management to manage these changes in a targeted and thoughtful manner. One of the reasons for the failure to implement innovative changes is the lack of effective organizational support for the activation of the innovation management system at the enterprise [27–29].

Many studies show that local authorities play an important role in stimulating innovation. In this case, not only direct investments from the local budget are important, but also the creation of favorable institutional and legal conditions for innovation [25, 28]. Funds from local sources are usually allocated on a competitive basis or by direct decision of local authorities. Informal mechanisms are also important, and their role is growing with the increase in funding.

An analysis of the factors that contribute to the intensification of innovation activities of enterprises shows that, first, the innovation process is market-oriented and should take into account the needs of both the national and global markets; second, the production of innovations must meet the level of effective demand; third, it is necessary to form an innovation infrastructure. On 14.03.2023, the Department of Investment, Innovation and Intellectual Property published information on the state of development of innovation infrastructure on the State website of Ukraine, where it was stated that Ukraine has created and is operating in accordance with the Strategy for the Development of Innovation Activities until 2030: industrial parks, technology parks, centers of innovation and technology transfer, commercialization centers,

innovative business incubators, clusters, etc. However, their activities are hampered by the hostilities. In order to intensify innovation, it is necessary to restore state financial support by amending the legislative acts that regulate its receipt and in which its effect is suspended, to initiate the adoption of the draft law "On State Financial Support for Innovation", which would provide state financial support and benefits through the creation of venture capital funds at the regional and state levels. In order to make the right decisions in innovation, it is necessary to process a large amount of information. In this regard, it is advisable to create centers of innovative knowledge. Taking into account the unsatisfactory current state of marketing support of innovation activities of enterprises, which is aggravated by the low level of information support at enterprises and the decrease in the creative activity of employees, it is necessary to improve the work of marketing departments and to direct their activities to the implementation of innovative research [22], which would have a direct connection with the regional and the State Center for Innovative Knowledge. At the stage of intensification of innovation activity, it is important to quickly and efficiently perform each stage and phase of the innovation process, reflecting the transition of innovation to material production: from the initiation and implementation of basic research, prototyping and laboratory testing, to the organization of serial or mass production of new products and their implementation and maintenance. In addition to accelerating the quality of the stages, it is also very important not to spend more time than competitors at the intersections of stages and phases of the innovation process.

To intensify the innovation activities of enterprises, it is necessary to determine the direction, features and composition of the factors of influence of the external environment on the internal environment of enterprises, namely their innovation activities. In article [15], the authors refer to the internal influence as: production; economic; environmental; innovative and organizational and structural factors. They divided the external influence into the macro level, which is characterized by: scientific and technical; geographical; economic; environmental; social; state and political factors and the micro level, which includes suppliers and consumers. The authors of [16] propose a division into endogenous and exogenous factors of innovation potential. Thus, they include the following endogenous factors: history and image of the enterprise; strategic priorities; quality of management; marketing; production; financial condition and economic situation. The exogenous factors include the political and legal environment; economic environment; technological environment; scientific and technical environment; socio-cultural environment; and competitors.

The authors of [17] propose to divide internal factors into 5 groups: production factors; financial factors; market factors; organizational factors; and human factors. External factors are divided into macroeconomic, political, social, and environmental.

In addition, a balanced scorecard can also be used to identify the impact of factors on the company's operations. A balanced scorecard is a system of strategic management of an organization based on measuring and evaluating the effectiveness of its activities by a set of indicators selected in such a way as to take into account all significant (from the point of view of strategy) aspects of the organization's activities (financial, marketing, production, etc.) [18].

Summarizing the proposals of scientists, as well as relying on the possibility of taking into account the quantitative values of the measurement of factors, their list can be presented as follows. The internal environment may include financial, material, technical and technological, human, information, innovation, marketing, and organizational factors. External factors include economic, scientific and technical, political, legislative, socio-demographic, environmental and geographical.

Since it is necessary to find the impact of VUCA-world and BANI-world on the enterprise's activities, it is necessary to understand that it is necessary to choose an analysis that will take into account the nonlinearity of these two worlds and, among a large amount of input information, will leave only those indicators that will have a high impact. In many cases, the performance indicator is influenced by more than one factor. There are complex interrelationships between the factors, so their impact on the performance attribute is complex. In this case, multivariate factor analysis can be used for mathematical modeling, which makes it possible to prioritize indicators and reasonably reduce their number without losing information. Multivariate factor analysis is a research method used to study and evaluate the impact of several variables (factors) on a dependent variable. This analysis helps to understand how different factors interact with each other and how they jointly affect the results [31, 32].

The advantages of this analysis are as follows: this method provides a comprehensive view of the impact of various factors on the results, which helps to make informed management decisions. Improves forecast accuracy by taking into account more variables and their interaction. Reduces the risk of simplistic analysis by taking into account more aspects of the problem.

Among the disadvantages is that the use of multivariate factor analysis requires a large amount of data and data quality for accurate results. There is a risk of creating an overly complex model that takes into account too many variables, which can lead to overfitting and poor generalizability of results. Conducting multivariate

factor analysis can be very costly in terms of time and resources, especially for large and complex studies.

After obtaining the results of multidimensional factor analysis, which is able to reasonably limit the number of indicators by factors, the next step is to combine them into integrated indicators for internal and external environments using the same methodology to achieve comparability (ISP) by the additive convolution method [32]:

$$ISP = \sum_{i=1}^{n} C_{sign.i} \frac{X_{ac.i}}{X_{r.i}} \quad (1.1)$$

where, $C_{sign.i}$ is the significance coefficient of the i -th partial indicator;

$X_{ac.i}$ – actual value of the i -th partial indicator;

$X_{r.i}$ is the reference value of the i -th partial indicator;

n – number of partial indicators.

Having calculated the integral indicators for the internal and external environments, the next step is to find out whether the environments actually influence each other. To do this, you need to use the neural network method. Neural networks are one of the methods of machine learning, a subdivision of artificial intelligence (AI), and are the basis of deep learning algorithms. They are able to search for patterns in unstructured data and solve many problems [33].

Neurons process input signals using a specific activation function [34]. Neurons are organized into 3 layers: input layer, hidden layers, and output layer. Input layer: receives input data. Hidden layers: process input data through weighted connections. Output layer: generates the final result of processing. Activation functions characterize the types of connections between the internal and external environments. Since, according to proposals and hypotheses, the worlds under consideration are characterized by non-linear relationships, the most likely function is a multi-layer perceptron. A Multi-Layer Perceptron (MLP) is a type of artificial neural network consisting of at least three layers of neurons: an input layer, one or more hidden layers, and an output layer. It is one of the simplest and most common types of neural networks for classification and regression tasks.

Neural networks, in particular multilevel perceptrons, are appropriate for proving the nonlinearity of worlds because they are able to learn and model complex nonlinear relationships between variables. They effectively use nonlinear activation functions and multilayer architecture to detect and process nonlinear patterns in data, confirming that the real world contains complex relationships that cannot be reduced to simple linear models [33, 34].To apply neural networks,

we chose the Statistica 10.0 application program, a statistical analysis package developed by StatSoft. In the same package, it is possible to determine the sensitivity rating of indicators by factors in order to model changes in their quantitative values with the greatest effectiveness of influence on the relationship between the internal and external environments of enterprises.

As the main indicators of the internal environment, it is advisable to choose those that characterize innovation activity, since world experience shows that in the most economically developed countries, innovation is a crucial condition for ensuring stable long-term economic development [35, 36]. For example, Japan's innovative development has the following features: enhanced government intervention in the management of innovative development; promotion of the acquisition of science and technology achievements of foreign countries by enterprises; close interaction of all stages of the innovation process; creation of togusan (large innovative business structures) to develop joint investment projects to penetrate new areas; financial support for science at universities; a system of preferential taxation and lending. The source of South Korea's economic growth is large industrial groups and government support for their innovative development. China is characterized by an imitation model of innovative development based on active imports of foreign technologies and their industrial assimilation for the purpose of manufacturing high-tech products. The country has created a streamlined system of centralized management, and a program-targeted approach to the development of scientific and technical programs is widely used [35, 39].

Germany, the United Kingdom, France, the United States, and Japan form the technological core of global development. Each of these countries is a world leader in terms of absolute expenditures on research and development. In other countries, tax incentives are used to stimulate scientific and technological progress. For example, preferential tax regimes have been introduced in the United States, Germany, the United Kingdom, Italy, Japan, and Brazil [38]. According to international experience, improving the system of innovation management at enterprises requires theoretical and practical research on the possibilities of stimulating innovation not only at the enterprise level, but also at the national level, in particular, ensuring favorable conditions for investment, improving innovation, economic and tax policies, strengthening legal guarantees [39–40]. An effective innovation management system is an efficient tool for the development of enterprises in the modern competitive environment. Innovative activity in an unstable world, such as the VUCA-world and the BANI-world, allows enterprises not only to survive but also to achieve long-term success. It allows to adapt to rapid changes, increase

competitiveness, use resources efficiently, meet new market needs, ensure sustainability and open up new opportunities for development, attract consumers and attract profitable partners, so it is advisable for enterprises in the era of unstable worlds to use such a model of economic relations as the model of the experience economy, which allows to increase added value and profit at a faster pace than other models of economic development.

2 Modeling the relationship between the internal environment of enterprises and the external environment VUCA-world and BANI-world

In the process of building economic relations based on the impression economy model, it is necessary to clearly define which indicators should be used to convey information to consumers and partners in order to form positive impressions of the enterprise, its performance and expectations, due to which these stakeholders will seek to cooperate with business entities. This task is especially challenging in an unstable external environment – VUCA-world and BANI-world.

The modern economic world, where uncertainty, complexity and fragility are the norm, creates obstacles and challenges for business entities. In order to understand what exactly is happening in the external environment, where to direct management decisions and production capacities, and what innovations to implement, it is necessary to conduct an in-depth analysis of these two environments. To do this, it is advisable to use the methodology described in the previous subsection, which involves the following steps.

The first stage involves data collection. Using the literature sources analyzed in Section 1, data were collected for the primary system of indicators that objectively characterize the state of the internal and external environment for the period 2015–2023. Thus, in the internal environment, 24 indicators were identified, the average values of which for 10 food industry enterprises are presented in Fig. 2.1, in the external environment – 14 partial indicators, which are shown in Fig. 2.2, which were prepared for processing by the STATISTICA 10.0 application package.

The second stage consists in the use of multivariate factor analysis with the help of STATISTICA 10.0 application software.

The results of the analysis of the internal environment are shown in Figure 2.3, which presents the eigenvalues of the factors, their variance and cumulative variance, and Figure 2.4, which shows the factor loadings by partial indicators in the factors.

The value of cumulative variance is more than 70% [32]. it is possible to determine the number of factors to be considered. In this case, this value is 73.02% of the variance of the primary data, which is sufficient to continue the analysis. The corresponding number of factors to be considered is 3.

STATISTICA - [Дані: Таблиця (38v * 9c)]

Файл Правка Вид Вставка Формат Аналіз Добування Даних Графіка Сервіс Дані Вікно Довідка

Додати у Робочу книгу Додати у Звіт Додати у MS W

Calibri 11

	1 Absolute liquidity ratio	2 Return on total equity	3 Net profitability of sales	4 Capital turnover ratio	5 Financial stability ratio	6 Capital manoeuvrability ratio	7 Financial risk ratio	8 Fixed asset serviceability ratio
2015	0,02	0,08	0,72	15,74	0,01	1,00	146,45	0,00
2016	0,04	-22,39	-25,06	-8,23	-0,15	1,00	-7,69	0,00
2017	0,01	-61,02	-49,80	-3,43	-0,47	1,05	-3,12	0,82
2018	0,01	-7,57	-2,78	-6,25	-0,41	1,18	-3,44	0,95
2019	0,05	6,65	0,03	75,78	0,26	0,82	2,79	0,94
2020	0,02	1,43	0,48	-12,70	-0,20	1,95	-6,11	0,86
2021	0,05	2,87	1,66	11,16	0,18	0,23	6,30	0,78
2022	0,01	1,06	1,15	6,00	0,21	-0,09	4,76	0,71
2023	0,01	1,96	1,89	5,43	0,21	0,18	3,77	0,54

	9 Fixed asset renewal rate	10 Return on assets	11 Capital equipment	12 Share of material costs in the cost of production	13 Share of employees employed full-time	14 Share of employees aged 29 to 50 years	15 Share of employees with university degrees	16 Share of employees trained in new professions
2015	0,00	0,00	0,00		100,00	60,00	60,00	0,00
2016	0,00	0,00	0,00	37,98	100,00	50,00	68,75	6,25
2017	1,00	108,52	12,21	42,69	100,00	60,87	65,22	0,00
2018	0,75	44,70	32,71	68,11	100,00	61,36	68,18	2,27
2019	0,22	24,75	24,91	69,13	100,00	68,06	72,22	0,00
2020	0,70	14,18	75,88	52,62	100,00	59,15	61,97	0,00
2021	0,54	9,76	149,50	58,56	100,00	58,57	57,14	2,86
2022	0,25	4,29	200,31	44,57	95,38	67,69	41,54	0,00
2023	-0,26	5,02	122,38	59,14	95,16	58,06	46,77	0,00

	17 Share of employees who improved their skills in the reporting year	18 Share of labour costs in total production costs	19 Average annual output per employee	20 Share of employees performing R&D work	21 Share of trade mark expenses in total expenses	22 Share of innovative products (flavour) in the total volume of products shipped	23 Share of new technologies acquired abroad in total acquisitions	24 Share of production facilities modernisation in total expenditure
2015	0,00	25,20	0,00	13,33	9,69	0,00	0,00	0,00
2016	12,50	21,96	27355,82	18,75	0,39	0,00	0,00	3,09
2017	8,70	36,15	53465,57	21,74	0,07	5,24	0,00	0,26
2018	0,00	49,58	72274,00	15,91	0,06	0,00	0,00	2,22
2019	6,94	110,44	75444,35	11,11	0,06	0,00	0,00	0,47
2020	1,41	79,19	111981,55	11,27	0,01	0,00	2,52	7,14
2021	0,00	76,38	97233,35	8,57	0,04	4,36	1,77	0,07
2022	0,00	85,92	89047,57	7,69	0,11	15,75	0,00	4,95
2023	3,23	68,08	69471,11	8,06	0,01	0,00	0,00	0,25

Fig. 2.1. Baseline data on indicators of internal environment factors

	25 Nominal GDP of Ukraine	26 GNI	27 Inflation index	28 Economic decline index	29 Total turnover of business entities	30 Business freedom index	of active enterprises by type of economic activity (Code NACE	32 Taxes on income, profits, and capital gains	33 Taxes on goods and services	34 Economic freedom, overall index	35 Total population	36 Net migration	37 Number of registered unemployed	38 Human flight and brain drain index
2015	1979458	9,48E+10	143,3		92044,7	59	3	11,14907	40,00627	47	45154036	-21937	461,1	
2016	2383182	9,43E+10	112,4	7	102455	57	4	15,16648	44,54158	47	45004673	-54333	407,2	5,4
2017	2982920	1,14E+11	113,7	6,8	137116,4	62	3	14,50349	43,99258	48	44831135	-50447	352,5	5,2
2018	3558706	1,32E+11	109,8	6,6		63	7	16,35945	43,68816	52	44622518	-33273	341,7	4,9
2019	3974564	1,56E+11	104,1	6,5	172461,2	66	12	16,99131	40,36539	52	44386203	-7812	338,2	5,2
2020	4194102	1,60E+11	105	6,2	236868,6	61	13	16,41963	40,0977	55	44132049	-2173	459,2	5,5
2021	5459574	1,94E+11	110	6,8	181987,2	64	15	17,26709	43,35201	56	43822901	831	295	5,8
2022	5191028	1,69E+11	126,6	6,5		61	18	11,97265	26,2739	54	38000000	-6673580	186,5	5,9
2023	6437825		105,1	8,5								1784718	96,1	8,9

Fig. 2.2. Baseline data on indicators of external environment factors

Знач.	Власні значення (Таблиця даних1) Виділення: Головні компоненти Власн. Знач.	% загал. дисперс.	Кумулятивн. Власн. Знач.	Кумулятивн. %
1	9,300502	38,75209	9,30050	38,75209
2	4,657332	19,40555	13,95783	58,15764
3	3,567411	14,86421	17,52525	73,02186

Fig. 2.3. Results of multy/exploratory factor analysis
by internal environment of enterprise

Змінні	Фактор. навантаження (Без. оберт.) (Таблиця даних1) Виділення: Головні компоненти (Зазначені навантаження >,700000) **Фактор 1**	Фактор 2	Фактор 3
Absolute liquidity ratio	-0,140321	0,172574	-0,780036
Return on total equity	-0,797132	0,134954	-0,391206
Net profitability of sales	-0,835105	0,052436	-0,276608
Capital turnover ratio	-0,396384	-0,085889	-0,668335
Financial stability ratio	-0,785418	0,464460	-0,317930
Capital manoeuvrability ratio	0,542290	-0,581389	-0,176527
Financial risk ratio	-0,826363	0,146271	-0,012052
Fixed asset serviceability ratio	-0,439107	-0,870559	0,027949
Fixed asset renewal rate	0,300342	-0,823406	0,269388
Return on assets	0,504127	-0,609427	0,292918
Capital equipment	-0,822029	0,252647	0,427626
Share of material costs in the cost of production	-0,482006	-0,453257	-0,544011
Share of employees employed full-time	0,570310	-0,500192	-0,500812
Share of employees aged 29 to 50 years	-0,618651	-0,434917	0,082561
Share of employees with university degrees	0,640333	-0,398443	-0,635396
Share of employees trained in new professions	0,539232	0,528756	-0,316065
Share of employees who improved their skills in the reporting year	0,746984	0,333766	-0,288074
Share of labour costs in total production costs	-0,857726	-0,247755	-0,297895
Average annual output per employee	-0,745276	-0,493474	0,097398
Share of employees performing R&D work	0,960295	-0,175779	0,067289
Share of trade mark expenses in total expenses	0,617845	0,669502	-0,125164
Share of innovative products (flavour) in the total volume of products shipped	-0,372401	0,185074	0,662814
Share of new technologies acquired abroad in total acquisitions	-0,220572	-0,369208	-0,065806
Share of production facilities modernisation in total expenditure	-0,051775	-0,062098	0,325673
Загал.дис.	9,300502	4,657332	3,567411
Загал.частка	0,387521	0,194056	0,148642

Fig. 2.4. Factor loadings of indicators for internal environment

To improve the result of selecting partial indicators in the factors, the primary data were rotated by the Varimax module, the result of the rotation is shown in Fig. 2.5.

Змінні	Фактор. навантаж (Вар.вихідн.) (Таблиця даних1) Виділення: Головні компоненти (Зазначені навантаження >,700000) Фактор 1	Фактор 2	Фактор 3
Absolute liquidity ratio	0,658338	-0,151129	0,449087
Return on total equity	0,837877	0,285689	-0,151713
Net profitability of sales	0,759792	0,387489	-0,221879
Capital turnover ratio	0,664926	0,216199	0,349716
Financial stability ratio	0,903247	0,015055	-0,342930
Capital manoeuvrability ratio	-0,464606	0,161312	0,649133
Financial risk ratio	0,618335	0,334319	-0,458595
Fixed asset serviceability ratio	-0,039710	0,964938	0,137061
Fixed asset renewal rate	-0,676068	0,544128	0,296023
Return on assets	-0,750454	0,257353	0,286244
Capital equipment	0,372017	0,292542	-0,835733
Share of material costs in the cost of production	0,508724	0,580746	0,371017
Share of employees employed full-time	-0,245691	0,042968	0,874098
Share of employees aged 29 to 50 years	0,205352	0,710207	-0,179261
Share of employees with university degrees	-0,169365	-0,094632	0,966888
Share of employees trained in new professions	0,032349	-0,769629	0,277264
Share of employees who improved their skills in the reporting year	-0,196893	-0,720201	0,441491
Share of labour costs in total production costs	0,679107	0,645664	-0,088031
Average annual output per employee	0,259827	0,830176	-0,227456
Share of employees performing R&D work	-0,754873	-0,377831	0,494977
Share of trade mark expenses in total expenses	-0,091812	-0,908284	0,110557
Share of innovative products (flavour) in the total volume of products shipped	-0,106797	0,125936	-0,764847
Share of new technologies acquired abroad in total acquisitions	0,056167	0,419640	0,100224
Share of production facilities modernisation in total expenditure	-0,196815	0,115840	-0,245854
Заган.дис.	6,319219	6,061026	5,145001
Заган. частка	0,263301	0,252543	0,214375

Fig. 2.5. The result of the factor loadings of indicators analysis in the internal environment after factor rotation using the Varimax raw method

Based on the rule that the final system of indicators may include those that have a strong impact on the studied processes, characterized by factor loadings greater than 0.7 [32]. 2.5, these indicators are marked in red in accordance with the condition of the STATISTICA 10.0 software. Thus, according to the modeling results, the internal environment of enterprises is characterized by three latent factors.

The first factor includes the return on total capital; net profitability of sales; financial stability ratio; capital efficiency; and the share of employees engaged in R&D. In other words, the most important factor is the first one, which characterizes the integrated use of economic resources by enterprises, namely financial, material, i.e. fixed assets and human resources in the context of innovation.

The second factor includes the following indicators: fixed assets depreciation rate; share of employees aged 29 to 50; share of employees trained in new professions; share of employees who improved their skills in the reporting year; average annual output per employee; share of trademark costs in total costs. Since the

vast majority of the indicators of the second factor characterize the quality of human resources and their intensive use, bordering on professional development, together with the quality of available production assets and brand expenditures, i.e., the maintenance of intellectual capital, the second factor can also be considered comprehensive, but with a focus on the quality of human and intellectual capital of enterprises, which corresponds to the focus of the impression economy model.

The third factor includes indicators of capital equipment; the share of full-time employees; the share of employees who have graduated from higher education institutions; and the share of innovative products in the total volume of shipped products. In other words, the third factor characterizes the extensive use of human resources and the results of innovative activities of enterprises, which are also responsible for the formation of positive impressions of the ability of enterprises to innovate, which correlates with the general objectives of the impression economy model.

The selected indicators are included in the final system of indicators of the internal environment of enterprises, on the basis of which the integral indicator of the internal environment is calculated using the method of additive convolution in accordance with the proposed methodology. It is worth noting that the best values by years for all enterprises were chosen as reference indicators, and the normalized values of their factor loads by years were used as coefficients of significance of partial indicators.

The calculated values of the integral indicator of the internal environment, which can be considered as the results of the use of the strategic potential of enterprises by years, are shown in Figure 2.6.

Applying the Harington scale, adjusted for the conditions of Ukraine [37], it can be noted that the integral indicator has an average level of use of the factors of the internal environment of enterprises to ensure their strategic potential. However, in 2019, 2020, and 2022, the value of the integral indicator moved to a high qualitative level, but only just crossing the line between medium and high levels. This makes it possible to conclude that there is an internal potential of enterprises that can be used in case of stabilization of the economic and military situation in Ukraine. The medium level of values of the integrated indicator of the internal environment can be explained by the fact that there is some competition in the market, enterprises do not pay enough attention to brand development, increasing the share of innovative products shipped, which are important factors for taking advantage of the impression economy and increasing their values.

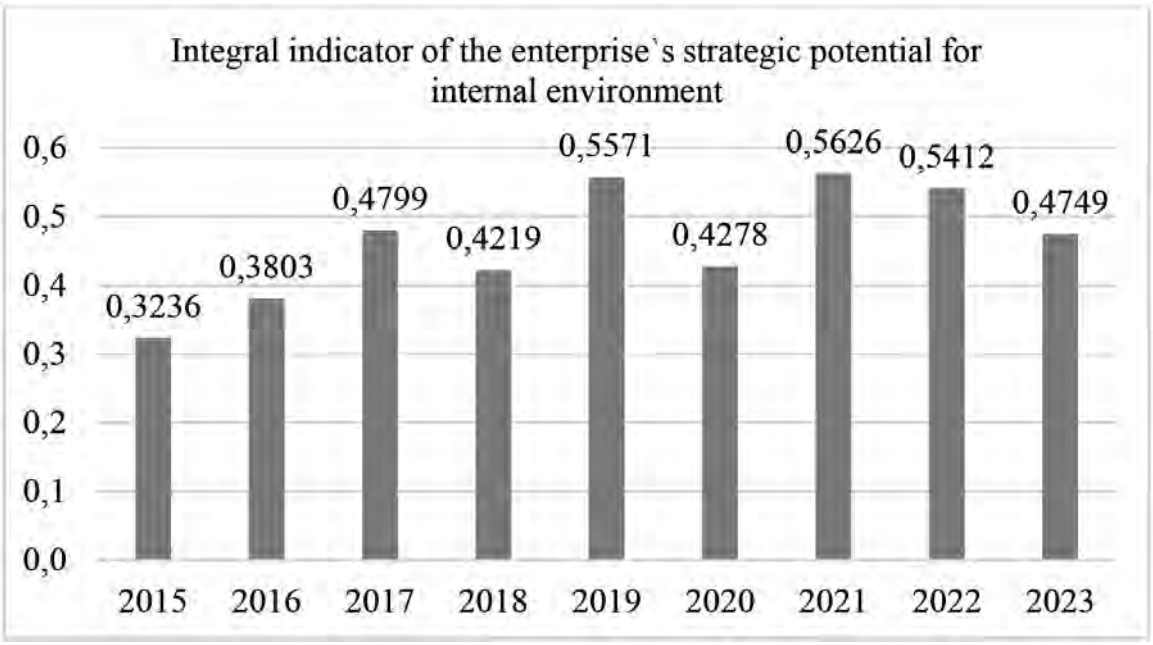


Fig. 2.6. Integral indicator of the internal environment of enterprises, i.e. their strategic potential for the period 2015-i2023

At the third stage, in accordance with the proposed methodology, the type of functional dependence between partial indicators of the internal environment and their integral indicator is determined, and the sensitivity of partial indicators to changes is determined using the neural network method. The type of functional dependence will allow to substantiate it, predict the value of strategic potential and prove the existence of internal links between factors in enterprises in accordance with a certain model of the world of economic relations. And the sensitivity of indicators will allow to focus the efforts of managers and owners of enterprises on those partial indicators, the change in the values of which will best affect the growth of the results of using the strategic potential of enterprises. That is, the most sensitive indicators will become the points of growth of the strategic potential due to the relevant use of factors of the internal environment of enterprises.

To use neural networks, the integral indicator of the internal environment is taken as a continuous objective function, and the values of selected partial indicators as a result of multivariate factor analysis are taken as a continuous input function. The result of neural network modeling for the internal environment is shown in Fig. 2.7.

As a result of using the neural network method, 5 models were built, according to Figure 2.7. The criteria for selecting models are the values of training performance (i.e., the correlation coefficient of the integral indicator with partial indicators) and training errors for each model. According to these criteria, the fifth model of the

multilevel perceptron (MLP 15-11-1) is the best, because it has 11 hidden neurons, the highest value for learning performance (0.999592) and the lowest value for learning error (0.000002). Since the multilevel perceptron is a nonlinear model, this proves the nonlinearity of the influence of internal environment factors on each other and on the life of enterprises, as well as the fact that the hypothesis about the functioning of domestic enterprises in the BANI world is confirmed. The predicted values of the integrated indicator of the internal environment for each model are shown in Fig. 2.8.

Підсумки моделей (Таблиця даних у Робоча книга1)

N	Архітектура	Продуктивність навчання	Помилка навчання	Контрольна помилка	Тестова помилка	Алгоритм навчання	Функція помилки	Ф-я актив. прихованих нейр.	Ф-я актив. вихідних нейр.
1	MLP 15-15-1	0,905582	0,000445	0,000020	0,002483	BFGS 5	Сум. квадр.	Гіперболічна	Тотожна
2	RBF 15-3-1	0,591967	0,001364	0,004242	0,002884	RBFT	Сум. квадр.	Гауссіан	Тотожна
3	RBF 15-3-1	0,753386	0,002054	0,013024	0,001869	RBFT	Сум. квадр.	Гауссіан	Тотожна
4	MLP 15-14-1	0,830082	0,000713	0,001605	0,004648	BFGS 3	Сум. квадр.	Експонента	Логістична
5	MLP 15-11-1	0,999592	0,000002	0,007768	0,007027	BFGS 0	Сум. квадр.	Гіперболічна	Гіперболічна

Fig. 2.7. The result of neural network modeling of the internal environment of enterprises

Таблиця передбачених значень Integral indicator of the enterprise`s strategic potential for internal environment (Таблиця даних у Робоча книга1)
Вибірки: Навчальна

Спостереж номер #	Integral indicator of the enterprise`s strategic potential for internal environment Цільова	Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 1. MLP 15-15-1	Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 2. RBF 15-3-1	Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 3. RBF 15-3-1	Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 4. MLP 15-14-1	**Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 5. MLP 15-11-1**
2016	0,380280	0,392090	0,436293	0,486686	0,398518	0,380258
2017	0,479948	0,464427	0,451771	0,487617	0,441554	0,479948
2018	0,421947	0,465866	0,479614	0,488475	0,466456	0,421961
2019	0,557073	0,545861	0,476180	0,489313	0,544850	0,562133
2021	0,562641	0,509364	0,546649	0,489540	0,550687	0,561108
2022	0,541222	0,525251	0,497033	0,487969	0,535994	0,541188
2023	0,474934	0,501454	0,530506	0,488446	0,551556	0,474958

Fig. 2.8. Predicted (forecasted) values of the integrated indicator of the internal environment of enterprises according to the built models

Analyzing the fifth model, it can be confirmed that the calculated predicted values of this model do not differ significantly from the actual values of the integrated indicator of the internal environment, which confirms the good quality of the built and selected fifth model.

In accordance with the constructed neural network models, it is advisable to determine the sensitivity of the partial indicators included in them (Fig. 2.9).

In accordance with Fig. 2.9. and the rationality coefficient presented therein, the sensitivity of indicators is determined, which in economic terms demonstrates

how many units the growth of the integrated indicator of the internal environment will change if the partial indicator changes by one. This means that the company's management should primarily manage those indicators that are the most sensitive. According to the rationality coefficient, the partial indicators were ranked, which is presented in Table 2.1.

Чутливість (Таблиця даних у Робоча книга1)
Вибірки: Навчальна

Мережі	**Share of employees employed full-time**	Financial stability ratio	Return on total equity	Share of innovative products (flavour) in the total volume of products shipped	Share of employees performing R&D work	Share of trade mark expenses in total expenses	Average annual output per employee	Share of employees who improved their skills in the reporting year
1.MLP 15-15-1	1,090	1,3696	1,3749	1,2004	1,1591	1,0966	1,0707	1,0027
2.RBF 15-3-1	1,019	1,0512	0,9611	0,9361	1,0232	1,0318	1,0364	0,9955
3.RBF 15-3-1	0,999	1,0039	1,0024	0,9987	1,0019	1,0020	1,0021	1,0012
4.MLP 15-14-1	1,015	1,1285	1,1160	1,0680	0,9195	1,0063	0,9934	0,9007
5.MLP 15-11-1	1253,429	695,2002	622,2457	383,2191	347,0873	113,2460	100,4827	100,2742
Середнє	251,510	139,9507	125,3400	77,4845	70,2382	23,4765	20,9171	20,8348

Мережі	Fixed asset serviceability ratio	Share of employees trained in new professions	Capital equipment	Return on assets	Share of employees aged 29 to 50 years	Net profitability of sales	Share of employees with university degrees
1.MLP 15-15-1	1,01388	1,14825	0,98701	1,001850	1,071361	0,946828	1,032736
2.RBF 15-3-1	1,02194	1,00187	0,98523	0,985194	0,940823	0,992572	0,963320
3.RBF 15-3-1	1,00198	1,00098	1,00005	1,000451	1,000736	1,000769	0,999166
4.MLP 15-14-1	1,00026	1,07876	1,00899	0,966728	1,013863	1,001373	1,010445
5.MLP 15-11-1	88,75458	24,89651	13,05529	9,991912	7,526922	3,823411	1,485664
Середнє	18,55853	5,82527	3,40731	2,789227	2,310741	1,552991	1,098266

Fig. 2.9. Sensitivity of partial indicators
of the internal environment according to the built neural network models

In accordance with Fig. 2.9. and the rationality coefficient presented therein, the sensitivity of indicators is determined, which in economic terms demonstrates how many units the growth of the integrated indicator of the internal environment will change if the partial indicator changes by one. This means that the company's management should primarily manage those indicators that are the most sensitive. According to the rationality coefficient, the partial indicators were ranked, which is presented in Table 2.1.

According to Table 2.1, the top 3 most sensitive indicators are: the share of full-time employees; financial stability ratio; and return on total capital. That is, these are the indicators that require the most attention from managers and business owners. Graphical visualizations of the scattering points of these indicators relative to the integral indicator (baseline) and the integral indicator (target) according to the

selected model (MLP 15-11-1) are shown in Figs. 2.10 – 2.12, which also visualizes the nonlinearity of changes in the values of indicators and factors of the internal environment. environment.

Table 2.1

Sensitivity rating of internal environment indicators of the multilevel perceptron model (MLP 15-11-1)

Rank	Indicator name	Value
1	Share of employees employed full-time	1253,43
2	Financial stability ratio	695,20
3	Return on total equity	622,25
4	Share of innovative products (flavour) in the total volume of products shipped	383,22
5	Share of employees performing R&D work	347,09
6	Share of trade mark expenses in total expenses	113,25
7	Average annual output per employee	100,48
8	Share of employees who improved their skills in the reporting year	100,27
9	Fixed asset serviceability ratio	88,75
10	Share of employees trained in new professions	24,90
11	Capital equipment	13,06
12	Return on assets	9,99
13	Share of employees aged 29 to 50 years	7,53
14	Net profitability of sales	3,82
15	Share of employees with university degrees	1,49

Based on the results of a comprehensive analysis of the impact of VUCA-world and BANI-world on the internal environment of food industry enterprises, it is advisable to draw the following conclusions. The internal environment factors are characterized by an average level of utilization in relation to the strategic potential of enterprises in accordance with the challenges of fragility, uncertainty, instability, and turbulence of the external environment. After the full-scale invasion, the results have changed insignificantly, due to a certain resilience due to solvent consumer demand and the desire of partners to maintain cooperation with enterprises. Using the neural network method, it is substantiated that the factors of the internal environment are interdependent in a non-linear manner, their interrelationships correspond to the model of a multi-level perceptron.

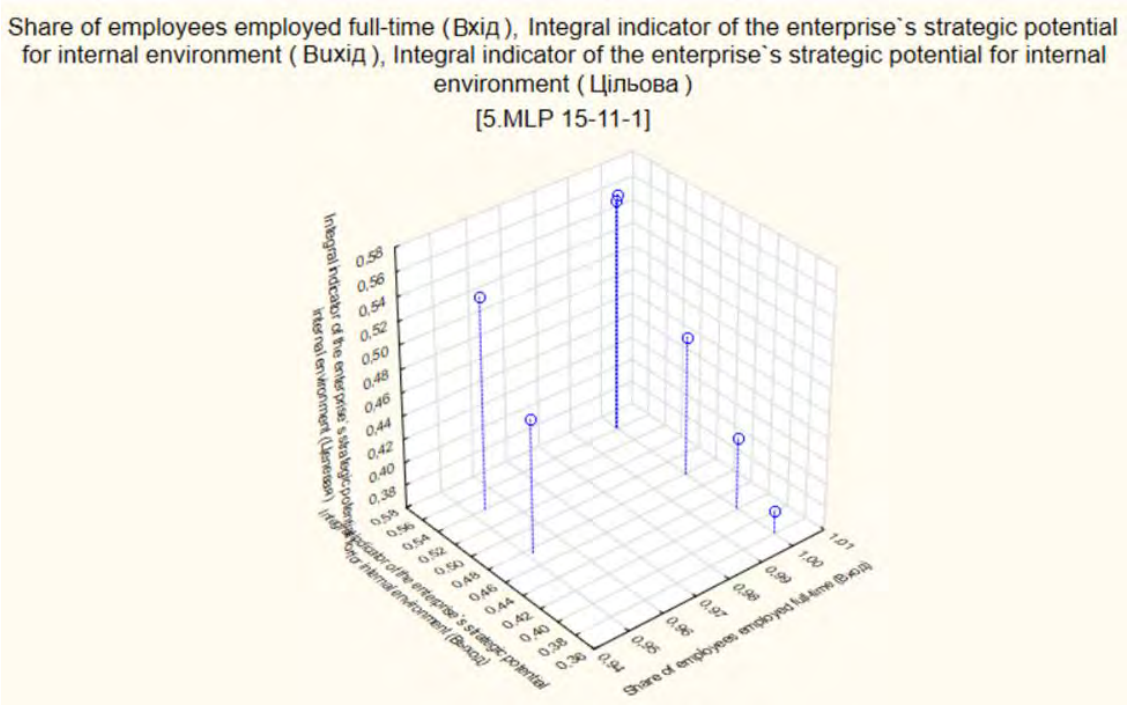


Fig. 2.10. Graphical visualization of the values
of the share of full-time employees in relation to the integral indicator
of the internal environment, i.e. strategic potential (Output) and the integral indicator
of the internal environment, i.e. strategic potential (Target)

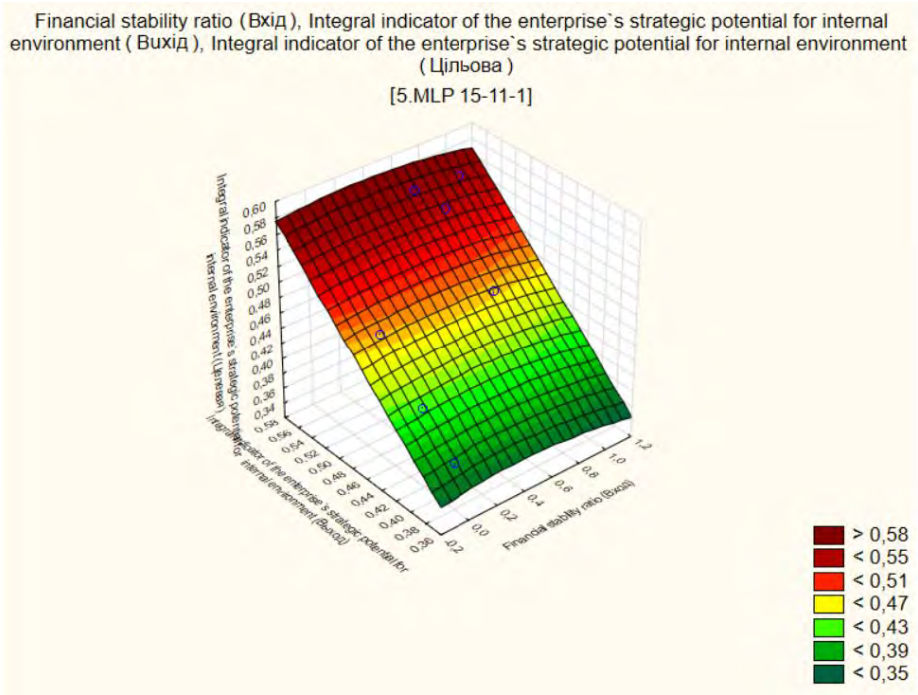


Fig. 2.11. Graphical visualization of the values
of the financial stability ratio in relation to the integral indicator
of the internal environment, i.e. strategic potential (Output) and the integral indicator
of the internal environment, i.e. strategic potential (Target)

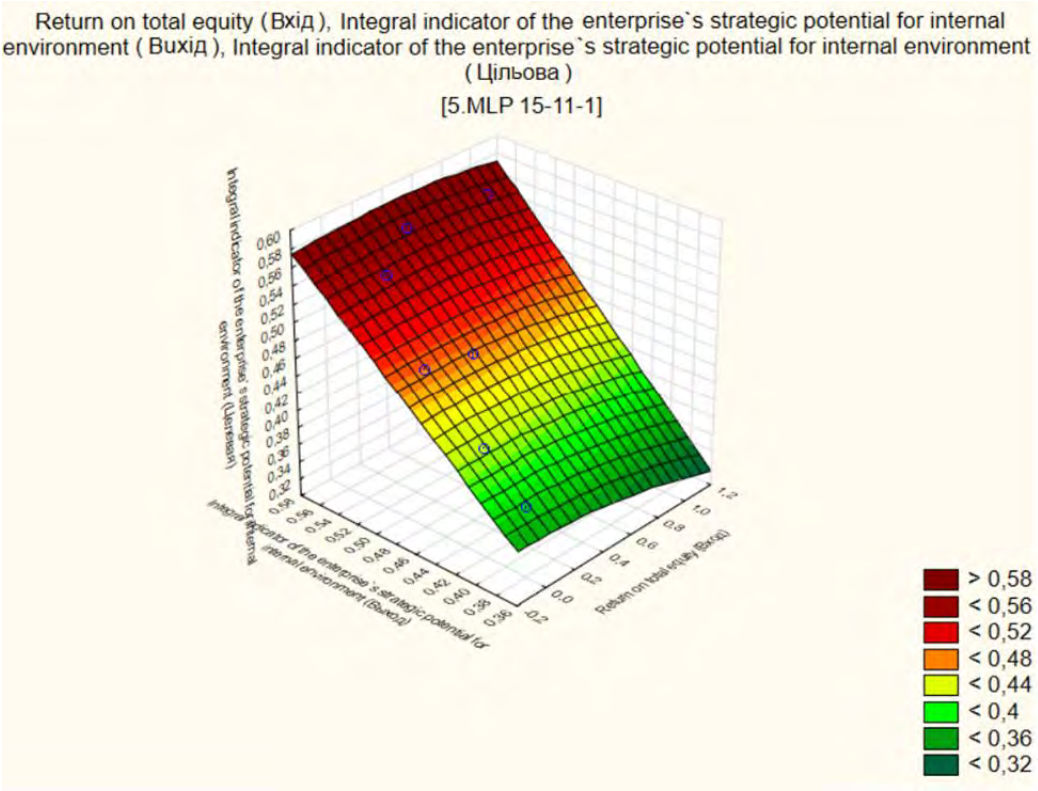


Fig. 2.12. Graphical visualization of the values of the return on total capital relative to the integral indicator of the internal environment, i.e. strategic potential (Output) and the integral indicator of the internal environment, i.e. strategic potential (Target)

In order to improve its market position in the VUCA-world and BANI-world, the management of enterprises needs to pay attention and take appropriate management measures to maintain and improve the most sensitive indicators: The most sensitive indicators and factors of the internal environment are the proportion of full-time employees; financial stability ratio; return on total capital. It is these factors that should be selected as the main ones for the primary managerial influence on improving the state of the internal environment of enterprises.

As for the external environment of the studied enterprises, the methodology of analysis remains unchanged, which is its advantage.

The application of multifactor analysis to the factors and indicators of the external environment of enterprises allowed us to determine the number of latent factors (Fig. 2.13) and the composition of the primary system of indicators by factor loadings after the Varimax rotation (Fig. 2.14). The composition of environmental indicators is determined by the possibilities of their calculation on the basis of official statistical information and is presented in Fig. 2.14.

Знач.	Власні значення (Таблиця даних1) Виділення: Головні компоненти Власн. Знач.	% загал. дисперс.	Кумулятивн. Власн. Знач.	Кумулятивн. %
1	9,520661	68,00472	9,52066	68,00472
2	2,654740	18,96243	12,17540	86,96715

Fig.2.13. Results of multy/exploratory factor analysis by external environment

Змінні	Фактор. навантаж (Вар.вихідн.) (Таблиця даних1) Виділення: Головні компоненти (Зазначені навантаження >,700000) Фактор 1	Фактор 2
Nominal GDP of Ukraine	0,982215	0,147434
GNI	0,965370	0,248787
Inflation index	-0,379237	-0,859205
Economic decline index	-0,227428	-0,954044
Total turnover of business entities	0,569744	0,750691
Business freedom index	0,652773	0,220965
Number of active enterprises by type of economic activity (Code NACE. Rev.2 11.03)	0,888493	0,428538
Taxes on income, profits, and capital gains	0,866619	0,337132
Taxes on goods and services	-0,286266	-0,937616
Economic freedom, overall index	0,889689	0,405859
Total population	-0,943746	-0,285996
Net migration	0,852618	0,519751
Number of registered unemployed	-0,556486	0,603056
Human flight and brain drain index	0,735692	-0,220872
Загал.дис.	7,725427	4,449974
Загал.частка	0,551816	0,317855

Fig. 2.14. The result of the factor loadings of indicators analysis in the external environment after factor rotation using the Varimax raw method

According to the value of the cumulative variance (86.97%), which is more than 70%, we can say that the number of factors characterizing the state of the external environment is 2. The results after rotation in Fig. 2.14 show that in the external environment, among the 14 input indicators, 12 indicators are the most important with factor loadings greater than 0.70. The first factor consists of 8 significant indicators, such as: nominal GDP of Ukraine; gross national income; number of operating enterprises by type of economic activity (NACE 2010 code: 11.03); taxes on income, profit and capital gains; general index of economic freedom; total population; net migration; and the index of population outflow (brain drain). Based on the composition of the first factor's indicators, it should be defined as a comprehensive one that characterizes economic performance. The second factor is formed by such indicators as: inflation index; economic recession index; volume of products (goods, services) sold by business entities: 11.03; taxes on goods and services. Based on the composition of indicators of the second factor, it can be perceived as a factor of destructive influence.

Thus, these are the most influential and adequate indicators of the state of the external environment, which describe the VUCA-world and the BANI-world and form a system of partial indicators of the external environment.

Using the method of additive convolution, it is advisable to combine the selected partial indicators into an integral indicator of the external environment. Its calculation is presented by years in Fig. 2.15.

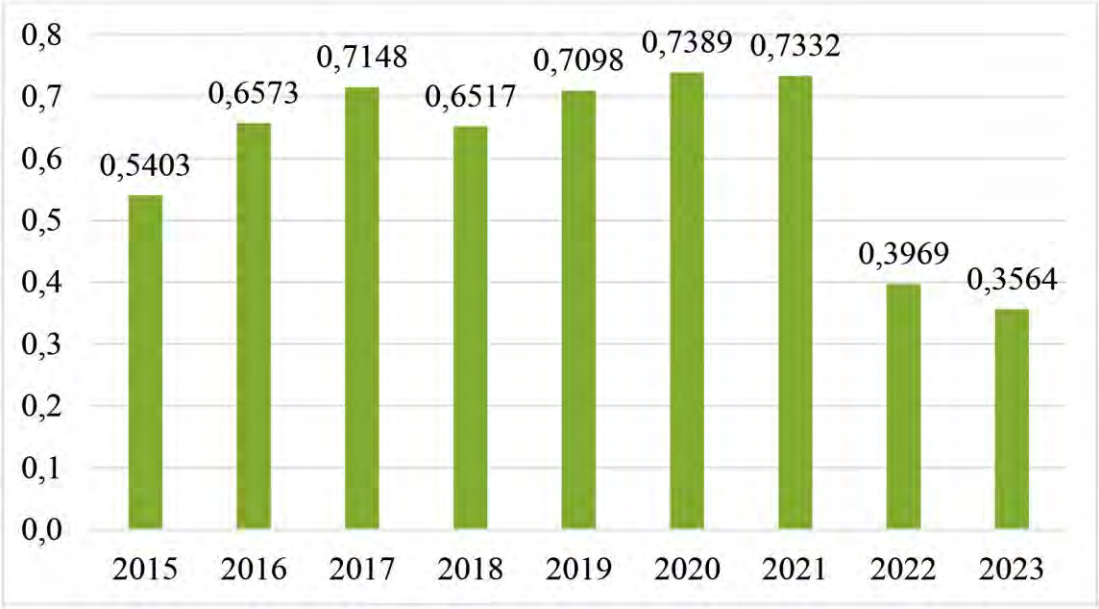


Fig. 2.15. Integral indicator of the external environment of enterprises for the period 2015–2023

The value of the integral indicator of the external environment indicates its high level (according to the Harington scale, adjusted for the business environment in Ukraine) for the period 2015-2021. In 2020 and 2021, the best results were observed, which indicates that the conditions for starting and doing business in Ukraine are attractive. However, after the beginning of the full-scale military invasion in 2022 and 2023, there was a sharp decrease in the value of the integral indicator and its fall into the middle interval of the Harington scale, which was adjusted for the conditions of Ukraine's economy, indicating a sharp decrease in the quantitative values of environmental factors by 1.85 times and its unattractiveness for business entities and the complexity of doing business.

In order to determine the functional relationship between the indicators of the external environment, the method of neural networks is used to build models that would adequately describe the state of the external environment of enterprises in Ukraine. The quantitative values of the integral indicator of the external environment are used as a continuous objective function, and partial indicators selected after

applying multivariate factor analysis are used as a continuous input function. The result of modeling by the neural network method is shown in Fig. 2.16.

Підсумки моделей (Таблиця даних у Робоча книга1)

N	Архітектура	Продуктивність навчання	Помилка навчання	Контрольна помилка	Тестова помилка	Алгоритм навчання	Функція помилки	Ф-я актив. прихованих нейр.	Ф-я актив. вихідних нейр.
1	RBF 12-2-1	0,238867	0,010678	0,001960	0,009252	RBFT	Сум. квадр.	Гауссіан	Тотожна
2	MLP 12-10-1	0,883946	0,007229	0,000017	0,006695	BFGS 3	Сум. квадр.	Логістична	Тотожна
3	RBF 12-3-1	-0,933469	0,010678	0,001960	0,009252	RBFT	Сум. квадр.	Гауссіан	Тотожна
4	MLP 12-5-1	0,873931	0,004472	0,000013	0,000051	BFGS 4	Сум. квадр.	Експонента	Експонента
5	MLP 12-13-1	0,931873	0,007463	0,000078	0,000001	BFGS 4	Сум. квадр.	Гіперболічна	Експонента

Fig. 2.16. Characteristics of the models of the external environment of enterprises

Taking into account the values of the training performance criteria (0.931873) and the training error (0.007463), the best model is the fifth model of the multilevel perceptron (MLP 12-13-1), which is a nonlinear model with 13 latent neurons, which confirms the hypothesis that the VUCA-world and the BANI-world function in the Ukrainian economy with the predominance of the latter. the results of the predicted values of the integral indicator by this model. According to the selected model (and other built models), the predicted (expected) values of the integral indicator of the external environment of enterprises are presented in Fig. 2.17.

Таблиця передбачених значень Integral indicator of the enterprise`s strategic potential for external environment (Таблиця даних у Робоча книга1)
Вибірки: Навчальна

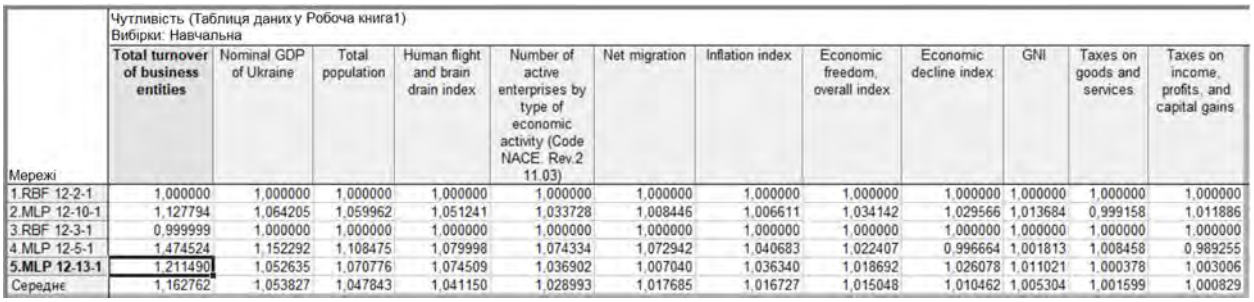
Спостереж номер #	Integral indicator of the enterprise`s strategic potential for external environment Цільова	Integral indicator of the enterprise`s strategic potential for external environment - Вихід 1. RBF 12-2-1	Integral indicator of the enterprise`s strategic potential for external environment - Вихід 2. MLP 12-10-1	Integral indicator of the enterprise`s strategic potential for external environment - Вихід 3. RBF 12-3-1	Integral indicator of the enterprise`s strategic potential for external environment - Вихід 4. MLP 12-5-1	**Integral indicator of the enterprise`s strategic potential for external environment - Вихід 5. MLP 12-13-1**
2016	0,657254	0,602861	0,615216	0,602861	0,731143	0,703266
2017	0,714808	0,602861	0,620504	0,602861	0,743396	0,719779
2018	0,651741	0,602861	0,603248	0,602861	0,690175	0,678647
2019	0,709768	0,602861	0,617664	0,602861	0,734594	0,723165
2021	0,733214	0,602861	0,609579	0,602861	0,712764	0,698978
2022	0,396875	0,602861	0,584154	0,602862	0,623397	0,636082
2023	0,356371	0,602861	0,527676	0,602862	0,406430	0,563843

Fig. 2.17. Estimated values of the integral indicator of the external environment of enterprises according to the built neural network models

Comparing the predicted values of the integral indicator based on the MLP 12-13-1 model with its actual values for the periods of 2022 and 2023, it is worth noting significant deviations. This means that the real external world is indeed fragile and incomprehensible, i.e., the BANI world. Therefore, it is very important for enterprises to pay attention to the composition and changes in sensitive environmental indicators and to adapt to them as quickly as possible or try to influence changes in their values as much as possible. The results of modeling

the sensitivity of the indicators of the multilevel perceptron model (and other built models) are shown in Fig. 2.18.

The rating of sensitivity of the indicators of the external environment of enterprises according to the best model of the multilevel perceptron is presented in Table 2.2.



Чутливість (Таблиця даних у Робоча книга1)
Вибірки: Навчальна

Мережі	Total turnover of business entities	Nominal GDP of Ukraine	Total population	Human flight and brain drain index	Number of active enterprises by type of economic activity (Code NACE. Rev.2 11.03)	Net migration	Inflation index	Economic freedom, overall index	Economic decline index	GNI	Taxes on goods and services	Taxes on income, profits, and capital gains
1.RBF 12-2-1	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000
2.MLP 12-10-1	1,127794	1,064205	1,059962	1,051241	1,033728	1,008446	1,006611	1,034142	1,029566	1,013684	0,999158	1,011886
3.RBF 12-3-1	0,999999	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000
4.MLP 12-5-1	1,474524	1,152292	1,108475	1,079998	1,074334	1,072942	1,040683	1,022407	0,996664	1,001813	1,008458	0,989255
5.MLP 12-13-1	1,211490	1,052635	1,070776	1,074509	1,036902	1,007040	1,036340	1,018692	1,026078	1,011021	1,000378	1,003006
Середнє	1,162762	1,053827	1,047843	1,041150	1,028993	1,017685	1,016727	1,015048	1,010462	1,005304	1,001599	1,000829

Fig. 2.18. Sensitivity of indicators of the external environment of enterprises according to the built models

Table 2.2

Rating of sensitivity of environmental indicators according to the best multilevel perceptron model (MLP 12-13-1)

Rank	Indicator name	Value
1	Total turnover of business entities	1,2115
2	Human flight and brain drain index	1,0745
3	Total population	1,0708
4	Nominal GDP of Ukraine	1,0526
5	Number of active enterprises by type of economic activity (Code NACE. Rev.2 11.03)	1,0369
6	Inflation index	1,0363
7	Economic decline index	1,0261
8	Economic freedom, overall index	1,0187
9	GNI	1,0110
10	Net migration	1,0070
11	Taxes on income, profits, and capital gains	1,0030
12	Taxes on goods and services	1,0004

In accordance with Table 2.2, the top 3 most sensitive indicators of the external environment include: the volume of products (goods, services) sold by business entities: 11.03; population outflow (brain drain) index; total population. These indicators require managerial influence, as changes in their values will significantly affect the improvement of business results in the unstable BANI world. As for businesses, they can also influence the stabilization of the situation by

adjusting the volume of products (goods, services) sold, paying attention to market research on consumer solvency, and increasing the desire to buy products or receive services by creating positive impressions of the performance of enterprises, which coincides with the main additional opportunities provided to business entities by the impression economy.

The growth of the population and brain drain index threatens businesses with the loss of qualified personnel and actual and potential customers. It is necessary to constantly monitor the population and its location to identify promising markets.

Graphical visualizations of the nonlinearity of environmental factors and points of scattering of environmental indicators with the highest sensitivity relative to the integral indicator (baseline) and the integral indicator (target) according to the selected model (MLP 12-13-1) are shown in Figs. 2.19 – 2.21.

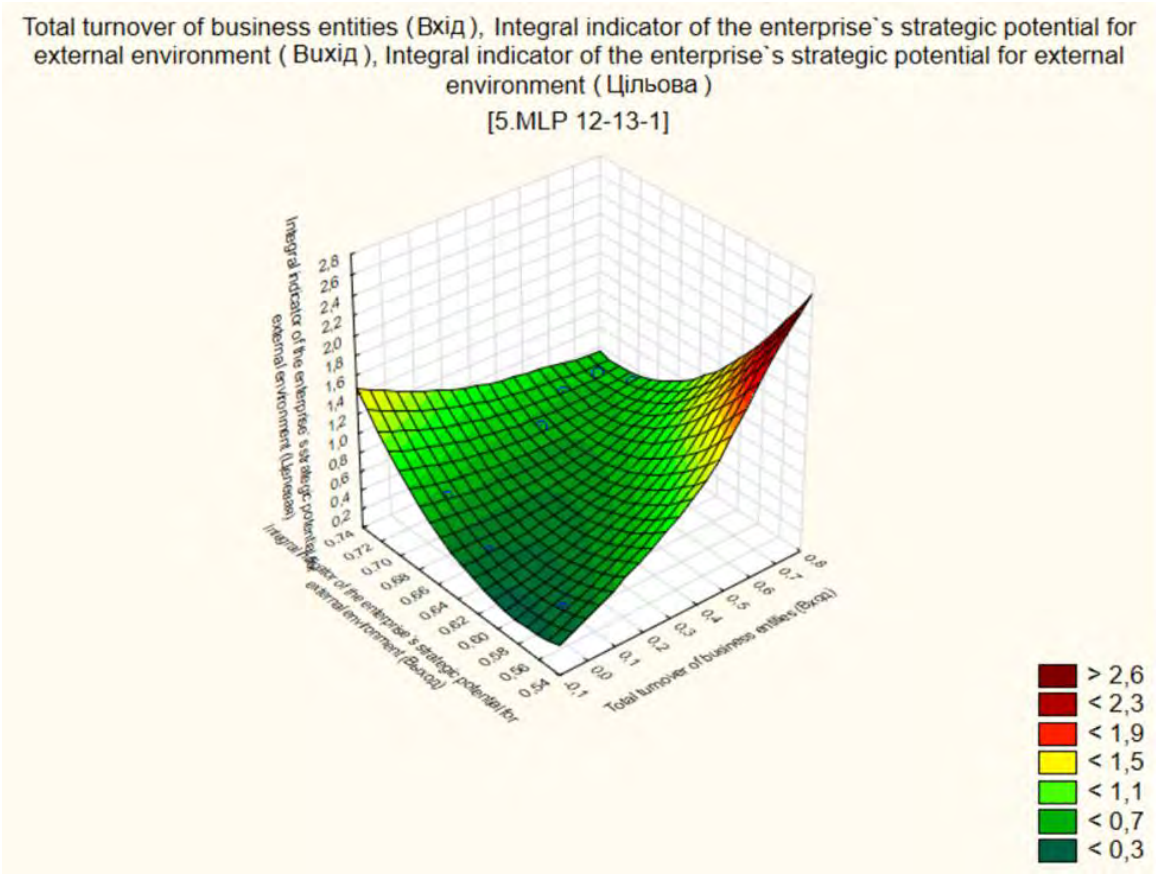


Fig. 2.19. Graphical visualization of the values of the indicator of the volume of products (goods, services) sold by business entities: 11.03 relative to the integral indicator of the external environment

Determination of factors, indicators of the external environment of enterprises and their functional interdependence proves the functioning of economic relations in Ukraine as VUCA-world and BANI-world with the predominance of the latter.

According to the results of the study, it can be concluded that after a full-scale military invasion, the external environment of enterprises has changed significantly and has moved from a high quality level to an average level, which significantly worsens the business environment and increases uncertainty, nonlinearity and fragility of its manifestation. It is possible to improve the situation by taking advantage of the impression economy to form positive impressions about the possibilities of the external environment, which can be presented as attractive in terms of compensating for business risk with higher sales profitability or other profitability indicators or other indicators of the use of economic resources that will be of interest to business owners, managers or investors in a risky environment.

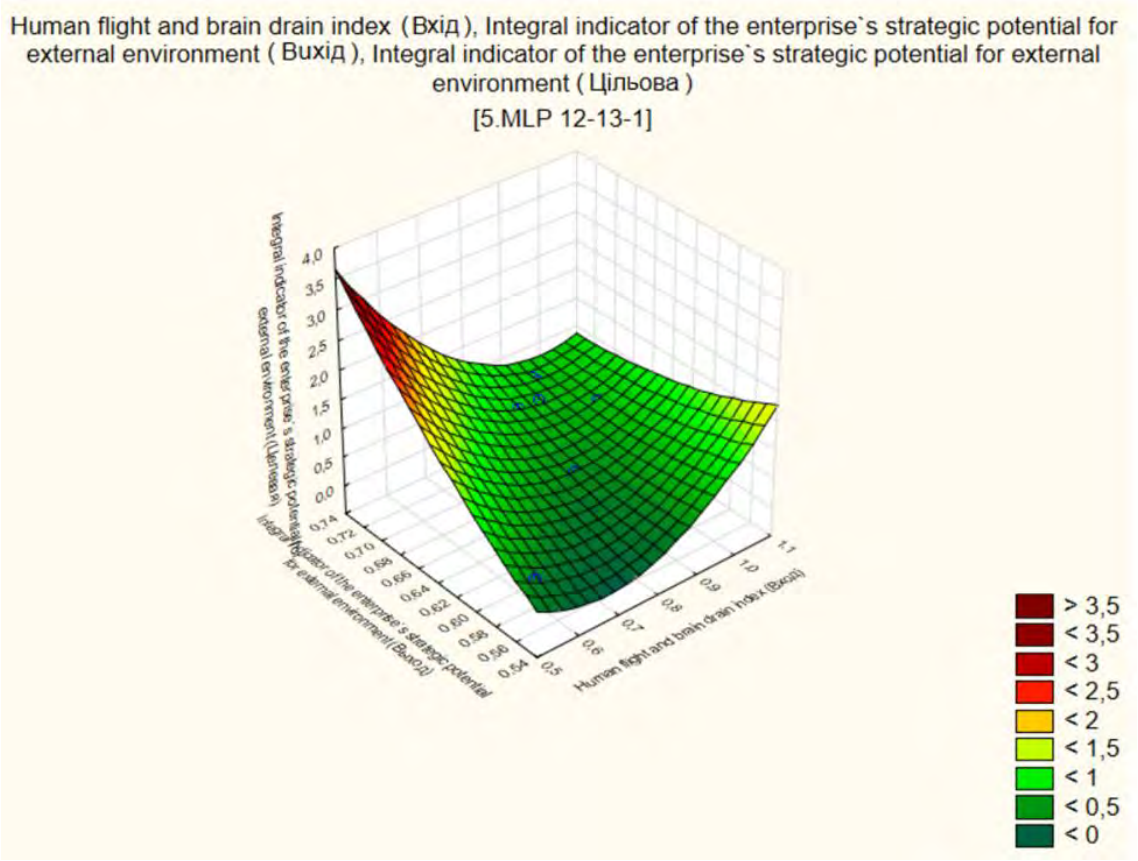


Fig. 2.20. Graphical visualization of the values of the population (brain) outflow index relative to the integrated indicator of the external environment

In addition to a separate study of the internal and external environments of enterprises, it is advisable to prove their mutual influence on each other using the neural network method. For this purpose, the value of the integrated indicator of the internal environment was used as a continuous objective function and the value of the external environment indicators as a continuous input function.

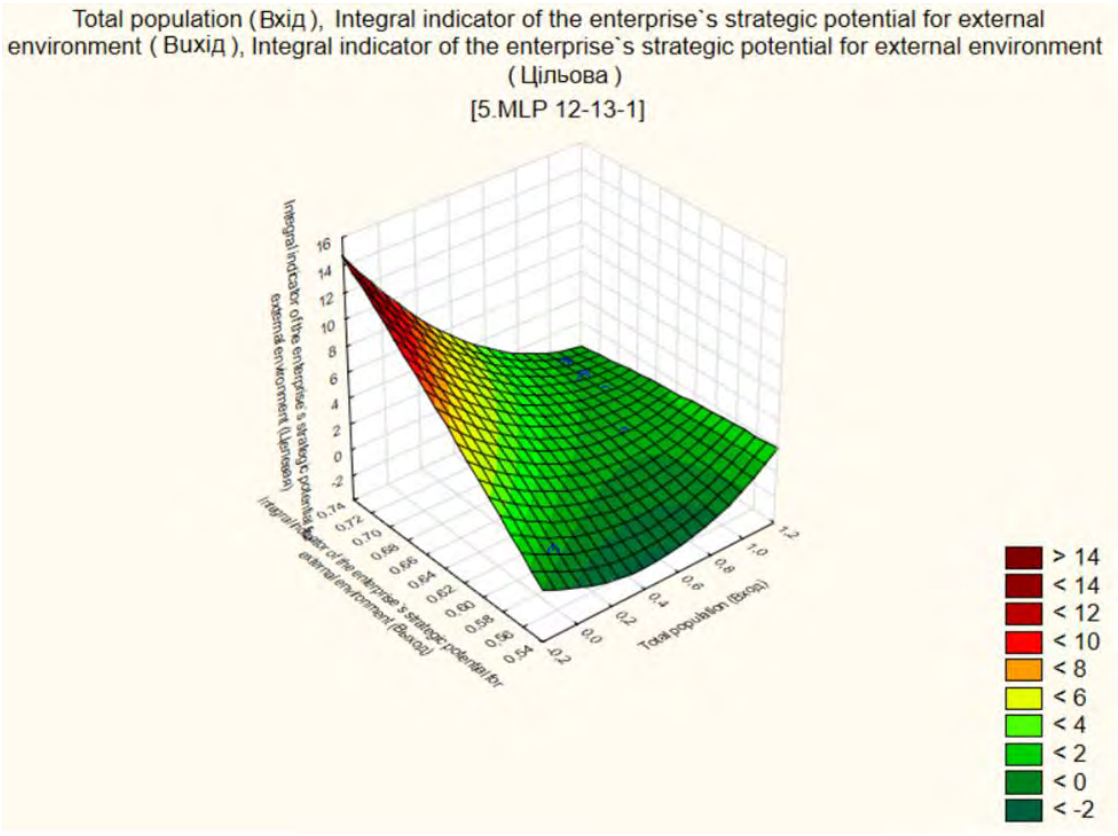


Fig. 2.21. Graphical visualization of the values of the total population indicator relative to the integral indicator of the external environment

The results of the models formed by the neural network method are shown in Fig. 2.22.

Підсумки моделей (Таблиця даних у Робоча книга1)

N	Архітектура	Продуктивність навчання	Помилка навчання	Контрольна помилка	Тестова помилка	Алгоритм навчання	Функція помилки	Ф-я актив. прихованих нейр.	Ф-я актив. вихідних нейр.
1	RBF 12-2-1	0,794645	0,000773	0,011865	0,007098	RBFT	Сум. квадр.	Гауссіан	Тотожна
2	RBF 12-2-1	0,604661	0,002098	0,013557	0,001831	RBFT	Сум. квадр.	Гауссіан	Тотожна
3	MLP 12-10-1	0,920524	0,000322	0,000002	0,008802	BFGS 4	Сум. квадр.	Логістична	Тотожна
4	MLP 12-11-1	0,995302	0,000035	0,001611	0,009093	BFGS 5334	Сум. квадр.	Експонента	Логістична
5	RBF 12-3-1	0,447162	0,001679	0,025335	0,002879	RBFT	Сум. квадр.	Гауссіан	Тотожна

Fig. 2.22. Models of the relationship between the integrated indicator of the internal environment and indicators of the external environment

The fourth model (MLP 12-11-1) is the best according to the values of the training performance criteria of 0.995302 and the training error of 0.000035. This and other models predicted the results of the predicted values of the integrated indicator of the internal environment (Fig. 2.23).

Спостереж номер #	Integral indicator of the enterprise`s strategic potential for internal environment Цільова	Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 1. RBF 12-2-1	Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 2. RBF 12-2-1	Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 3. MLP 12-10-1	**Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 4. MLP 12-11-1**	Integral indicator of the enterprise`s strategic potential for internal environment - Вихід 5. RBF 12-3-1
	Таблиця передбачених значень Integral indicator of the enterprise`s strategic potential for internal environment (Таблиця даних у Робоча книга1) Вибірки: Навчальна					
2016	0,380280	0,428701	0,488292	0,408247	0,380280	0,462994
2017	0,479948	0,420960	0,488292	0,431906	0,479948	0,468469
2018	0,421947	0,470936	0,488292	0,450432	0,421947	0,453330
2019	0,557073	0,534622	0,488292	0,549609	0,562641	0,483650
2021	0,562641	0,577132	0,488292	0,562935	0,562641	0,496038
2022	0,541222	0,499305	0,488292	0,560477	0,562641	0,509837
2023	0,474934	0,486389	0,488292	0,461464	0,474934	0,543726

Fig. 2.23. Predicted values of the integral indicator of the internal environment in relation to the strategic potential of enterprises according to the built models

In accordance with the predicted values of the integrated indicator of the internal environment according to the best MLP 12-11-1 model and comparing them with its actual values, it can be stated that they differ insignificantly. That is, the companies responded to external changes in a sustainable and flexible manner.

As for determining the sensitivity of the indicators, according to the best multilevel perceptron model, they are shown in Fig. 2.24.

Мережі	**Nominal GDP of Ukraine**	Number of active enterprises by type of economic activity (Code NACE. Rev.2 11.03)	Total turnover of business entities	Human flight and brain drain index	Net migration	GNI	Economic decline index	Total population	Economic freedom, overall index	Taxes on goods and services	Inflation index	Taxes on income, profits, and capital gains
	Чутливість (Таблиця даних у Робоча книга1) Вибірки: Навчальна											
1.RBF 12-2-1	1,2792	1,1888	1,15480	1,02200	0,95826	1,10500	0,99787	1,00833	1,01616	0,99464	0,92342	0,976433
2.RBF 12-2-1	1,0000	1,0000	1,00000	1,00000	1,00000	1,00000	1,00000	1,00000	1,00000	1,00000	1,00000	1,000000
3.MLP 12-10-1	4,0344	2,6275	3,24836	1,46990	0,96212	1,48325	1,03793	1,12057	0,97231	0,97489	1,00892	0,992968
4.MLP 12-11-1	141,5343	122,9342	77,40267	72,63175	66,98528	32,47401	30,77907	25,52927	25,41838	17,99181	16,97031	9,143599
5.RBF 12-3-1	1,0328	1,0583	1,22239	0,99844	1,04466	1,01203	0,97823	0,98348	0,98581	1,00382	1,05569	0,995217
Середнє	29,7761	25,7617	16,80564	15,42442	14,19006	7,41486	6,95862	5,92833	5,87853	4,39303	4,19167	2,621644

Fig. 2.24. Sensitivity of environmental indicators according to the best multilevel perceptron model.

According to the values of the rationality coefficients, the most sensitive indicators of the top 3 external environment are: nominal GDP of Ukraine; number of operating enterprises by type of economic activity (NACE 2010: 11.03); and volume of products (goods, services) sold by economic entities: 11.03. The last sensitive indicator of the volume of products sold was also in the top 3 in the previous analysis. This indicates that the company's management needs to continuously monitor its changes and form positive impressions of products and services using the advantages of the impression economy model.

Graphical visualizations of the scatter points of the external environment indicators with the highest sensitivity to the integrated indicator of the internal environment (baseline) and the integrated indicator of the internal environment (target) according to the selected model (MLP 12-11-1) are shown in Figures 2.25 – 2.27.

Based on the results of the analysis of the interrelationships and the impact of external environment indicators on the value of the integrated indicator of the internal environment, i.e., the strategic potential of enterprises, the following conclusions can be drawn. According to the best model of the multilevel perceptron, the external environment, characterized by nonlinearity of influence, does have interrelations with the internal environment of enterprises. However, if an enterprise has a good understanding of what is happening in the external world and identifies and anticipates its changes, while implementing innovative activities to reduce the risk of negative impact by creating positive impressions of its activities, results and opportunities, it can successfully operate and be competitive in the BANI-world.

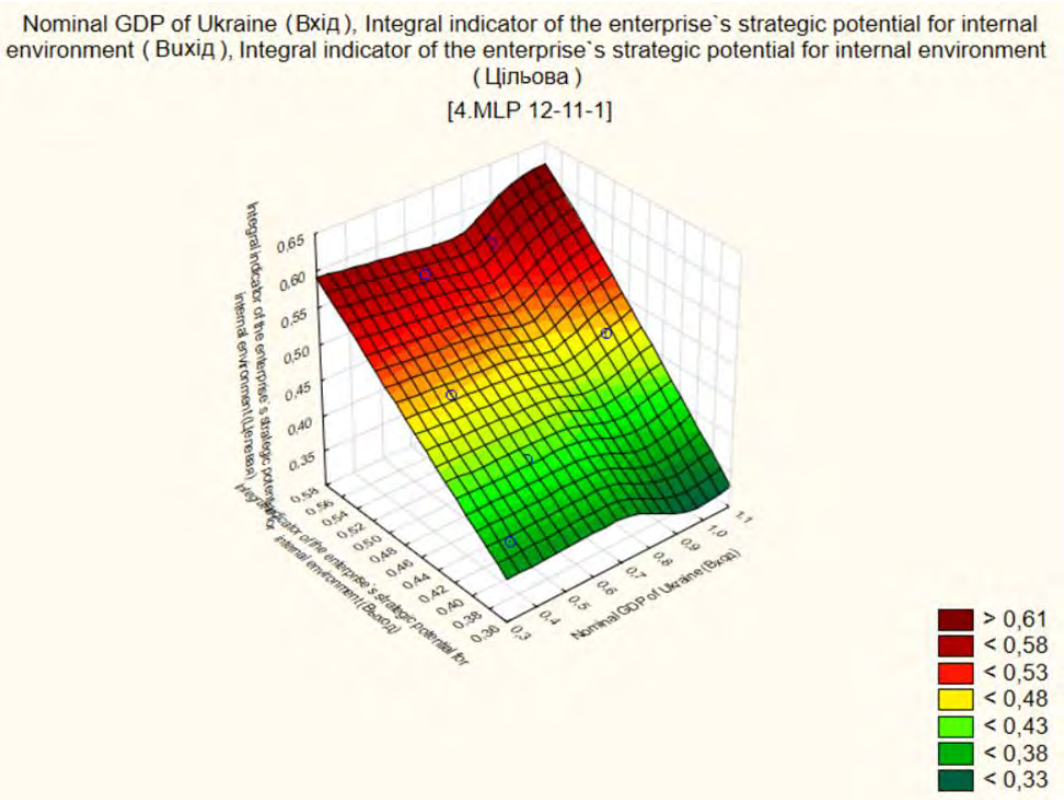


Fig. 2.25. Graphical visualization of the values of nominal GDP of Ukraine relative to the integrated indicator of the internal environment (baseline) and the integrated indicator of the internal environment (target)

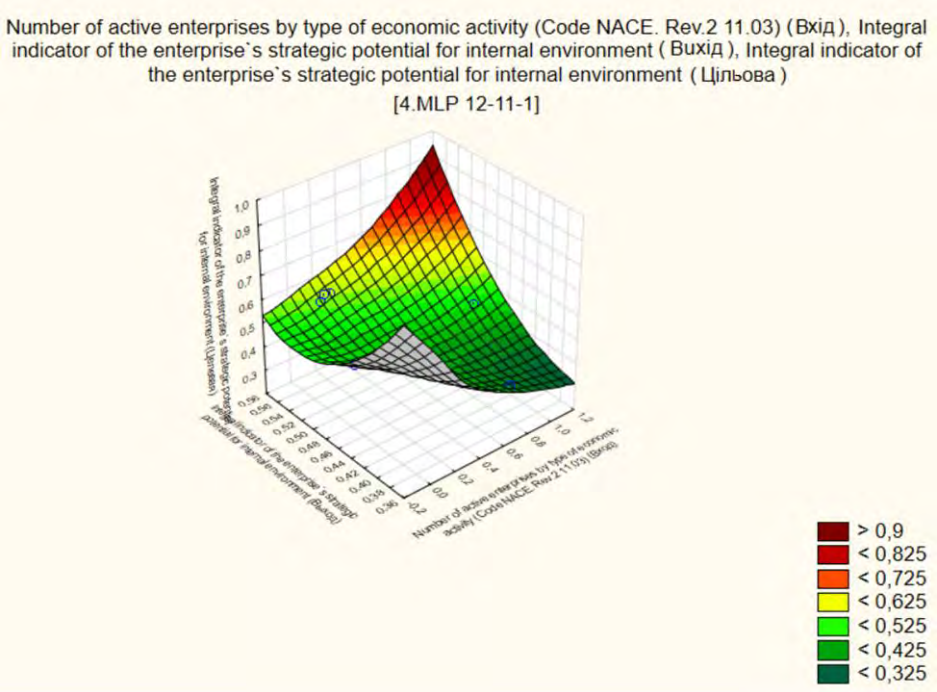


Fig. 2.26. Graphical visualization of the number of operating enterprises by type of economic activity (NACE 2010: 11.03) relative to the integrated indicator of the internal environment (output) and the integrated indicator of the internal environment (target)

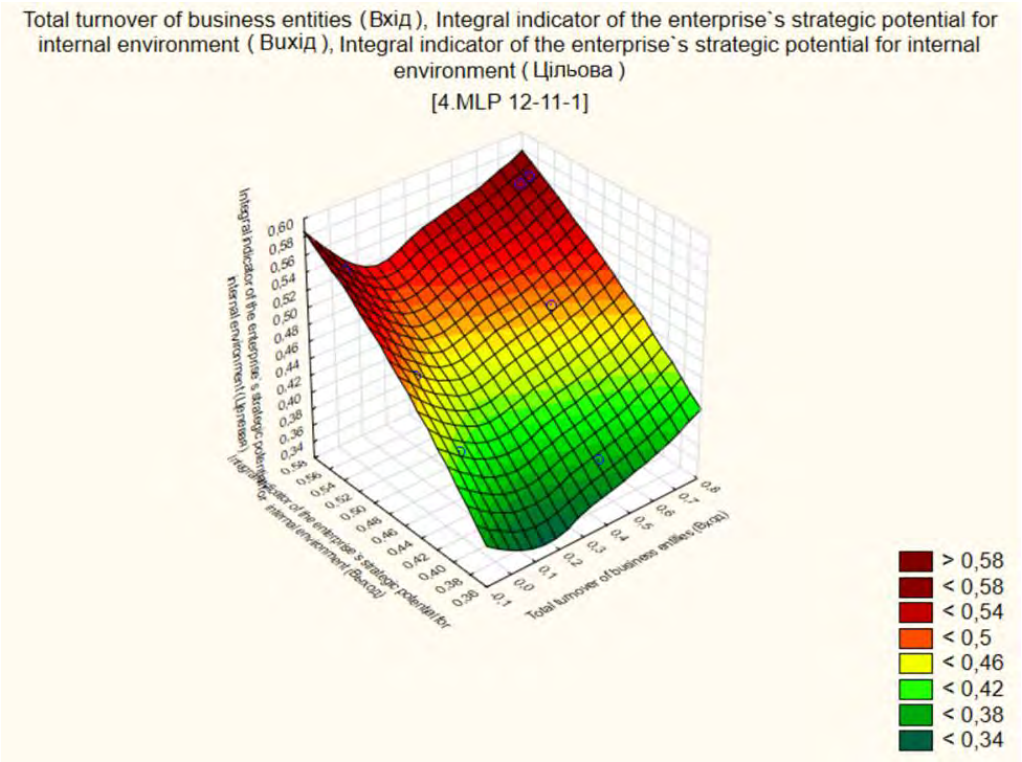


Fig. 2.27. Graphical visualization of the values of the indicator of the volume of products (goods, services) sold by business entities:
11.03 relative to the integrated indicator of the internal environment (output) and the integrated indicator of the internal environment (target)

Having proved the existence of influence and relationships between the indicators of the external environment and the integral indicator of the internal environment of enterprises, it is advisable to analyze the opposite situation, where the integral indicator of the external environment is taken as a continuous objective function, and the indicators of the internal environment are taken as a continuous input function. The results of modeling by the neural network method are shown in Fig. 2.28.

Підсумки моделей (Таблиця даних у Робоча книга1)

N	Архітектура	Продуктивність навчання	Помилка навчання	Контрольна помилка	Тестова помилка	Алгоритм навчання	Функція помилки	Ф-я актив. прихованих нейр.	Ф-я актив. вихідних нейр.
1	MLP 15-11-1	0,538244	0,010621	0,003064	0,009379	BFGS 1	Сум. квадр.	Логістична	Тотожна
2	RBF 15-3-1	-0,891610	0,010678	0,001960	0,009252	RBFT	Сум. квадр.	Гауссіан	Тотожна
3	MLP 15-16-1	0,999502	0,000032	0,000250	0,000105	BFGS 12	Сум. квадр.	Експонента	Експонента
4	RBF 15-3-1	0,528844	0,007692	0,001008	0,004395	RBFT	Сум. квадр.	Гауссіан	Тотожна
5	MLP 15-13-1	0,962726	0,009835	0,002725	0,009068	BFGS 1	Сум. квадр.	Гіперболічна	Гіперболічна

Fig. 2.28. Models of interrelation between the integral indicator of the external environment of enterprises and indicators of their internal environment

In accordance with Fig. 2.28, according to the values of the training performance criteria of 0.999502 and the training error of 0.000032, the best is the third model of the multilevel perceptron (MLP 15-16-1) with the number of hidden neurons greater than the number of input indicators, which confirms the hypothesis of the nonlinearity of the economic world. The results of the predicted values of the integral indicator of the external environment according to this model are shown in Fig. 2.29.

Таблиця передбачених значень Integral indicator of the enterprise`s strategic potential for external environment (Таблиця даних у Робоча книга1)
Вибірки: Навчальна

Спостереж номер #	Integral indicator of the enterprise`s strategic potential for external environment Цільова	Integral indicator of the enterprise`s strategic potential for external environment - Вихід 1. MLP 15-11-1	Integral indicator of the enterprise`s strategic potential for external environment - Вихід 2. RBF 15-3-1	**Integral indicator of the enterprise`s strategic potential for external environment - Вихід 3. MLP 15-16-1**	Integral indicator of the enterprise`s strategic potential for external environment - Вихід 4. RBF 15-3-1	Integral indicator of the enterprise`s strategic potential for external environment - Вихід 5. MLP 15-13-1
2016	0,657254	0,603606	0,602861	0,657391	0,554947	0,602911
2017	0,714808	0,604368	0,602861	0,718214	0,724830	0,605974
2018	0,651741	0,603584	0,602861	0,661434	0,718046	0,606493
2019	0,709768	0,603827	0,602861	0,721953	0,582574	0,606844
2021	0,733214	0,602509	0,602861	0,744378	0,573330	0,604206
2022	0,396875	0,602079	0,602861	0,389261	0,527207	0,591905
2023	0,356371	0,603105	0,602861	0,358598	0,540738	0,592096

Fig. 2.29. Predicted values of the integral indicator of the external environment according to the built models

Analyzing the values of the integrated indicator of the external environment in accordance with Fig. 2.29 according to the MLP 15-16-1 model and comparing them

with the actual values of the integral indicator, it can be noted that they do not differ significantly. However, according to the results of the analysis of the external environment alone, there were significant deviations in the values of the integral indicator in 2022 and 2023. This means that the activities of enterprises with regard to the internal environment can help to stabilize the fragility of the external environment to some extent, but both the actual values of the integral indicator and those predicted in 2022 and 2023 showed a significant decrease compared to previous years. Thus, the full-scale military invasion has indeed increased the unpredictability of the BANI-world's impact on the activities of enterprises in terms of the use of domestic economic resources.

The sensitivity analysis of the indicators of the best multilevel perceptron model is presented in Fig. 2.30.

Чутливість (Таблиця даних у Робоча книга1)
Вибірки: Навчальна

Мережі	**Share of employees employed full-time**	Net profitability of sales	Share of innovative products (flavour) in the total volume of products shipped	Share of employees with university degrees	Capital equipment	Share of employees performing R&D work	Fixed asset serviceability ratio	Financial stability ratio
1.MLP 15-11-1	0,9995	0,99865	1,00122	1,001197	0,999627	1,002927	1,000064	0,999660
2.RBF 15-3-1	1,0000	1,00000	1,00000	1,000000	1,000000	1,000000	1,000000	1,000000
3.MLP 15-16-1	328,6469	43,96422	26,51991	8,431454	8,109295	5,904246	4,928814	4,822136
4.RBF 15-3-1	1,1023	1,01296	1,02376	1,038294	1,006784	0,996511	0,970804	0,948079
5.MLP 15-13-1	1,0436	0,99557	1,00334	1,018971	1,002275	1,012067	1,002605	0,997918
Середнє	66,5585	9,59428	6,10965	2,497983	2,423596	1,983150	1,780457	1,753559

Мережі	Return on total equity	Return on assets	Share of employees aged 29 to 50 years	Average annual output per employee	Share of trade mark expenses in total expenses	Share of employees trained in new professions	Share of employees who improved their skills in the reporting year
1.MLP 15-11-1	1,000870	1,002393	0,999847	1,001454	1,000377	0,999419	0,998169
2.RBF 15-3-1	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000
3.MLP 15-16-1	4,447472	3,618059	2,789187	2,322627	1,549948	0,908658	0,880823
4.RBF 15-3-1	0,912775	0,981976	0,976330	0,974773	0,969149	0,969205	0,985206
5.MLP 15-13-1	1,000902	1,005684	0,998542	0,997143	1,000849	1,007249	0,999632
Середнє	1,672404	1,521622	1,352781	1,259199	1,104065	0,976906	0,972766

Fig. 2.30. Sensitivity of indicators of the internal environment of enterprises to changes in the integrated indicator of the external environment according to the built models

The ranking of sensitivity values of the internal environment indicators by rationality coefficients according to the best multilevel perceptron model is presented in Table 2.3.

Table 2.3

Ranking of sensitivity of indicators of the internal environment of enterprises according to the best model of the multilevel perceptron model (MLP 15-16-1)

Rank	Indicator name	Value
1	Share of employees employed full-time	328,65
2	Net profitability of sales	43,96
3	Share of innovative products (flavour) in the total volume of products shipped	26,52
4	Share of employees with university degrees	8,43
5	Capital equipment	8,11
6	Share of employees performing R&D work	5,90
7	Fixed asset serviceability ratio	4,93
8	Financial stability ratio	4,82
9	Return on total equity	4,45
10	Return on assets	3,62
11	Share of employees aged 29 to 50 years	2,79
12	Average annual output per employee	2,32
13	Share of trade mark expenses in total expenses	1,55
14	Share of employees trained in new professions	0,91
15	Share of employees who improved their skills in the reporting year	0,88

According to Table 2.3, the top 3 most sensitive indicators of the internal environment to changes in the values of the integrated indicator of the external environment include the following: the share of full-time employees; net profitability of sales; and the share of innovative products in the total volume of shipped products. As in the previous separate analysis of the internal environment of enterprises, the share of full-time employees remained one of the most important indicators. This indicates that managers and owners of enterprises should create conditions for full-time employment. It is positive that the external environment encourages enterprises to intensify their innovation activities, as the third indicator in the top 3 is the share of innovative products in the total volume of shipped products. In the previous separate analysis of the internal environment of enterprises, this indicator was the fourth, i.e., not in the top 3. This indicates that one of the preferred ways to improve the economic condition of enterprises and counteract the uncertainty of the external environment is through innovation, which should be focused on the effective demand of consumers who have a positive impression of the capabilities of enterprises.

Graphical visualizations of the scatter points of the values of the internal environment indicators with the highest sensitivity to the integrated indicator of the

external environment (baseline) and the integrated indicator of the external environment (target) according to the selected model (MLP 15-16-1) are shown in Figures 2.31 – 2.33.

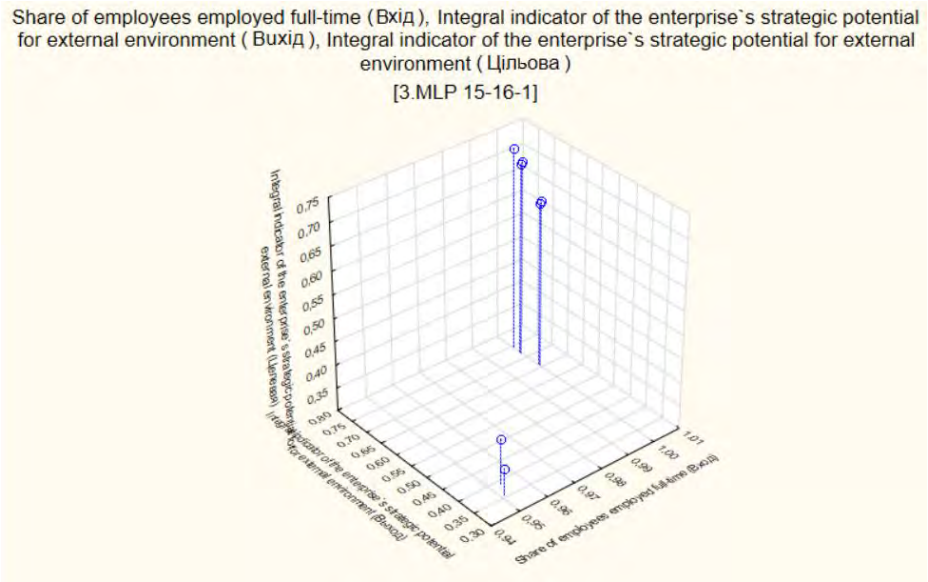


Fig. 2.31. Graphical visualization of the values of the share of full-time employees relative to the integrated environmental indicator (Output) and the integrated environmental indicator (Target)

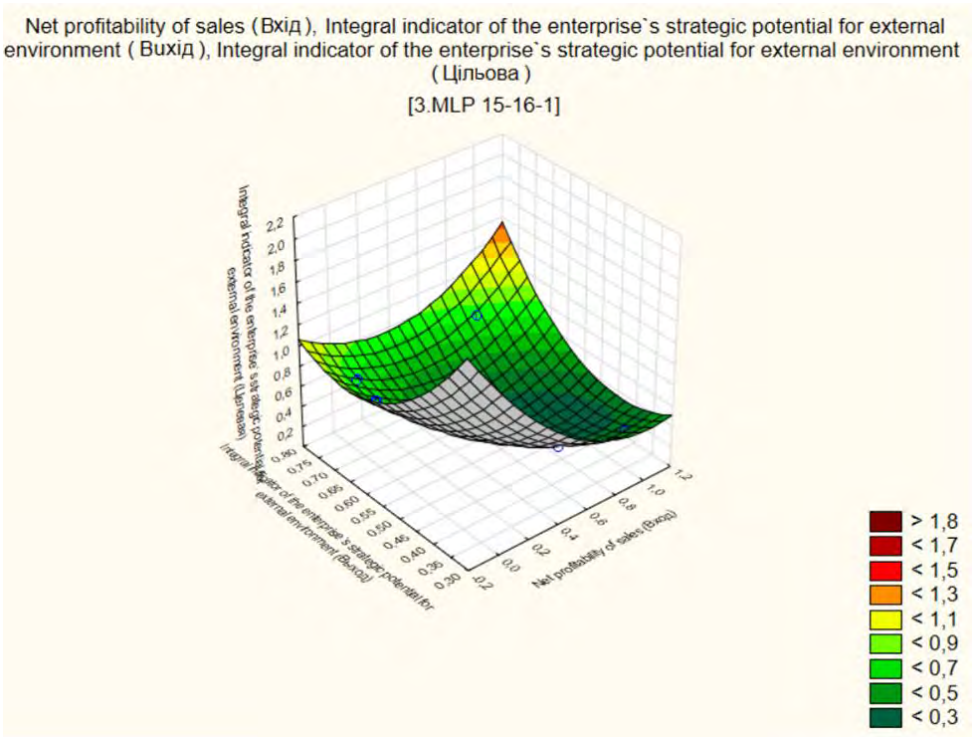


Fig. 2.32. Graphical visualization of the values of the net profitability of sales indicator relative to the integrated indicator of the external environment (Output) and the integrated indicator of the external environment (Target)

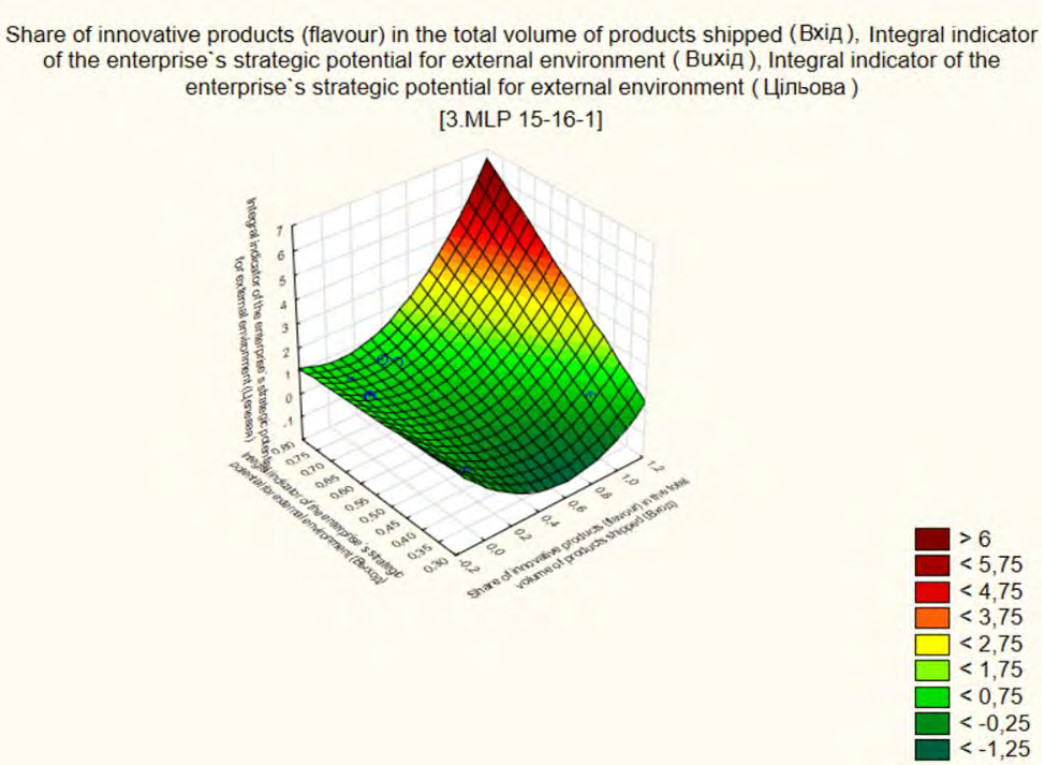


Fig. 2.33. Graphical visualization of the values of the indicator of the share of innovative products in the total volume of shipped products in relation to the integrated indicator of the external environment (Output) and the integrated indicator of the external environment (Target)

Based on the results of the analysis of the relationship and influence of the indicators of the internal environment of enterprises on the integrated indicator of the external environment, the following conclusions can be drawn. The internal environment of enterprises has a non-linear effect on the state of the external environment. The most sensitive indicators to the impact are: the share of full-time employees; net profitability of sales; the share of innovative products in the total volume of shipped products. By changing the values of these indicators, companies can adapt to the complex BANI world and smooth out its negative effects. It is important that management decisions encourage consumers and partners to cooperate with enterprises, based on their positive impressions of the company's products, their new innovative advantages, price competitiveness in the market by increasing the productivity of full-time employees, increasing the profitability of sales of attractive products for consumers that can provide new types of pleasure, which is in line with the model of the experience economy.

Conclusions

In the current conditions of economic relations, the external environment of enterprises functions as unstable, nonlinear, fragile, and risky, which corresponds to the main characteristics of the VUCA world and the BANI world. The VUCA (Volatility, Uncertainty, Complexity, Ambiguity) and BANI (Brittle, Anxious, Nonlinear, Incomprehensible) worlds are characterized by a high level of instability and uncertainty, which directly affects all sectors of the economy, including the food industry. Studying the impact of the VUCA and BANI worlds helps to improve enterprise management systems, which will increase their resilience to external shocks and ensure sustainable development.

For Ukraine, under martial law, the BANI world is more inherent, so studying the peculiarities of the functioning of business entities in its conditions is an urgent need. It is possible to smooth out the difficulties and challenges of the external environment and the complexities of life in the internal environment using the latest progressive model of economic relations – the economy of impressions, which is aimed at forming positive impressions among enterprise stakeholders that promote close cooperation, increase in the volume of contracts, their signing on favorable terms, increase in sales, and, above all, innovation, which can enhance the positivity of impressions and satisfaction from cooperation. However, an important and still unresolved issue is the substantiation of indicators of the internal and external environment of enterprises, on which it is advisable to exercise managerial influence, models of interaction and management measures. Therefore, this study presents the proposed methodology for determining the interrelationships and managerial influence on the factors and indicators of the internal and external environment of enterprises on the example of the food industry. The main stages of the methodology are as follows:

– analysis of external and internal environment factors, determination of the most relevant factors of priority importance, for this purpose it is advisable to use the method of modeling by multivariate factor analysis;

– determination of adequate models of the relationship between these factors; as a method of determining the relationship, it is advisable to use neural networks that are close in their algorithm to the process of human thinking, it is possible to hypothesize that such models and relationships between the factors of the internal and external environments of enterprises will be non-linear;

– in accordance with the selected and substantiated models, to forecast the values of indicators of the internal and external environment and to determine the

most sensitive indicators characterizing the factors of the internal and external environment by rating;

– to make management decisions on changing the values of selected sensitive indicators, the impact of which will allow enterprises to adapt to the relevant changing world as soon as possible in the process of functioning of the impression economy model;

– to use change-sensitive indicators as the basis for forming positive impressions of the enterprise (according to the impression economy model), which are characteristic and necessary for the growth of their added value and profit at a faster rate compared to other models of economic relations development to start and continue productive cooperation with partners and relationships with consumers.

The proposed methodology has been tested, and the results of the testing are presented in this study separately for the factors of the internal environment, the external environment of enterprises, as well as in their direct and inverse relationship. The obtained models of interrelation and influence of these factors in the form of multilevel perceptrons confirm the hypothesis of their nonlinearity and compliance of the Ukrainian economy with the characteristics of the BANI world. The practical use of the modeling results, the identified sensitive indicators on which managers and owners should exert managerial influence, will allow enterprises to maintain competitiveness in difficult modern operating conditions and form positive impressions of the results and capabilities of their activities for rapid growth of added value and profit, to withstand the challenges of the external environment of the BANI-world in wartime. In general, the proposed methodology can be applied to both the BANI world and the VUCA world, which proves its versatility and practical significance.

Directions for further research are the application of Agile management technologies to achieve the required level of adaptability to rapidly changing environmental conditions by enterprises.

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