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MODELING INNOVATIVE DEVELOPMENT OF INTEGRATED BUSINESS STRUCTURES THROUGH OPEN INNOVATIONS

This paper seeks to explore the process of innovative development modeling for integrated business structures using an open innovation platform, both at the microlevel (the investment attractiveness of small and medium-sized businesses is viewed from the perspective of a systemic approach), and at the mesolevel (the investment attractiveness of small and medium-sized businesses relies upon a comprehensive assessment of infrastructure development based on the unity and interaction of criteria for business investment attractiveness across the region). It is argued that despite certain crisis phenomena encountered in the financial and economic performance of integrated business structures, a vast body of scientific knowledge and applied experience in searching for new effective innovative management tools is being accumulated. To survive in modern competitive environment, small and medium-sized enterprises while integrating should invest their owner's funds or borrowed capital to update, expand and diversify their business, as well as focus their policy towards open innovation. Thus, in the context of the whole range of risks and challenges associated with the role of open innovations within the performance of integrated business structures, maintaining a process of modeling innovative development seems critically important. From this perspective, effective information support to generate and consolidate information data in all areas of financial and economic performance is paramount. Apart from the above, it will also contribute to boosting the efficiency of modern integrated business structures. The study findings demonstrate that socioeconomic growth rates in Ukraine are greatly affected by its investment policy focus aimed at facilitating innovative structural transformation in priority industries, modernization and technical renewal, the implementation of energy- and resource-saving and eco-friendly technologies. It is concluded that the declared investment imperative support in Ukraine within the framework of the government innovation policy will enhance further innovative development of integrated business structures and encourage the overall economic growth.

Keywords: *integrated business structures; cooperation; corporatization; economic growth; modeling; innovation; integration processes.*

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МОДЕЛЮВАННЯ ІННОВАЦІЙНОГО РОЗВИТКУ ІНТЕГРОВАНИХ СТРУКТУР БІЗНЕСУ ЧЕРЕЗ СИСТЕМУ ВІДКРИТИХ ІННОВАЦІЙ

У статті досліджено процеси моделювання інноваційного розвитку інтегрованих структур бізнесу через систему відкритих інновацій на двох рівнях: на мікрорівні – інвестиційної привабливості підприємств малого та середнього бізнесу з позицій системного підходу; на мезорівні – інвестиційної привабливої підприємств малого та середнього бізнесу на підставі комплексної оцінки інфраструктурного розвитку, що засновано на єдності та взаємодії критеріїв привабливості об'єктів інвестування в межах регіону. Обґрунтовано, що незважаючи на наявність кризових явищ у фінансово-

господарській діяльності інтегрованих структур бізнесу, нагромаджується певний науковий та практичний досвід роботи щодо пошуку нових ефективних інноваційних механізмів управління. Для того щоб вистояти в конкурентній боротьбі, підприємства малого та середнього бізнесу, які інтегруються, мають постійно спрямовувати власні чи залучені кошти на оновлення, розширення та диверсифікацію виробництва, а їх політика має бути націлена на відкриті інновації. Тому в комплексі проблем, які пов'язані з визначенням ролі відкритих інновацій у діяльності інтегрованих структур бізнесу, великого значення в сучасних реаліях набуває організація такого процесу моделювання інноваційного розвитку, який би був підкріплений ефективним інформаційним забезпеченням, спроможним виявляти і систематизувати інформаційні дані щодо всіх аспектів фінансово-господарської діяльності, а також сприяв би підвищенню ефективності інтегрованих структур бізнесу. З урахуванням результатів дослідження доведено, що прискорення темпів соціально-економічного розвитку країни великою мірою визначається сутністю її інвестиційної політики, спрямованої на інноваційні зрушення в галузях, які потребують першочергових структурних змін, модернізації й технічного оновлення, впровадження енерго- й ресурсозберігаючих та екологічно безпечних технологій. Робиться висновок, що проголошене сприяння інвестиційній активності в Україні в межах державної інноваційної політики має забезпечити подальший інноваційний розвиток інтегрованих структур бізнесу та національної економіки загалом.

Ключові слова: *інтегровані структури бізнесу; кооперація; корпоратизація; економічний розвиток; моделювання; інновації; інтеграційні процеси.*

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МОДЕЛИРОВАНИЕ ИННОВАЦИОННОГО РАЗВИТИЯ ИНТЕГРИРОВАННЫХ СТРУКТУР БИЗНЕСА ЧЕРЕЗ СИСТЕМУ ОТКРЫТЫХ ИННОВАЦИЙ

В статье исследованы процессы моделирования инновационного развития интегрированных структур бизнеса через систему открытых инноваций на двух уровнях: на микроуровне – инвестиционной привлекательности предприятий малого и среднего бизнеса с позиций системного подхода; на мезоуровне – инвестиционной привлекательности предприятий малого и среднего бизнеса на основании комплексной оценки инфраструктурного развития, основанной на единстве и взаимодействии критериев привлекательности объектов инвестирования в пределах региона. Обосновано, что, несмотря на наличие кризисных явлений в финансово-хозяйственной деятельности интегрированных структур бизнеса, накапливается определённый научный и практический опыт работы по поиску новых эффективных инновационных механизмов управления. Для того чтобы выстоять в конкурентной борьбе, интегрируемые предприятия малого и среднего бизнеса должны постоянно направлять собственные или привлечённые средства на обновление, расширение и диверсификацию производства, а их политика должна быть нацелена на открытые инновации. Поэтому в комплексе проблем, связанных с определением роли открытых инноваций в деятельности интегрированных структур бизнеса, большое значение в современных реалиях приобретает организация такого процесса моделирования инновационного развития, который был бы подкреплён эффективным информационным обеспечением, способным выявлять и систематизировать информационные данные по всем аспектам финансово-хозяйственной деятельности, а также обеспечил бы повышение эффективности интегрированных структур бизнеса. С учётом результатов исследования

доказано, что ускорение темпов социально-экономического развития страны во многом определяется сущностью её инвестиционной политики, направленной на инновационные сдвиги в отраслях, нуждающихся в первоочередных структурных изменениях, модернизации и техническом обновлении, внедрении энерго- и ресурсосберегающих и экологически безопасных технологий. Сделан взвод о том, что провозглашённое содействие инвестиционной активности в Украине в рамках государственной инновационной политики должно способствовать дальнейшему инновационному развитию интегрированных структур бизнеса и национальной экономики в целом.

Ключевые слова: *интегрированные структуры бизнеса; кооперация; корпоратизация; экономическое развитие; моделирование; инновации; интеграционные процессы.*

Statement of the problem. Interrelationships between these elements are of key importance for the innovative viability of the business model for the development of integrated business structures, its ability to achieve the company's strategic goals, and the ability to adapt to environmental changes. Thus, objects of intellectual capital participate in the creation of value: objects created independently or purchased on the know-how market are used as a source of value to increase the value of the created product. Closed models correspond to the positioning of the company as an integrator; mutually hinder – the conductor (since it implies the coordination of innovation processes) and are incompatible with positioning as a licensor. Open models impose less restrictions on the range of possible positioning options [1].

Along with the interrelationships of strategic decisions in the composition of traditional and innovative elements, external interrelationships with other strategic decisions and actions of the company (with strategies, technologies, intra-organizational resources and processes), as well as factors of its external environment are distinguished: competitive – strategic decisions and actions of the company on the markets of the company's main product; technological – the company's strategic decisions and actions on the development of technologies, response to technological trends; innovative – innovative activity of the company, strategic decisions and actions for commercialization of products and knowledge; patent – the company's strategic decisions and actions on legal registration and protection of the results of intellectual work.

Analysis of recent publications on the problem. The question of determining the role of modeling the innovative development of integrated business structures through the system of open innovation in the process of managing small and medium-sized enterprises is actively researched in the world and domestic scientific literature. Among foreign scientists, various aspects of this problem were studied by I. Ansoff, G. Birman, Y. Blech, E. Brigham, M. Bromvych, Y. Kornai, L. Krushwitz, M. Meskon, Y. Honko, U. Sharp, and others. The activation of the innovation process at small and medium-sized enterprises, in a certain industry and the economy in general was reflected in the works of domestic economists O. Amoshi, I. Blank, V. Geets, I. Hryshchenko, M. Gerasimchuk, V. Hrynyov, S. Zhukov, P. Zavlin, A. Zahorodnyi, O. Koyuda, O. Kuzmin, T. Lepeiko, V. Miklovda, A. Peresada, V. Ponomarenko, Yu. Stadnytskyi, V. Shevchuk and others.

The purpose of the study is research on modeling the innovative development of integrated business structures through the open innovation system.

The main results and their justification. The business model of innovative development of integrated business structures through the system of open innovation is considered as a connecting link between technologies and the company's environment, therefore the company's adaptation to external changes is in the area of the business model as a whole and its individual components and relationships [4].

Businesses: Strategic decisions should be made taking into account technological trends and the situation in the field of business. Integrated business structures, first of all, need an analysis of threats from disruptive technologies, which, due to their rapid development and potential mass, are able to create greater value. Reinventing companies have the opportunity to achieve greater performance using original business solutions and disruptive technologies. In addition, a life cycle analysis and the emergence of new technological standards are needed – a system of principles for the operation of knowledge-intensive products and rules for joining technological platforms, which in this case can be identified with networks of value creation, innovation or business ecosystems.

The effectiveness and sustainability of the business model also depend on its compliance with internal features – resources, processes and potential of the company: competencies; resources (finances, fixed assets and other resources at the disposal of the company); innovation potential (the company's ability to implement innovative processes, create value, products and generate profit based on them).

Typical variants of business models of science-intensive companies, which reflect strategic priorities and the interrelation of traditional and innovative elements of doing business. The author's analysis of the company's strategic business and innovative solutions from the standpoint of relationships and mutual influence of traditional and innovative elements of a typical business model structure showed that the differences between business model types are largely determined by the features of innovative elements that allow companies to take into account and use modern trends in technology development and know-how markets.

Along with the technology and architecture of the industry, the type of business model of the company determines the nature of value creation, the model of transformation of value into incoming cash flow, the nature of the use of intellectual capital and innovative positioning, the scale of the business and its compatibility with the decisions of partners, as well as the methods of protecting cash flows and IR.

Based on the synthesis of traditional and innovative elements of business models, the nature of the relationships between these elements, as well as the parameters of the technological and market environment, it is possible to distinguish four main variants of business models for the development of integrated business structures, which are characterized by stable relationships between elements: traditional closed innovation model and value creation (traditional approach), open innovation model and network model of value creation (technological companies and "systems and networks" centers), modular approach to technology development, innovation process and value creation (modular leaders), focus on technological advantage and leadership in innovation (technological leaders).

1. The traditional closed model of innovation and value creation of the development of integrated business structures: Porter's value chain as a structure and method of value creation for the consumer; an economic model for generating cash flows and profits that is not demanding on the intellectual capital intensity of the product (creating a system of high-margin and protective products in lower market segments; creating a system of high-margin and mass supporting products; creating a system of multiple use of the product in various ways); integrator as a way of innovative positioning; non-specific elements of the business scale model (small, medium or large company); secrecy and patenting as methods of strategic control of IP.

2. The open model of innovation and the network model of value creation of the development of integrated business structures: the network as a structure and method of value creation for the consumer; the economic model of generating cash flows and profits, demanding intellectual capital intensity of the product, the activity of the company in the know-how markets (creating a product that is a standard or implementing it and necessary for the operation of a wide range of related products; creating a system with paid transactions between participants and control

over it; creation of a product that increases the activity of buyers and supports demand from them); conductor as a way of innovative positioning of the company; medium or large company size, characterizing the scale of business; openness as a way to protect IR.

3. A modular approach to the development of technologies, the innovation process and the creation of value for the development of integrated business structures: a value chain or a workshop as ways of creating value for the consumer; an economic model demanding the intellectual capital intensity of the product, which implies the activity of the company in the know-how markets (cyclical creation of products that, over a certain period of time, carry unique customer value; creation of a product that is maximally adapted to the client's requirements by the forces of a highly professional, motivated to improve communication with by customers, teams to create a high-quality modular product with high customer value); integrator or licensor as ways of innovative positioning; the average size of the company, which characterizes the scale of the business; embedding in the network as one of the participants; secrecy or patenting as methods of strategic control.

4. Focus on technological advantage and leadership in innovation: value chain or workshop as ways of creating value for the consumer; the economic model of generating cash flows and profits, demanding intellectual capital intensity of the product, the activity of the company in the know-how markets (creating a high-quality modular product with high customer value; high sales volumes of a small number of products with high fixed and low marginal costs); integrator or licensor as ways of positioning at the stages of the innovation process; small company size as an element of the business scale model; secrecy as a way of strategic control of IC [4–6].

Introversion (explerant generates, stakeholder helps):

1. The amount of venture capital – Ki1.
2. Number of purchased innovations (patents, licenses, copyrights, etc.) – Ki2.
3. Coefficient of expansion of innovative activity – Ki3.
4. The coefficient of involved investments in innovative projects – Ki4.
5. Coefficient of international openness to innovative products – Ki5.
6. Specific importance of partnership in the activity of the open innovation system – Ki6.

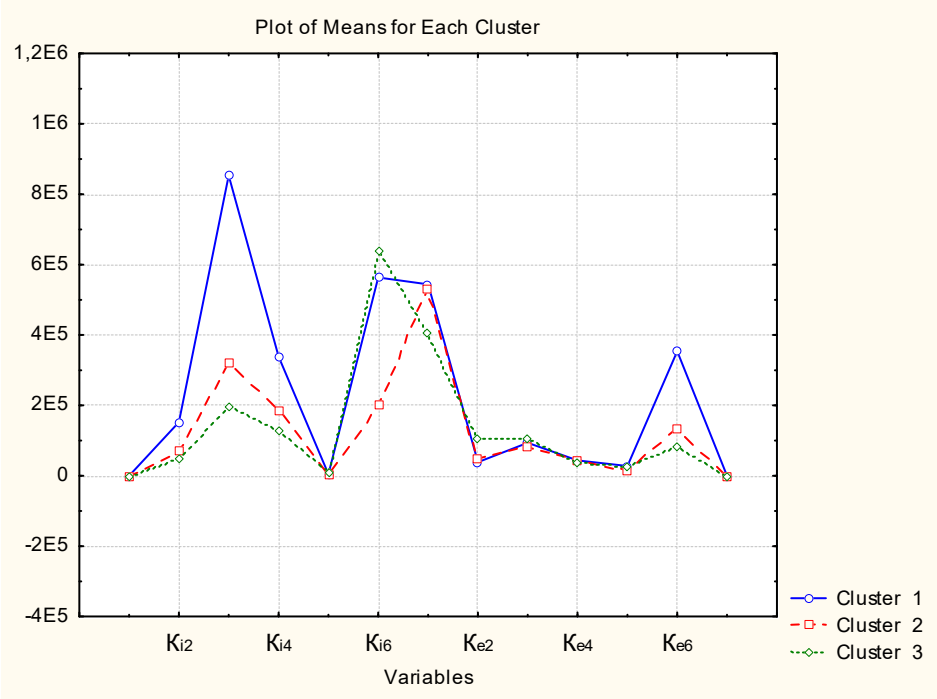
Extraversion (violent accepts):

1. Specific weight of income from open innovations – Ke1.
2. The specific weight of costs for open innovations – Ke2.
3. Coefficient of rejection of innovations – Ke3.
4. Coefficient of transfer of non-specific functions to outsourcing – Ke4.
5. Knowledge and technology transfer indicator – Ke5.
6. Percentage of information transfer to modern "open innovation" databases – Ke6.
7. Actual effectiveness of R&D – Ke7.

The author's cluster analysis and case analysis of typical representatives of groups allowed to confirm the existence of typical variants of business models and significant relationships between their elements. Multivariate cluster analysis was carried out with the aim of revealing the presence of stable groups of companies with characteristic interrelationships between elements with similar business models and economic results. There were 101 companies in the sample. Given the low correlation (according to Spearman) between the listed factors, a hierarchical algorithm using the method of single connections was used (metric – minimum Euclidean distances). Statistically, the quality of clustering was checked by calculating and evaluating the point-biserial correlation coefficient and C-Index 14.

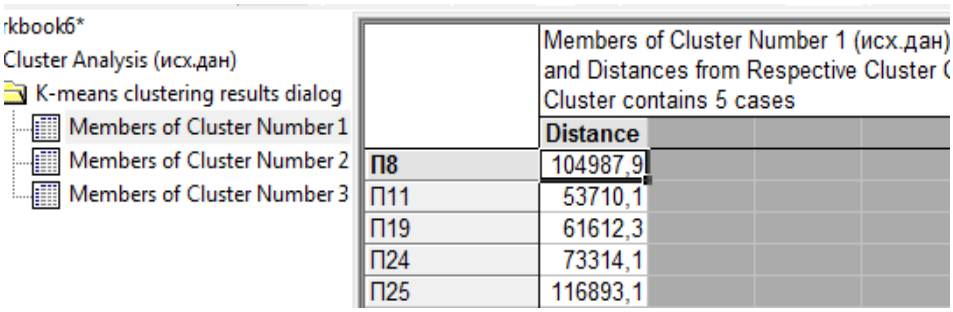
With regard to the resulting clustering, the values of these indices were 0.6 and 0.03, respectively, which indicates a fairly high degree of difference between individual clusters and a

very high density of observations within clusters. Information on the distribution of companies between clusters is given in the fig. 1.



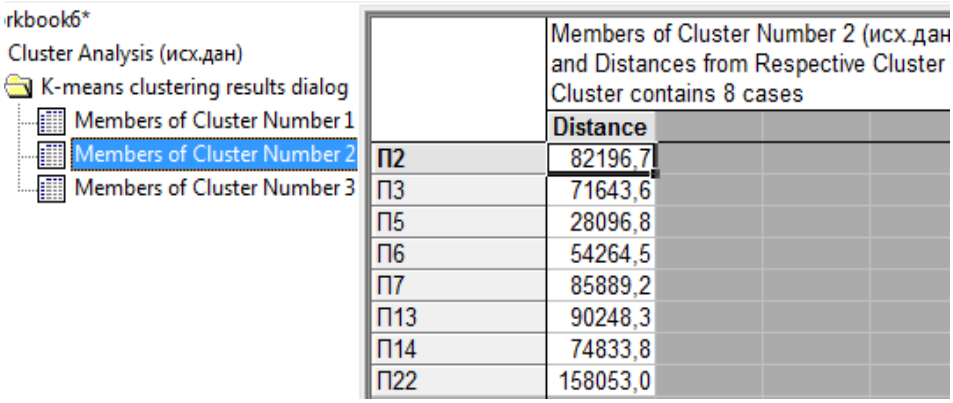
Source: calculated by the authors.

Fig. 1. **Listing (fragment of the program) – results of clustering of the studied companies**



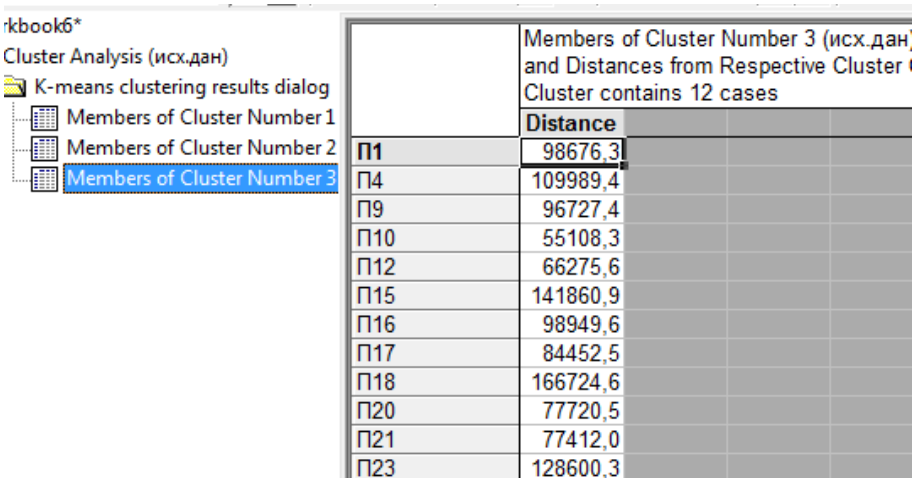
Source: calculated by the authors.

Fig. 2. **Listing (fragment of the program) – researched enterprises included in the 1st cluster**



Source: calculated by the authors.

Fig. 3. **Listing (fragment of the program) – researched enterprises included in the 2nd cluster**

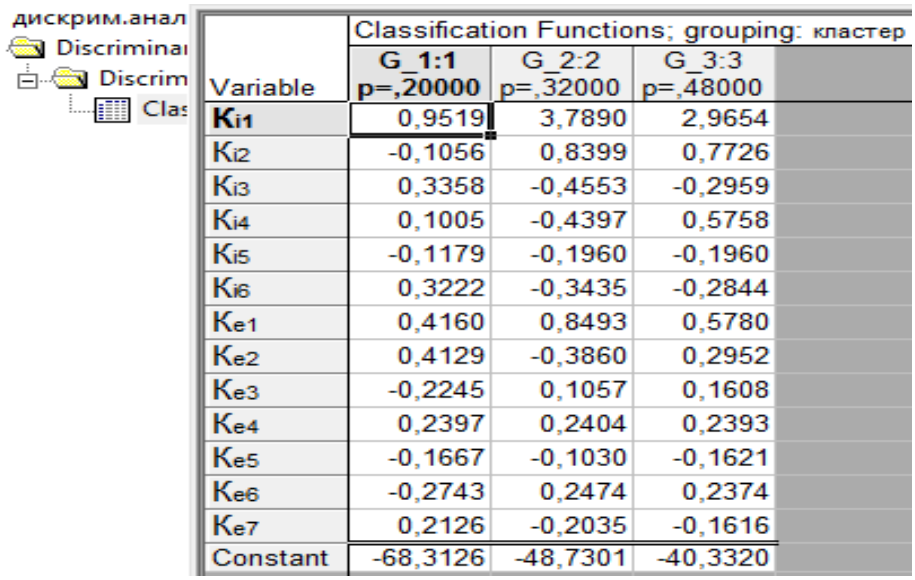


Members of Cluster Number 3 (исх.дан) and Distances from Respective Cluster Center
Cluster contains 12 cases

	Distance
П1	98676,3
П4	109989,4
П9	96727,4
П10	55108,3
П12	66275,6
П15	141860,9
П16	98949,6
П17	84452,5
П18	166724,6
П20	77720,5
П21	77412,0
П23	128600,3

Source: calculated by the authors.

Fig. 4. **Listing (fragment of the program) – investigated enterprises included in the 3st cluster**

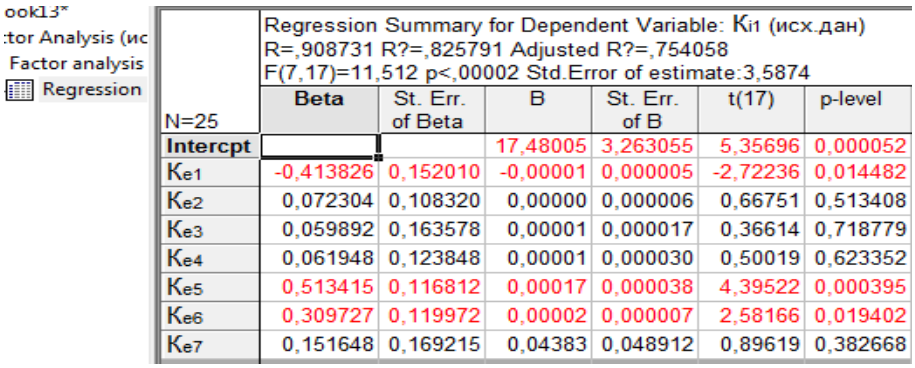


Classification Functions; grouping: кластер

Variable	G_1:1 p=,20000	G_2:2 p=,32000	G_3:3 p=,48000
K_{i1}	0,9519	3,7890	2,9654
K_{i2}	-0,1056	0,8399	0,7726
K_{i3}	0,3358	-0,4553	-0,2959
K_{i4}	0,1005	-0,4397	0,5758
K_{i5}	-0,1179	-0,1960	-0,1960
K_{i6}	0,3222	-0,3435	-0,2844
K_{e1}	0,4160	0,8493	0,5780
K_{e2}	0,4129	-0,3860	0,2952
K_{e3}	-0,2245	0,1057	0,1608
K_{e4}	0,2397	0,2404	0,2393
K_{e5}	-0,1667	-0,1030	-0,1621
K_{e6}	-0,2743	0,2474	0,2374
K_{e7}	0,2126	-0,2035	-0,1616
Constant	-68,3126	-48,7301	-40,3320

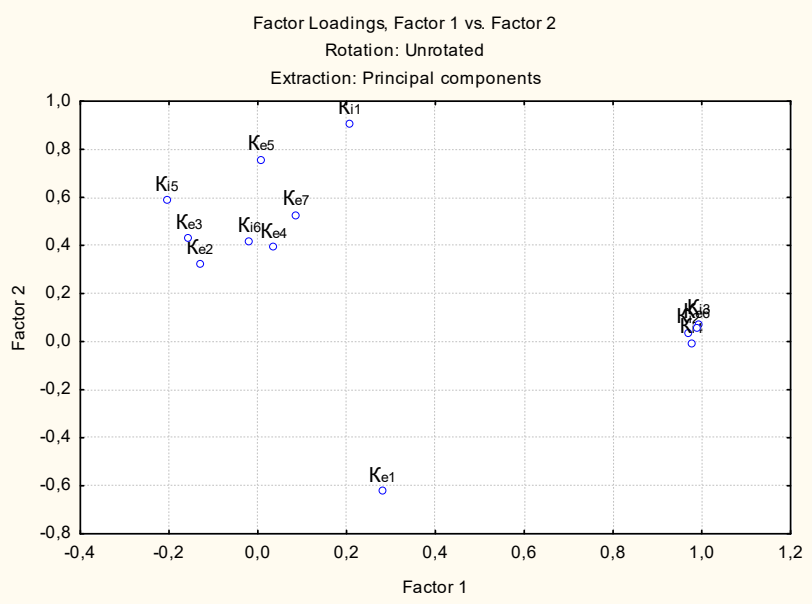
Source: calculated by the authors.

Fig. 5. **Program listing – results of discriminant analysis identification of enterprises by belonging to one of three clusters**



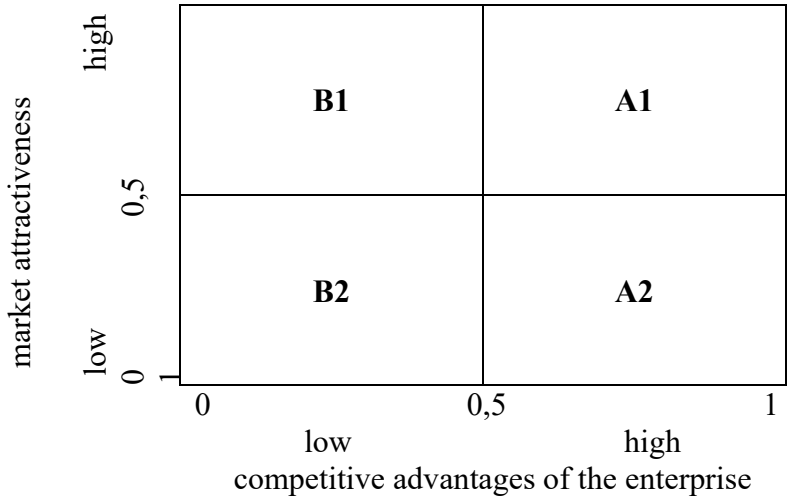
Regression Summary for Dependent Variable: K_{i1} (исх.дан)
R=,908731 R?=,825791 Adjusted R?=,754058
F(7,17)=11,512 p<,00002 Std.Error of estimate:3,5874

N=25	Beta	St. Err. of Beta	B	St. Err. of B	t(17)	p-level
Intercpt			17,48005	3,263055	5,35696	0,000052
K_{e1}	-0,413826	0,152010	-0,00001	0,000005	-2,72236	0,014482
K_{e2}	0,072304	0,108320	0,00000	0,000006	0,66751	0,513408
K_{e3}	0,059892	0,163578	0,00001	0,000017	0,36614	0,718779
K_{e4}	0,061948	0,123848	0,00001	0,000030	0,50019	0,623352
K_{e5}	0,513415	0,116812	0,00017	0,000038	4,39522	0,000395
K_{e6}	0,309727	0,119972	0,00002	0,000007	2,58166	0,019402
K_{e7}	0,151648	0,169215	0,04383	0,048912	0,89619	0,382668



факторн.анализ 2 фактора
Factor Analysis (исх.дан)
Factor analysis results
Factor Loadings (U

Variable	Factor 1	Factor 2
	Factor Loadings (Unrotated) (исх.дан Extraction: Principal components (Marked loadings are >,700000)	
Ki1	0,906201	0,038643
Ki2	0,968493	0,038643
Ki3	0,991912	0,073306
Ki4	0,975525	-0,004794
Ki5	0,588424	0,047935
Ki6	-0,019765	0,416496
Ke1	0,279578	0,621636
Ke2	-0,131555	0,925175
Ke3	-0,155518	0,429164
Ke4	0,034836	0,393579
Ke5	0,006504	0,755980
Ke6	0,016504	0,987639
Ke7	0,084905	0,527397
Expl.Var	4,062469	3,032044
Prp.Totl	0,471815	0,333234



Source: calculated by the authors.

Fig. 6. Matrix for determining the competitive position of enterprises

Processing of received private characteristics:

1. Form matrices:

- market estimates: $R = \left[R_i^Q; R_i^{TQ}; R_i^{CTQ}; R_i^R; R_i^M; R_i^{CI}\right]$;
- estimates of the enterprise: $D = \left[D_{ij}^S; D_{ij}^{ST}; D_{ij}^C; D_{ij}^{CP}; D_{ij}^F; D_{ij}^R; D_{ij}^{RA}; D_{ij}^L; D_{ij}^{AD}\right]$.

2. We form these matrices into a dimensionless standardized form:

- market estimates: $r = \left[r_i^Q; r_i^{TQ}; r_i^{CTQ}; r_i^R; r_i^M; r_i^{CI}\right]$;
- estimates of the enterprise: $d = \left[d_{ij}^S; d_{ij}^{ST}; d_{ij}^C; d_{ij}^{CP}; d_{ij}^F; d_{ij}^R; d_{ij}^{RA}; d_{ij}^L; d_{ij}^{AD}\right]$,

де $r_i = \frac{R_i}{\overline{R}}$; $d_{ij} = \frac{D_{ij}}{\overline{D_i}}$.

3. We form standard matrices, where 0 is the best value by column:

- market estimates: $r_0 = \left[r_0^Q; r_0^{TQ}; r_0^{CTQ}; r_0^R; r_0^M; r_0^{CI}\right]$;
- estimates of the enterprise: $d_0 = \left[d_{i0}^S; d_{i0}^{ST}; d_{i0}^C; d_{i0}^{CP}; d_{i0}^F; d_{i0}^R; d_{i0}^{RA}; d_{i0}^L; d_{i0}^{AD}\right]$.

4. We determine the multidimensional Euclidean distance from it to each studied object, as well as the average value of the Euclidean distance from all objects to the standard – according to the corresponding formulas:

$$L_i^r = [(r_i^Q - r_0^Q)^2 + (r_i^{TQ} - r_0^{TQ})^2 + (r_i^{CTQ} - r_0^{CTQ}) + (r_i^R - r_0^R) + \left(r_i^M - r_0^M\right) + \left(r_i^{CI} - r_0^{CI}\right)^2]^{1/2}$$

$$\overline{L^r} = \frac{1}{N} \cdot \sum_{i=1}^{N} L_i^r \,,\ \overline{L_i^d} = \frac{1}{M^t} \cdot \sum_{j=1}^{M} L_{ij}^d \,,$$

where N is the number of product segments in which the analyzed enterprise performs;

M is the total number of enterprises operating in this market.

Further processing of statistical information is carried out by calculating the root mean square deviations of multidimensional distances and the corresponding general indicators of the development of each product segment and each enterprise operating in the analyzed market:

$$\sigma^r = \frac{1}{N} \cdot \left[\sum_{i=1}^{N} \left(L_i^r - \overline{L^r}\right)^2\right]^{1\backslash 2},\ \sigma_i^{\,d} = \frac{1}{M} \cdot \left[\sum_{i=1}^{M} \left(L_{ij}^d - \overline{L_i^d}\right)^2\right]^{1\backslash 2}.$$

The indicator of the level of development of the commodity segment of the studied market is a characteristic of its attractiveness as a direction of the use of enterprise resources. Accordingly, the indicator of the level of development of the enterprise is a characteristic of its competitive advantage in each specific product segment of the studied market.

Conclusions. Mutual influence, interdependence, interaction of all constituent parts of modern society and its dynamism determine the influence of the external environment on enterprises. Integrated business structures are an open, complex, dynamic, relatively independent socio-economic system within the national economy, which is connected to the feedback macro environment [8]. Macroenvironmental systems include: political-legal, social-cultural, scientific-technological, economic, natural, demographic and international systems. The negative factors in the formation of the industry situation are: a decrease in the innovative activity of small and medium-sized businesses, the acceleration of moral aging and material wear and tear of fixed assets, an increase in the number of unprofitable enterprises, a lack of own funds to finance production, a lack of innovation and development of scientific and technical support, a reduction in investments in domestic economy. In the process of modeling the innovative development of integrated business structures through the system of open innovations, it has been proven that a certain level of improvement will be achieved in material, technical and information support, personnel

development, working conditions and the formation of social infrastructure, improvement of efficiency indicators, formation of an effective control mechanism, improvement of intra-economic production and management processes due to increased innovation activity and investment attractiveness.

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