

A SYSTEM-SCENARIO MULTIFACTOR MODEL FOR OPTIMIZING MESO-LEVEL ECONOMIC POTENTIAL USING MATRIX METHODS

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Summary. This study develops a system-scenario multifactor model for optimizing meso-level economic potential using matrix methods. The model considers an industry as a complex socio-economic system in which resource and institutional components interact under internal and external influences. It integrates indicators of potential profitability, return, and intensity within a hierarchical matrix framework to support strategic decision-making. The empirical analysis uses data from leading enterprises in the Belarusian light and textile industry, incorporating 42 indicators of local resource potential and 72 indicators of local institutional potential. The methodology involves constructing state and index matrices, aggregating indicators at three analytical levels, and positioning enterprises within a strategic decision-making matrix. The results reveal differences in resource and institutional potential, with an integral economic potential index of 0.963 for the analyzed enterprise. Institutional potential demonstrated stronger performance than resource potential. The proposed model provides a quantitative framework for identifying constraints, comparing development scenarios, and selecting strategies to improve economic efficiency and adaptability at the meso-level.

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1. Introduction

The optimization of economic potential has become increasingly important for industrial systems operating under uncertainty, globalization, integration, and digital transformation (Kostikova et al., 2016). At the meso-level, an industry represents a complex socio-economic system comprising interconnected enterprises and multiple resource, institutional, and managerial components. These components interact dynamically and are influenced by both internal and external factors (Andrianov & Grebnev, 2015; Kvyatkovskaya & Frenkel, 2009).

Existing approaches to economic potential optimization do not fully capture the complex relationships among its structural components. In particular, limited attention has been paid to the dynamic interdependence of resource and institutional parameters and their combined influence on industrial development. This limitation complicates the assessment of economic potential and the selection of appropriate development strategies.

Matrix modeling provides a useful analytical framework for addressing this problem because it enables multiple economic indicators and their interrelationships to be represented within an integrated quantitative system (Brinza et al., 2016; Romanenko, 2007; Yaroshevich, 2023). Combined with scenario analysis, this approach can support the assessment of alternative development trajectories and the selection of strategies for improving economic potential.

2. Methodology

This study applies a system-scenario multifactor modeling approach to assess and optimize economic potential at the meso-level. The methodological framework is based on matrix modeling, which enables the

interrelationships among multiple parameters of economic potential to be represented and analyzed within an integrated system (Brinza et al., 2016; Romanenko, 2007; Yaroshevich, 2023).

The model distinguishes between two principal components of economic potential: local resource potential and local institutional potential. Their performance is evaluated through three analytical dimensions: potential profitability, potential return, and potential intensity. These dimensions provide the basis for assessing changes in economic potential and comparing the relative efficiency of its structural components.

The modeling procedure consists of three analytical levels. At the first level, state matrices are constructed from the initial economic parameters. The local resource potential matrix comprises 42 specific indicators, calculated from all possible paired ratios of seven initial parameters. The local institutional potential matrix comprises 72 specific indicators reflecting institutional and external-environment factors relevant to industrial development.

At the second level, dynamic index matrices are constructed to measure changes in the indicators over time. Individual indicators are subsequently aggregated using a hierarchical procedure to obtain composite measures of resource and institutional potential. At the third level, the resulting indices are normalized and used to position industrial entities within a strategic decision-making matrix. This positioning provides the basis for identifying appropriate development scenarios according to the relative performance of resource and institutional potential.

The empirical application was conducted using economic data from enterprises of the Belarusian light and textile industry. The detailed calculation is illustrated for JSC Mogotex, while the strategic analysis also incorporates other enterprises within the industry. The matrix calculations were performed using spreadsheet-based computational procedures.

The calculation module is based on a number of microsystems, claterized by the level of economic potential development (microsystems can be grouped according to other criteria in accordance with the objectives of the IAS of the RPR (for example, by the level of contribution to sectoral GDP, financial level, level of innovation sensitivity, and others).

3. Results and discussion

The proposed model was applied to economic data from leading enterprises of the Belarusian light and textile industry. JSC Mogotex (Microsystem 1) was selected to illustrate the detailed matrix calculations. The analysis distinguishes between local resource and local institutional potential and evaluates both components in terms of potential profitability, return, and intensity. The selection and application of matrix modeling procedures were informed by established approaches to assessing the economic efficiency of industrial enterprises (Romanenko, 2007). The matrix model for the scenario analysis of local resource potential in Microsystem 1 (JSC Mogotex) for 2016 and 2017 is presented in Table 1.

Table 1

Matrix Model for the Scenario Analysis of Local Resource Potential (Microsystem 1)

2016							
Designations	PR	OP	VR	OPF	OS	HR	FOT
PR	1	21,454	24,591	14,060	10,383	0,585	3,532
OP	0,047	1	1,146	0,655	0,484	0,027	0,165
VR	0,041	0,872	1	0,572	0,422	0,024	0,144
OPF	0,071	1,526	1,749	1	0,738	0,042	0,251
OS	0,096	2,066	2,368	1,354	1	0,056	0,340
HR	1,710	36,690	42,055	24,046	17,756	1	6,040
FOT	0,283	6,074	6,963	3,981	2,940	0,166	1
2017							
Designations	PR	OP	VR	OPF	OS	HR	FOT
PR	1	14,421	27,027	16,330	7,580	0,316	1,964
OP	0,069	1	1,874	1,132	0,526	0,022	0,136
VR	0,037	0,534	1	0,604	0,280	0,012	0,073
OPF	0,061	0,883	1,655	1	0,464	0,019	0,120
OS	0,132	1,902	3,565	2,154	1	0,042	0,259
HR	3,160	45,566	85,397	51,599	23,951	1	6,206
FOT	0,509	7,342	13,760	8,314	3,859	0,161	1
PR – profit from sales; OP – volume of production; VR – revenue from sales; OPF – fixed assets; OS – working capital; HR – number of employees; FOT – wage fund							

Source: compiled by the author

The corresponding matrix model for the scenario analysis of local institutional potential in Microsystem 1 for 2016 and 2017 is presented in Table 2.

Table 2

Matrix Model for the Scenario Analysis of Local Institutional Potential (Microsystem 1)

2016									
Designations	PR	OP	VR	RM	NIR	E	RU	I	IP
PR	1	21,454	24,591	0,181	1,614	11,479	1,734	0,051	3,124
OP	0,047	1	1,146	0,008	0,075	0,535	0,081	0,002	0,146
VR	0,041	0,872	1	0,007	0,066	0,467	0,071	0,002	0,127
RM	5,522	118,459	135,782	1	8,912	63,384	9,574	0,282	17,250
NIR	0,620	13,292	15,236	0,112	1	7,112	1,074	0,032	1,936
E	0,087	1,869	2,142	0,016	0,141	1	0,151	0,004	0,272
RU	0,577	12,374	14,183	0,104	0,931	6,621	1	0,029	1,802
I	19,592	420,320	481,789	3,548	31,623	224,904	33,969	1	61,206
IP	0,320	6,867	7,872	0,058	0,517	3,675	0,555	0,016	1
2017 r.									
Designations	PR	OP	VR	RM	NIR	E	RU	I	IP
PR	1	14,421	27,027	0,120	1,027	11,086	1,152	0,035	2,037
OP	0,069	1	1,874	0,008	0,071	0,769	0,080	0,002	0,141
VR	0,037	0,534	1	0,004	0,038	0,410	0,043	0,001	0,075
RM	8,319	119,976	224,850	1	8,548	92,226	9,588	0,294	16,944
NIR	0,973	14,036	26,305	0,117	1	10,790	1,122	0,034	1,982
E	0,090	1,301	2,438	0,011	0,093	1	0,104	0,003	0,184
RU	0,868	12,514	23,452	0,104	0,892	9,619	1	0,031	1,767
I	28,268	407,657	763,996	3,398	29,044	313,367	32,577	1	57,573
IP	0,491	7,081	13,270	0,059	0,504	5,443	0,566	0,017	1
RM – marketing expenses; NIR – expenses on scientific and information resources; E – export volume; RU – management expenses; I – investment volume; IP – volume of sales of innovative products based on the criteria of "new product" and "with new functions"									

Source: compiled by the author

To assess changes over time, the state matrices were transformed into dynamic index matrices. The resulting indices capture changes in potential profitability, return, and intensity and provide the basis for subsequent aggregation. Because the individual matrix elements represent intermediate calculations, the analysis below focuses on the aggregated indicators that are directly relevant to evaluating economic potential and selecting development strategies.

The multidimensional nature of the resulting indicators requires hierarchical aggregation to facilitate comparison among industrial entities. Accordingly, the model applies a three-level aggregation procedure, beginning with the first-level indices of resource and institutional potential presented in Table 3.

Table 3

First-Level Aggregated Indices of Resource and Institutional Potential

Industry entity	Index	Local resource potential			Local institutional capacity		
		potential output	potential intensity	potential profitability	potential output	potential intensity	potential profitability
Microsystem 1	2013 / 2012	1,289	1,240	0,544	1,151	1,071	0,498
	2014 / 2013	0,873	1,010	0,453	0,830	0,951	0,431
	2015 / 2014	0,992	0,960	0,028	1,377	1,411	0,038
	2016 / 2015	1,016	1,034	30,529	1,293	1,367	37,739
	2017 / 2016	0,867	1,546	1,321	0,895	1,559	1,350
	I_{rpi}	0,997	1,140	0,774	1,088	1,251	0,839
I_{rpi} – the aggregated index of the first level of generalization according to indicators of potential output, potential intensity, potential profitability							

Source: compiled by the author

The results reveal substantial variation in the development of resource and institutional potential over the analyzed period. Changes in profitability were particularly pronounced, reflecting fluctuations in sales profits

and the financing of marketing, innovation, investment, and information-related activities. Export performance also influenced the observed dynamics, as the analyzed enterprise operated with a substantial share of export-oriented production.

At the first aggregation level, the resource potential profitability index was 0.774, indicating an average annual decline of 22.6%, whereas the potential intensity index reached 1.140, corresponding to an average annual increase of 14%. Institutional potential demonstrated comparatively stronger performance: the aggregated indices of potential return and potential intensity reached 1.088 and 1.251, respectively. However, the institutional profitability index remained below unity at 0.839. These results indicate that improvements in institutional capacity were not accompanied by comparable growth in profitability.

The results of analytical calculations of the aggregated indices of the second level of generalization and the integral index of the level of development of economic potential (the third level of generalization) for microsystem 1 are presented in Table 4.

Table 4

Aggregated Indices of the Second and Third Levels of Economic Potential Assessment

Industry entity	The indicator	Local resource potential			Local institutional capacity		
		potential output	potential intensity	potential profitability	potential output	potential intensity	potential profitability
Microsystem 1	I _{rpi}	0,997	1,140	0,774	1,088	1,251	0,839
	ki	0,067	0,218	0,715	0,067	0,218	0,715
	I _{rpi} ^{ki}	1,000	1,029	0,833	1,006	1,050	0,882
	I _{rp (ip)}	0,950			0,977		
	I _{ep}	0,963					

I_{rpi} – aggregated index of the first level of generalization; ki – significance coefficient; I_{rp (ip)} – aggregated index of the second level of generalization; I_{ep} – the integral index of the level of realization of economic potential (the third level of generalization).

Source: compiled by the author

The second- and third-level aggregation confirms the stronger performance of institutional potential compared with resource potential. The corresponding second-level aggregated indices were 0.950 for resource potential and 0.977 for institutional potential, resulting in an integral economic potential index of 0.963. Although the analyzed enterprise did not reach the reference value of unity, the results indicate that institutional factors contributed more strongly to overall economic potential than resource factors. A comparable calculation procedure was previously applied to other microsystems of the Bellegprom concern according to their contribution to industry GDP (Narkevich, 2024a). The present results further demonstrate the usefulness of hierarchical aggregation for identifying imbalances between the resource and institutional components of economic potential.

At the final stage, the aggregated indices were normalized and used to construct a strategic decision-making matrix. The relative positions of resource and institutional potential determine the location of each industrial entity within the matrix and provide the basis for selecting an appropriate development scenario. This approach builds on the author's previous application of a strategic decision-making matrix to economic potential optimization (Narkevich, 2024b) and extends the analysis through the system-scenario multifactor framework used in the present study.

Table 5

Strategic Positioning of Industrial Enterprises Based on Economic Potential

Industrial entity	Normalized coordinates	Matrix quadrant	Recommended strategic orientation
Microsystem 1 (JSC Mogotex)	0.765; 0.378	d	Concentrated growth and product/market development
Microsystem 2 (JSC BPHO)	0.673; 0.469	b	Vertical integration and integrated growth
Microsystem 3 (JSC Lenta)	1.000; 0.745	c	Investment- and innovation-oriented development

Source: compiled by the author

As shown in Table 5, the analyzed industrial enterprises occupy different positions within the strategic decision-making matrix, reflecting variations in their economic potential and corresponding development strategies.

The strategic positioning demonstrates that the analyzed enterprises require different development trajectories. JSC Mogotex is characterized by comparatively stronger institutional than resource potential and therefore requires strategies aimed at strengthening resource efficiency, market position, and product development. JSC BPHO is associated with an integrated-growth trajectory emphasizing vertical integration, whereas JSC Lenta requires a stronger investment and innovation orientation. These differences demonstrate the ability of the proposed model to translate quantitative assessments into differentiated strategic recommendations.

4. Recommendations

The proposed system-scenario multifactor model can be used to support strategic decision-making in complex industrial systems by integrating resource and institutional components of economic potential within a unified analytical framework. Its application enables industrial entities to identify imbalances between these components, assess alternative development trajectories, and select strategies consistent with their current economic potential.

For practical implementation, priority should be given to the components that constrain overall economic performance. Enterprises with comparatively weaker resource potential should focus on improving production efficiency, technological modernization, and resource utilization, while stronger institutional capacity can be used to support innovation, investment, and market development. Where institutional potential is comparatively weak, greater attention should be paid to marketing, innovation, investment, scientific and information resources, and management mechanisms.

The matrix-based calculations can be implemented using spreadsheet software, making the approach accessible for routine analytical and decision-support purposes. The framework may also be adapted to different industrial systems by modifying the initial indicators and their relative significance according to sector-specific characteristics.

5. Conclusion

This study developed and applied a system-scenario multifactor model for assessing and optimizing economic potential at the meso-level using matrix methods. The framework integrates resource and institutional components of economic potential and evaluates their dynamics through potential output, intensity, and profitability indicators. Hierarchical aggregation and strategic positioning enable the transformation of multiple economic indicators into interpretable measures for decision-making.

The empirical application to enterprises in the Belarusian light and textile industry demonstrated differences between resource and institutional potential. For JSC Mogotex, the second-level aggregated indices were 0.950 for resource potential and 0.977 for institutional potential, resulting in an integral economic potential index of 0.963. The results therefore indicate comparatively stronger institutional potential and identify resource efficiency as an area requiring greater attention. Strategic positioning further demonstrated that the analyzed enterprises require differentiated development trajectories depending on the balance between their resource and institutional components.

The proposed approach provides a quantitative basis for diagnosing structural imbalances, comparing development scenarios, and supporting the selection of industrial development strategies. Its matrix structure also allows the indicator system to be adapted to the characteristics of different industrial contexts. Further research should test the framework using more recent data, additional industries, and longer observation periods to assess its robustness and broader applicability.

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СИСТЕМНО-СЦЕНАРНАЯ МНОГОФАКТОРНАЯ МОДЕЛЬ ОПТИМИЗАЦИИ ЭКОНОМИЧЕСКОГО ПОТЕНЦИАЛА НА МЕЗОУРОВНЕ С ИСПОЛЬЗОВАНИЕМ МАТРИЧНЫХ МЕТОДОВ

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Резюме. В исследовании разработана системно-сценарная многофакторная модель оптимизации экономического потенциала на мезоуровне с использованием матричных методов. Модель рассматривает отрасль промышленности как сложную социально-экономическую систему, в которой ресурсные и институциональные компоненты взаимодействуют под влиянием внутренних и внешних факторов. Для поддержки принятия стратегических решений показатели потенциальной рентабельности, доходности и интенсивности объединяются в рамках иерархической матричной структуры. Эмпирический анализ основан на данных ведущих предприятий лёгкой и текстильной промышленности Беларуси и охватывает 42 показателя локального ресурсного потенциала и 72 показателя локального институционального потенциала. Методология предусматривает построение матриц состояний и индексов, агрегирование показателей на трёх аналитических уровнях и позиционирование предприятий в матрице принятия стратегических решений. Результаты выявили различия между ресурсным и институциональным

потенциалом, при этом интегральный индекс экономического потенциала анализируемого предприятия составил 0,963. Институтуциональный потенциал продемонстрировал более высокие показатели по сравнению с ресурсным потенциалом. Предлагаемая модель представляет собой количественную основу для выявления ограничений, сопоставления сценариев развития и выбора стратегий, направленных на повышение экономической эффективности и адаптивности на мезоуровне.

Ключевые слова: экономический потенциал, мезоуровень, матричное моделирование, системно-сценарная модель, оптимизация, текстильная промышленность.

MATRİS METODLARINDAN İSTİFADƏ ETMƏKLƏ MEZOSƏVİYYƏDƏ İQTİSADİ POTENSİALIN OPTİMALLAŞDIRILMASININ SİSTEM-SƏNARİ ƏSASLI ÇOXAMİLLİ MODELİ

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Xülasə. Tədqiqatda matris metodlarından istifadə etməklə mezosəviyyədə iqtisadi potensialın optimallaşdırılması üçün sistem-sənari əsaslı çoxamilli model işlənib hazırlanmışdır. Model sənaye sahəsini resurs və institusional komponentlərin daxili və xarici amillərin təsiri altında qarşılıqlı əlaqədə olduğu mürəkkəb sosial-iqtisadi sistem kimi nəzərdən keçirir. Strateji qərarların qəbulunu dəstəkləmək məqsədilə potensial rentabellik, gəlirlilik və intensivlik göstəriciləri iyerarxik matris strukturu çərçivəsində birləşdirilir. Empirik təhlil Belarusun yüngül və toxuculuq sənayesinin aparıcı müəssisələrinin məlumatlarına əsaslanır və lokal resurs potensialının 42, lokal institusional potensialın isə 72 göstəricisini əhatə edir. Metodologiya vəziyyət və indeks matrislərinin qurulmasını, göstəricilərin üç analitik səviyyədə aqreqasiyasını və müəssisələrin strateji qərarların qəbulu matrisində mövqeləndirilməsini nəzərdə tutur. Nəticələr resurs və institusional potensial arasında fərqləri aşkar etmiş, təhlil edilən müəssisə üzrə iqtisadi potensialın inteqral indeksi 0,963 təşkil etmişdir. İnstitusional potensial resurs potensialı ilə müqayisədə daha yüksək göstəricilər nümayiş etdirmişdir. Təklif olunan model məhdudiyyətlərin müəyyənəşdirilməsi, inkişaf ssenarilərinin müqayisəsi və mezosəviyyədə iqtisadi səmərəliliyin və adaptasiya qabiliyyətinin artırılmasına yönəlmiş strategiyaların seçilməsi üçün kəmiyyət əsaslı qiymətləndirmə çərçivəsi təqdim edir.

Açar sözlər: iqtisadi potensial, mezosəviyyə, matris modelləşdirilməsi, sistem-senari modeli, optimallaşdırma, toxuculuq sənayesi