OPTIMIZATION OF THE ECONOMIC POTENTIAL OF THE ENTERPRISE ON THE BASIS OF A STRATEGIC DECISION-MAKING MATRIX

Larisa Narkevich

•

Belarusian-Russian University, Mogilev, BELARUS
lora1166@yandex.ru

Abstract

The article is devoted to the issues of modeling the optimization of economic potential of the enterprise on the basis of matrix algorithm of decision-making. The article considers the final stage of algorithmization of system-scenario multifactor modeling of optimization of economic potential on the basis of strategic decision-making matrix, which includes analytical tools for point positioning of the level of economic potential development in the context of variability of complex analytical scenarios of growth of potential-efficiency of the enterprise taking into account the factors of globalization and international integration.

At the enterprise level the optimization strategic task of economic potential management is solved, which provides for the use of more detailed decomposition of economic potential, a wide range of indicators taking into account the specifics of the enterprise's activity, accurate determination of the values of the elements of potential. The development of economic and mathematical model of economic potential management at the level of textile industry enterprises is made in accordance with the general theory of systems.

In order to optimize management, modeling interactions between the parameters of the economic potential of textile enterprises is an effective management tool and relates to solving the task of targeted management related to the multilevel system of private criteria, their unequal value, the need to simultaneously take into account both quantitatively and qualitatively specified indicators of private potentials. Based on this definition, further modeling of economic potential and methods of its analysis are possible.

The model experiment allowed us to develop a scenario series of optimization of economic potential according to the criterion of growth potential-efficiency of its development level in the future; to carry out typologization of the description of functional tools of market strategies.

Keywords: economic potential, matrix, dynamics, development, potential-efficiency, index, optimization, strategic scenario, means of scenario development

I. Introduction.

The development of the theory and practice of system optimization modeling of the economic potential (EP) of microeconomic objects is considered an urgent direction of designing an information and analytical decision support system (IA DSS). In this context, the microeconomic system is considered as an object possessing dynamically developing economic potential and having the result of its level of development, quantifiably measured by potential efficiency.

Economically competent use of the EP optimization theory allows you to anticipate changes in the target indicators of its development.

The purpose of the study is to develop the optimization of the EP of microeconomic systems based on the strategic decision-making matrix integrated into the IA DSS of the enterprise.

The tasks are set: to develop the format of a strategic matrix for managing the development of economic potential in a system of indicators of market and factor potentials (a two-dimensional model of the efficiency of using the level of economic potential); to deduce the threshold values of the integral

index of market potential in the procedure of typology of enterprises; to present conceptual approaches to diagnostics based on the matrix of management decisions in the subsystem for developing strategic scenarios.

II. METHODS AND MATERIALS

The EP optimization model goes through a number of stages of algorithmization of analytical information processing, the final of which is the positioning of the level of development of the economic potential of microeconomic systems in the matrix of decision-making strategies. This stage of the IA DSS design algorithm in the subject area of EP optimization is preceded by the following blocks: a hierarchical model of a multi-criteria assessment of economic potential, which includes five levels of disaggregation of a generalized target criterion; fuzzy mathematical modeling and multi-criteria analysis of the market and factor potentials of microeconomic systems; mathematical modeling and analysis of the dynamics of integral indicators of the level of EP development in decomposition; econometric mathematical model and multifactorial correlation and regression analysis of EP optimization.

Economic and mathematical information processing based on the strategic decision-making matrix provides for setting goals, directions and criteria for the development of the EP microeconomic system; designing a matrix of decision-making strategies with subsequent positioning of the level of development of the EP microeconomic system; effective implementation of complex data analysis scenarios based on optimizing the pace and proportions of the development of integral indicators of market and factor potentials with step-by-step detailing of production, human resources, innovation and investment potentials; design of a DSS for optimizing the EP of a microeconomic system of fuzzy data analysis scenarios.

The target vector of optimization of the EP microsystem of the enterprise in the study provides for ensuring its sustainable development in the long term: increasing investment and export attractiveness, increasing the efficiency of using EP (based on the criterion of intensification) for all elements of decomposition; the criterion of EP development is focused on the outstripping growth of the integral indicator of market potential relative to the growth rate of the integral indicator of factor potential, provided an optimal combination of production, personnel, innovation and investment potentials; building up innovative and investment potentials in accordance with the design and target vector of EP development; system-scenario multifactorial modeling of EP optimization taking into account the factors of globalization and economic integration (points of growth of integration ties in the format of the Union State, the Eurasian Economic Union).

The matrix of EP optimization strategies at the micro-level of the enterprise is designed based on the selected decomposition of the EP, the hierarchy of structural elements, a sufficiently deep format for detailing the estimated parameters of the level of development of the EP, the characteristics of internal and external factors. Integrated indices of market potential development (characterizes the market effectiveness of using the EP system, taking into account the dynamics of the enterprise's market share under the influence of factors of globalization and integration) and factor potential generated on the basis of indices of the development of production, personnel, innovation and investment potentials (characterizes the dynamics of resource capabilities of the EP systems that ensure the production competitiveness of products and the rating of their positioning in the market).

The author's matrix of decision–making strategies has the property of a high degree of detail and sensitivity of the dimensional scale of the quadrants in accordance with the coordinate points of the selected indicators: a dependent variable is an integral indicator of the development of market potential, an independent variable is an integral indicator of the development of factor potential; implements the relationship "the level of development of the EP – the efficiency of the use of the EP – the effectiveness of the functioning of the microeconomic system".

The positioning of the EP development level at the enterprise level is detailed taking into account the developed information and analytical environment in the matrix field of coordinates: the typologization format is tied to the boundaries of the 16 quadrants of the matrix (high level of development, above average level of development, below average level of development, low level of

development). Each quadrant of the matrix is subject to economic interpretation in accordance with a combination of interval values of integral indices of market and factor potentials, given in the graph of characteristics of the zones of the field of the strategic decision-making matrix.

For each type of interval values of integral indices, taking into account external and internal factors, a vector of scenarios for the development of EP was selected and a market strategy for optimizing EP was adapted. The concept of diagnostics based on the decision-making matrix in the subsystem for the development of strategic scenarios for the development of EP includes the specification of: quadrant zones; typology of the microeconomic system according to the intervals of values of integral indices of EP; characteristics of the zones of the field of the strategic matrix according to the values of indicators; the content of the strategy and the vector of scenarios for the development of EP, taking into account the balance of the indicators of the matrix.

In the conducted research, the IA DSS optimization of the EP was carried out on the basis of the use of strategic scenarios in the following areas: pessimistic and optimistic. The format of the pessimistic scenario reflects the target indicators of EP development in quadrant a) (normalized indices of market and factor potentials, respectively, Irp [0÷0.5]; Ifp [0÷0.5]); optimistic scenario – in quadrant b), d), c) (normalized indices of market and factor potentials, respectively, Irp [0.5÷1.0]; Ifp [0.5-1.0]).

The starting point for scenario design is the position of the enterprise's EP development level in the coordinate system of the strategic matrix in the reporting period (the state of the EP at the endpoint of the dynamic series). The projected trajectory of movement in the strategic field of the matrix is set in accordance with the chosen EP optimization strategy and the variability of scenarios based on the genetic and target development options. The criterion of the positivity of the development of EP potential is the target integral indicator of economic potential, the increase of which corresponds to the increase of EP, taking into account the factors of globalization of production and interregional integration.

III. LITERATURE REVIEW

The study was based on the analysis of the works of Andreychikov et al. (1998), Bruskin (2016), Zadeh (1976), Mereste (1982), Chegerova (2021), Diligensky et al. (2004), Saati (1991), Kerns (1991), Savitskaya (2023), Finogenko (2017) in the field of system analysis, information and analytical system design and decision theory. The theory of market management strategies is considered in the works of Kuroedov et al. (2007). Some methodological aspects of economic potential assessment have been studied by scientists: Afinogenov et al. (2019), Khvorostov (2005), Gorbunova (2014), Vapne (2019), Gonin et al. (2014),), Sheshukova et al. (2013), Shcherbakov et al. (2019), Kovalev et al. (2006), Morozova (2009), Mogilina (2015), Nizamutdinov (2017), Peshkova (2017), Pisareva (2018), Rakhmanova (2018), Tashkinov (2018), Terekhova-Pushnaya (2019), Podolsky et al. (2020), Yarygina (2016), Gurieva (2018), and others.

The lack of a systematic theoretical and methodological approach to mathematical modeling of dynamic processes of the state and changes in economic potential, providing a genetic format for optimizing its development, actualizes the tasks of scenario modeling of optimization of EP enterprises.

IV. RESULTS AND DISCUSSION

The information base of the model experiment was the reporting data of textile industry enterprises: 56 factors were identified, rolled up on the basis of the fuzzy modeling method into integral indices of market, production, personnel, innovation and investment potentials with access to global factor potential (Table 1); a polynomial regression relationship between market and factor potentials was established, which was used to calculate target indicators in enterprise EP optimization scenarios.

The structural model of IIP quality in the cluster of analyzed textile industry enterprises showed a fairly high spread of integral parameters of local potentials (for example, the spread of the level of the integral indicator of investment potential development by enterprises for 2019-2023 was stated from

0.0014 (enterprise 3) to 1.0059 (enterprise 1). The average annual rate of change in the integral indicators of market and factor potentials in the decomposition indicated imbalances in the dynamics and prospective scenario development of the EP.

Table 1: *Structural dynamic model of quality of EP of textile industry enterprises*

Time series (year)	An integral indicator of market potential	Integral indicator of factor potential			
		including decomposition elements			
		production	personnel	innovation	investment
Enterprise 1					
2014	0,6246	0,3082	0,6535	0,6358	0,7400
2015	0,6029	0,2399	0,5894	0,7403	0,6568
2016	0,5248	0,2023	0,2357	0,8469	0,5105
2017	0,4360	0,3431	0,2484	0,9218	0,4545
2018	0,5845	0,3849	0,4371	0,9710	0,7583
2019	0,5635	0,4241	0,4788	0,6321	0,5297
2020	0,4475	0,2457	0,3690	0,7465	0,3352
2021	0,5775	0,5482	0,3787	0,7993	0,7583
2022	0,6553	0,8632	0,7225	0,7139	1,0059
2023	0,6460	0,8052	0,6743	0,8741	0,5632
The average annual rate of change, %	100,38	111,26	100,35	103,60	97,01
Enterprise 2					
2014	0,5067	0,6239	0,2518	0,5182	0,6105
2015	0,4384	0,2774	0,2177	0,5347	0,6185
2016	0,3871	0,2396	0,1978	0,6709	0,8561
2017	0,4100	0,4986	0,2238	0,7478	0,8990
2018	0,4356	0,4863	0,2492	0,6786	0,7815
2019	0,4319	0,5581	0,2052	0,6598	0,7142
2020	0,3707	0,2946	0,1896	0,6315	0,8494
2021	0,4508	0,4552	0,1959	0,6568	0,7515
2022	0,5284	0,6895	0,2499	0,8210	0,8777
2023	0,4042	0,7589	0,2557	0,6666	0,9740
The average annual rate of change, %	97,52	102,20	100,17	102,84	105,33
Enterprise 3					
2014	0,3724	0,6915	0,3660	0,4810	0,5724
2015	0,3695	0,2201	0,2187	0,5332	0,1670
2016	0,5414	0,2828	0,1361	0,7524	0,0960
2017	0,6072	0,4410	0,2195	0,7682	0,1261
2018	0,5412	0,3836	0,1876	0,6415	0,0878
2019	0,4219	0,4919	0,2476	0,6147	0,4819
2020	0,4407	0,4638	0,1979	0,6081	0,1678
2021	0,2968	0,1449	0,2057	0,6006	0,0014
2022	0,5275	0,7807	0,3708	0,5270	0,6442
2023	0,4549	0,7909	0,2757	0,4759	0,5746
The average annual rate of change, %	102,25	101,50	96,90	99,88	100,04
Note: enterprise 1 – JSC «Mogotex»; enterprise 2 – JSC «Lenta»; enterprise 3 – JSC «BPHO»					

Source: in-house development

Diagnostics of integral indicators in the dynamics of 2014-2023 for enterprises of the textile industry is characterized by the following provisions:

- enterprise 1: the most significant increase in the integral indicator is attributed to production potential (11.26%) with a simultaneous lag in personnel, innovation and investment potentials, which corresponds to a low level of growth in market potential (average annual growth rate of 100.38%);

- enterprise 2: high levels of innovation and investment potentials are indicated (the average annual increase, respectively, amounted to 2.84; 5.33%); low levels and intensity of dynamics in terms

of personnel potential and the rate of decline in terms of market productive potential (an average annual relative decrease of 2.48 %;

- enterprise 3: the general profile of integral indicators shows the active dynamics of the development of market potential (average annual growth rate of 102.25%) with a significant lag in the development of innovative, investment, human resources and production potentials.

The harmonious development of the economic potential of the microeconomic systems of enterprises as a whole is designed in the scenario format of the predictive development of the EP.

The regulations for the construction of strategic scenarios for the optimization of the EP included:

- the target values of the integral indicators of production, personnel, innovation, and investment potentials are set in accordance with the structure of the elements of factor potential corresponding to the largest value of the integral index of market potential in a series of dynamics over 10 years using the method of structural analogy;

- calculation of integral indicators of production, personnel, innovation, investment potentials was carried out in accordance with the boundaries of target indicators, the point of positioning of the enterprise in the strategic decision-making matrix for optimizing the EP in the last year of the studied series of dynamics and the optimal structure of factor potential;

- calculated values of the integral index of market potential are determined based on econometric models of regression dependence;

- interval grouping of target indicators was performed in groups of scenarios pessimistic, optimistic: the boundaries of the intervals are reduced to the format "lower bound – upper bound";

- the lower limit of the target integral indicator of factor potential is established based on the calculated values of the integral indices of production, personnel, innovation and investment potentials linked to the boundaries of the quadrants of the strategic matrix and the optimal structure of the factor potential of the analyzed enterprises;

- when designing the upper limits of the target indices of production, personnel, innovation and investment potentials, we proceeded from the balance of gains in the indices of market and factor potentials;

- based on the obtained regression dependence, the calculation of the lower and upper limits of the target market potential indices was performed;

- the target index of factor potential is calculated by multiplicative convolution using established significance coefficients;

- scenarios of target indicators for the optimization of EP enterprises: a set of target indices for the development of EP in tabular form (working out for the enterprise 1 table 2);

Table 2: *Scenarios of target indicators for optimization of EP of the enterprise 1*

EP optimiza-tion scenario	An integral indicator of market potential	Factor potential of the enterprise 1				
		the integral indicator	including decomposition elements			
			production	personnel	innovation	investment
Пессимистичный						
1	0,499-0,524	0,383-0,422	0,197-0,217	0,419-0,460	0,407-0,448	0,474-0,521
2	0,558-0,585	0,479-0,527	0,247-0,271	0,523-0,575	0,509-0,560	0,592-0,652
3	0,612-0,643	0,575-0,633	0,296-0,326	0,628-0,691	0,611-0,672	0,711-0,782
4	0,665-0,706	0,671-0,738	0,345-0,380	0,732-0,806	0,713-0,784	0,829-0,912
5	0,725-0,781	0,767-0,844	0,395-0,434	0,837-0,921	0,814-0,896	0,948-1,043
6	0,797-0,876	0,863-0,949	0,444-0,489	0,942-1,036	0,916-1,008	1,066-1,173
Оптимистичный						
7	0,886-0,974	0,959-1,035	0,493-0,533	1,046-1,130	1,018-1,099	1,185-1,280
8	0,999-1,122	1,054-1,139	0,543-0,586	1,151-1,243	1,120-1,209	1,303-1,407
9	1,141-1,311	1,150-1,242	0,592-0,640	1,256-1,356	1,222-1,319	1,422-1,535
10	1,319-1,456	1,246-1,309	0,641-0,674	1,360-1,428	1,323-1,390	1,540-1,617
11	1,537-1,718	1,342-1,409	0,691-0,725	1,465-1,538	1,425-1,496	1,659-1,742

| 12 | 1,803-2,036 | 1,438-1,510 | 0,740-0,777 | 1,569-1,648 | 1,527-1,603 | 1,777-1,866 |

Source: in-house development

- normalization of indicators of target indices for the development of EP enterprises in order to position them in the strategic decision-making matrix for the optimization of EP (the values of integral indicators of the market and factor potentials of the enterprise 1 in the scenarios are shown in Table 3);

Table 3: *Linear normalization of integral indices in the system of strategic scenarios for optimization of EP of the enterprise 1*

| EP optimization scenario	The designation of the scenario on the graph	The integral indicator				Normalized integral indicators			
		market potential		factor potential		market potential		factor potential	
		lower bound	upper bound	lower bound	upper bound	lower bound	upper bound	lower bound	upper bound
Pessimistic	1	0,499	0,524	0,383	0,422	0	0	0	0
	2	0,558	0,585	0,479	0,527	0,045	0,041	0,091	0,097
	3	0,612	0,643	0,575	0,633	0,086	0,079	0,182	0,194
	4	0,665	0,706	0,671	0,738	0,127	0,120	0,273	0,291
	5	0,725	0,781	0,767	0,844	0,173	0,170	0,364	0,388
	6	0,797	0,876	0,863	0,949	0,228	0,233	0,455	0,485
Optimistic	7	0,886	0,974	0,959	1,035	0,297	0,298	0,545	0,564
	8	0,999	1,122	1,054	1,139	0,383	0,396	0,636	0,659
	9	1,141	1,311	1,150	1,242	0,492	0,520	0,727	0,754
	10	1,319	1,456	1,246	1,309	0,629	0,616	0,818	0,815
	11	1,537	1,718	1,342	1,409	0,796	0,790	0,909	0,907
	12	1,803	2,036	1,438	1,510	1	1	1	1

Source: in-house development

- diagnostics based on the strategic decision-making matrix (Table 4) and the construction of strategic scenarios for the optimization of EP in the matrix field of economic potential (Figure 1);

Table 4: *Results of predictive diagnostics based on the strategic matrix of EP optimization*

Enterprise	Scenario trend of EP development	Optimistic scenarios of EP development			EP optimization Strategy
		quadrant	coordinate points (Ifp; Irp) in the strategic matrix		
			lower bound	upper bound	
Enterprise 1	d_2; c_4; c_3	d_2	7 (0,545; 0,297) 8 (0,636; 0,383)	7(0,564; 0,298) 8 (0,659; 0,396)	Market Development Strategy (SF2)
		c_4	9 (0,727; 0,492) 10 (0,818; 0,629)	9 (0,754;0,520) 10 (0,815;0,616)	Horizontal Diversification Strategy (SD2)
		c_3	11 (0,909; 0,796) 12 (1; 1)	11 (0,907;0,790) 12 (1; 1)	Conglomerate Diversification Strategy (SD3)
Enterprise 2	a_3; d_2; c_2; c_3	d_2	7 (0,518; 0,396)	7 (0,576; 0,687)	Market Development Strategy (SF2)
		c_2	8 (0,641; 0,760) 9 (0,731; 0,864)	8 (0,675; 0,807) 9 (0,773; 0,903)	Conglomerate Diversification Strategy (SD3)
		c_3	10 (0,820; 0,943) 11 (0,910; 0,989) 12 (1; 1)	10 (0,872; 0,966) 11 (0,970; 0,985) 12 (1; 1)	Conglomerate Diversification Strategy (SD3)
Enterprise 3	a_4; a_3; d_2; c_1; c_4; c_3	d_2	7 (0,556; 0,479)	7 (0,556; 0,479)	Market Development Strategy (SF2)
		c_1	8 (0,704; 0,638) 9 (0,741; 0,680)	8 (0,676; 0,607) 9 (0,741; 0,679)	Strategy of Centered Diversification (SD1)
		c_3	10 (0,815; 0,767) 11 (0,926; 0,904) 12 (1; 1)	10 (0,815; 0,766) 11 (0,926; 0,903) 12 (1; 1)	Conglomerate Diversificaton Strategy (SD3)

Source: in-house development
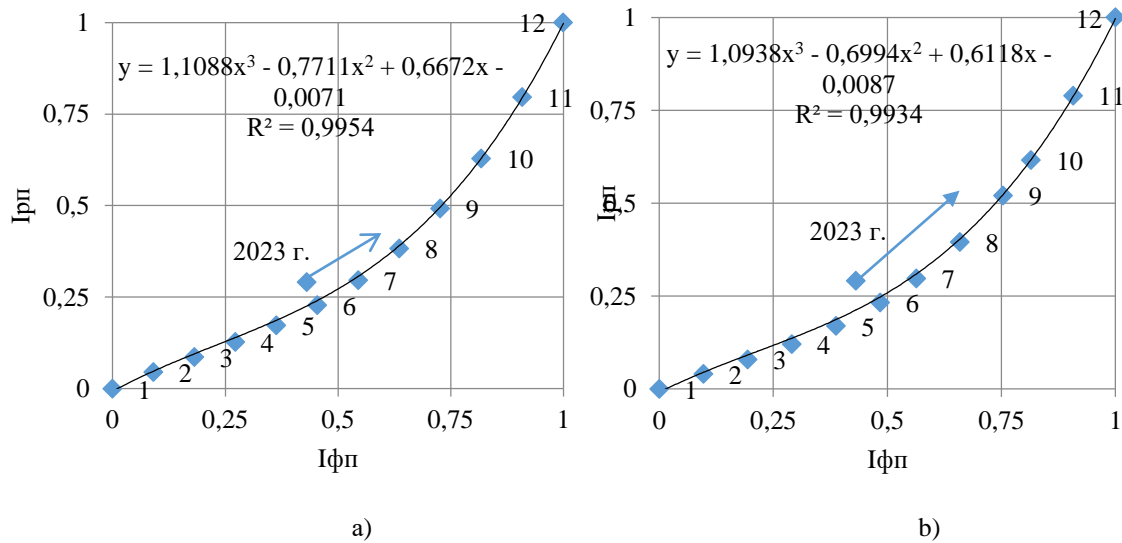
Figure 1: *Positioning of ES development scenarios in the matrix of EP optimization strategies of enterprise 1: a) by lower boundary of intervals; b) by upper boundary of intervals*
Source: in-house development

- estimation of EP utilization efficiency in scenario variants (enterprise 1, Table 5);

Table 5: *Economic effect in the context of prognostic scenario indices of the development of the EP of the enterprise 1*

EP optimization scenario	The target integral indicator of economic potential		Prospective baseline rates of change, %	
	lower bound	upper bound	lower bound	upper bound
Pessimistic	0,438	0,470	103,36	111,04
	0,517	0,556	122,19	131,22
	0,593	0,638	140,10	150,70
	0,668	0,722	157,82	170,52
	0,746	0,812	176,12	191,72
	0,829	0,912	195,81	215,36
Optimistic	0,922	1,004	217,67	237,19
	1,026	1,130	242,40	267,03
	1,146	1,276	270,62	301,42
	1,282	1,380	302,78	325,99
	1,436	1,556	339,26	367,49
	1,610	1,753	380,28	414,13
Comparison base	It is established according to the trend of the integral indicator of economic potential over 10 years: 0.423 (the average geometric value in the range of Iep dynamics).			

Source: in-house development

- the development and specification of the content of EP optimization strategies was carried out in accordance with the developed typologization of functional tools for the growth of potential efficiency of microeconomic systems.

As an indicator controlling the level of positivity (growth) of the efficiency potential in the mathematical model, the target integral indicator of the EP was adopted, the value of which, in the context of the studied enterprises, was distributed in the following directions:

- enterprise 1) is achieved already at the first point of the scenario format: the increase in the integral indicator of the EP along the lower; upper boundary, respectively, amounted to 3.36; 11.04% relative to the average value of the parameter for a number of dynamics over 10 years; in the group of optimistic scenarios, the growth of the integral indicator of the EP by more than 2 times (the highest value corresponds to the 12 scenario with a conglomerate diversification and an increase in the generalizing parameter along the boundaries by 3.80; 4.14 times, respectively);

- enterprise 2) is achieved at the second point of the scenario format: the increase in the integral indicator of the EP along the lower; upper boundary, respectively, amounted to 7.10; 17.68%; the increase in the group of optimistic scenarios ranges from 124.94 to 291.30 %;

- enterprise 3) is achieved at the second point of the scenario format: an increase of 9.41; 14.97%; a variation of the relative increase in the group of optimistic scenarios – from 74.11 to 150.33%.

V. CONCLUSION

Thus, a model for optimizing the economic potential of an enterprise based on a strategic decision-making matrix, designed based on the synthesis of the theory of fuzzy sets, the method of hierarchy analysis, the method of scenario verification of forecasts, which allows you to position the economic potential of an enterprise in a strategic matrix with a high level of reliability and select a scenario trajectory of the program-target vector of optimization of economic potential according to the criteria of economic growth taking into account the factors of globalization of production in the industry.

Testing of the developed system-scenario multifactorial model of EP optimization in the information field of textile industry enterprises has shown: the genetic variant is characterized by a low level of economic potential efficiency, negative dynamics of a decrease in integral indicators, an imbalance of structural elements in the decomposition, subject to significant fluctuations in indicators.

In the prognostic direction, an algorithm of scenario verification is undertaken when making decisions to optimize EP in the system of strategic development of market factors of globalization and international integration. During the model experiment, the developed scenarios are filled with functional tools for increasing the potential efficiency of the system in accordance with the types of strategies.

References

[1] Diligensky, N. V., Dymova, L. G., & Sevastyanov, P. V. (2004). Fuzzy modeling and multi-criteria optimization of production systems in conditions of uncertainty: technology, economics, ecology.

[2] Andrianov, D. L., & Grebnev, M. I. (2015). An overview of methods for aggregating production functions. Management of economic systems: an electronic scientific journal, (1 (73)), 4.

[3] Ibragimova, R. S., & Golovin, D. S. (2016). Methodological justification of the assessment of the economic potential of the enterprise. Modern high-tech technologies. Regional application, (3 (47)), 64-74.

[4] Ibragimova, M. H. (2015). Assessment of the company's economic potential for strategic management purposes. Management of economic systems: an electronic scientific journal, (10 (82)), 24.

[5] Khadzaragova, E. A. (2015). On methods of scalarization of vector estimates in multi-criteria optimization problems. Fundamental and Applied Research: Problems and Results, (18), 123-127.

[6] Mereste, W. I. (1982). On the matrix method of analyzing the economic efficiency of social production. Economics and Mathematical Methods, 18(1), 138-149.

[7] Finogenko, I. A., & Dyakovich, M. P. (2017). The method of hierarchy analysis and the construction of integral indicators of complex systems. Bulletin of Russian Universities. Mathematics, 22(6-1), 1335-1340. DOI: 10.20310/1810-0198-2017-22-6-1335-1340

[8] Merkulova, E. Y. (2017). Technological and methodological basis of strategic analysis. Socio-economic phenomena and Processes, 12(3), 131-138.

[9] Narkevich, L. V. (1998). Privatization of retail trade enterprises and its impact on the economic efficiency of their business activities (Doctoral dissertation).

[10] Sologubova, L. A., Trunkina, O. V., Baibekova, F. N., & Kulakov, A. A. (2018). Decision-making using the hierarchy analysis method. Innovations in science, (4 (80)), 11-14.

[11] Narkevich L. V., Rogachev A. F., Terelyansky P. V. (2021). Digitalization of the economy as a factor of sustainable development of the regions of Russia and Belarus. In socio-economic

systems: paradigms of the future (pp. 737-746). Cham: Springer International Publishing. DOI:10.1007/978-3-030-56433-9_78

[12] Belousova M. N., Belousov V. A., Narkevich L. V. (2021). Digital transformation of the educational process at the university in the context of globalization. In socio-economic systems: paradigms of the future (pp. 1267-1277). Cham: Springer International Publishing. DOI:10.1007/978-3-030-56433-9_133

[13] Chegerova, T. I., Nekhai, E. V., & Kruchinsky, N. G. (2021). Mathematical forecasting methods for managing the training process of qualified athletes: Message 1. Development of expert assessments. Applied Sports Science, (2 (14)), 43-51.

[14] Vasilyeva, L. V. (2017). Analysis of methodological approaches to the construction of integrated economic indicators/L. V. Sidorov. Economic Research and Development, 12, 8-18.

[15] Bruskin, S. N. (2016). Methods and tools of advanced business analytics for corporate information and analytical systems in the era of digital transformation. Modern Information Technologies and OT-education, 12(3-1), 234-239.

[16] Niyazbekova, S. U., Moldashbaeva, L. P., & Uspambaeva, M. K. (2019). On institutional and legal problems of state audit and financial control. Bulletin of Moscow University S. Yu. Witte. Series 1: Economics and Management, 3(30), 15-20. DOI: 10.21777/2587-554X-2019-3-15-20

[17] Niyazbekova, S. U., & Ivanova, O. S. (2020). Development of fintech and big data in the financial sphere: features, problems, opportunities. Moscow University Journal S. Yu. Witte. Series 1: Economics and Management, 1(32), 30-36. DOI: 10.21777/2587-554X-2020-1-30-36

[18] Yarovenko, S. E., & Niyazbekova, S. U. (2021). Comparative analysis of global financial crises, their causes and consequences. Bulletin of the Moscow State University named after S. Yu. Witte. Series 1: Economics and Management, (4 (39)), 48-57. DOI: 10.21777/2587-554X-2021-4-48-57

[19] Niyazbekova, Sh. U., & Bunevich, K. G. (2020). A brief overview of the DANISH financial sector. Bulletin of the Moscow State University named after S. Yu. Witte. Series 1: Economics and Management, (3 (34)), 50-56. DOI: 10.21777/2587-554X-2020-3-50-56

[20] Niyazbekova, Sh. U., & Bunevich, K. G. (2017). Analysis of the socio-economic development of Astana city. Bulletin of the Moscow State University named after S. Yu. Witte. Series 1: Economics and Management, (3 (22)), 24-31. DOI: 10.21777/2307-6135-2017-3-24-31

[21] Effectiveness of Regulatory Mechanisms of the Oil and Gas Industry in the Context of Environmental Problems.Butova, T.,Varzin, V., Niyazbekova, S., Yessymkhanova, Z.,Anzorova, S. Lecture Notes in Networks and Systems, 2023, 575 LNNS, pp 38–49 DOI:10.1007/978-3-031-21219-2_4

[22] Risk and Uncertainty in the Management System of a Commercial Bank. Kunanbayeva, K.B., Niyazbekova, S.U.,Urekeshova, A.B., Varzin, V.V., Maisigova, L.A. Approaches to Global Sustainability, Markets, and Governance, 2023, Part F643, PP. 375–381 DOI:10.1007/978-981-99-2198-0_41

[23] Using mathematical statistics to optimize the process of crossovers using Data Center Infrastructure Management. Pavlyuk, I.D., Britvina, V.V., Gavrilyuk, A.V., Niyazbekova, S.U., Nurgazina, G.E. Proceedings of SPIE – The International Society for Optical Engineering, 2023, 12637, 1263709 DOI:10.1117/12.2681655

[24] The Study of Mathematical Models and Algorithms for Face Recognition in Images Using Python in Proctoring System. Nurpeisova, A., Shaushenova, A., Mutalova, Z., ...Semenov, A.,Maisigova, L. Computation, 2022, 10(8), 136 DOI: 10.3390/COMPUTATION10080136

[25] Sustainable Energy Efficient Human-Centered Digital Solutions for ESG Megacities Development. Barykin, S.E., Sergeev, S.M.,Kapustina, I.V., ...Niyazbekova, S.U., Karmanova, A.E. Frontiers in Energy Research, 2022, 10, 938768 DOI: 10.3389/fenrg.2022.938768