ГОРЯЩЕНКО Ю.Г.

канд. екон. наук, доц.

доцент кафедри підприємництва та економіки підприємства

Університет митної справи та фінансів

вул. Володимира Вернадського, 2/4, м. Дніпро, Україна, 49000

E-mail: julia.goryaschenko@gmail.com

ORCID: 0000-0001-7020-1412

ДІАГНОСТУВАННЯ ІННОВАЦІЙНОГО РОЗВИТКУ ПІДПРИЄМСТВ ДНІПРОПЕТРОВСЬКОЇ ОБЛАСТІ

Актуальність. Постійно зростаючий гіперінтерес до інновацій, не в останню чергу, викликаний високими очікуваннями і, водночас, справдженням щодо характеристик їхньої природи, як продукту чи то послуги, що принесе користь та підвищить якість життя, результату поєднання найцінніших нині ресурсів – знань, інтелекту, мудрості, досвіду, творчого дару, здібностей, свободи, часу та інформації.

Мета та завдання. Метою статті є розробка рекомендацій щодо розробки інформаційного забезпечення діагностики інноваційного розвитку підприємств Дніпропетровської області. Вказана мета конкретизована в дослідницьких цілях: визначення значення та завдання діагностики, з'ясування змісту кластерного аналізу в цьому контексті, оцінка рівня інформаційного забезпечення діагностики інноваційного розвитку підприємств за допомогою методу багатовимірного статистичного аналізу.

Результати. У статті наведено діагностування та рейтингування інноваційного розвитку підприємств районів та міст лідерів і аутсайдерів Дніпропетровщини. На основі багатовимірного статистичного аналізу (кластерного аналізу) проведено оцінку рівня інформаційного забезпечення інноваційного розвитку Дніпропетровської області. Для порівняння методів такої оцінки в Україні та за кордоном наведено алгоритм визначення найбільших інноваційних компаній світу за методикою Forbes на основі запатентованого алгоритму від Credit Suisse HOLT. Встановлено високий ступінь розбіжності міст та районів Дніпропетровщини за показником інформаційного забезпечення інноваційного розвитку. Зокрема, місто Дніпро, Кривий Ріг, Кам'янське та Дніпровський район мають найвищі показники, а міста Вільногірськ, Тернівка, Першотравенськ, Покров та Марганець – найнижчі.

Висновки. На основі рейтингування розроблено програму діагностування інноваційного розвитку підприємств у регіонах України, яка включає заходи економічного, соціального та інноваційного характеру, серед них – розробка умов для комерціалізації та впровадження результатів наукових досліджень та пілотних проектів, розширення обміну науковими даними, поліпшення якості підготовки фахівців та впровадження дистанційної та змішаної освіти для державних службовців у галузі інформаційних та телекомунікаційних технологій; підвищення психологічної мотивації в реалізації інформаційної та інноваційної політики на основі спільної участі різних верств населення, зокрема активних громадських кампаній й місцевих засобів масової комунікації; активне залучення до інформаційно-телекомунікаційної мережі он-лайн навчальних закладів, музеїв, лікарень, бібліотек та інших соціально важливих організацій шляхом створення мереж передачі даних, спонукання підприємців до формування кластерів, орієнтованих не лише на стимулювання інновацій, а й на створення зон для активної співпраці підприємств, науково-дослідних установ й університетів, бізнесу, органів влади; забезпечення відповідної телекомунікаційної інфраструктури у сільській місцевості; розвиток інноваційного сектору економіки, реалізація високого наукового та освітнього потенціалу підприємств.

Ключові слова: діагностування, інноваційний розвиток підприємств, інформаційне забезпечення, інвестиції, інноваційна активність.

HORIASHCHENKO Yu.G.

Ph.D (Economics), Associate Professor

Associate Professor of the Department of Entrepreneurship and Economics of Enterprise

University of Customs and Finance

Volodymyra Vernadskoho Street, 2/4, Dnipro, Ukraine, 49000

E-mail: julia.goryaschenko@gmail.com

ORCID: 0000-0001-7020-1412

DIAGNOSIS THE INNOVATIVE DEVELOPMENT OF ENTERPRISES IN DNIPROPETROVSK REGION

Topicality. *In the difficult times of repeated economic crises, structurally deformed economy, the emergence of risks associated with the consequences of COVID-19, the problems of innovative development of enterprises become much deeper. Today, the country's innovative activity is declining, the entire chain of innovation is collapsing, as a result, the technical level of production is declining, and the volume of progressive production is declining.*

Constantly growing hyperinterest in innovation, not least caused by high expectations and, at the same time, the truth about the characteristics of their nature as a product or service that will benefit and improve quality of life, the result of combining the most valuable resources – knowledge, intelligence, wisdom, experience, creative gift, abilities, freedom, time and information. To characterize the innovation space of any region, it is important to explore and assess the potential of enterprises.

Aim and tasks. *The purpose of the study is to provide recommendations for the development of information support for diagnosing the innovative development of enterprises in Dnipropetrovsk region. The specified goal was concretized in following research tasks: determine the meaning and objectives of diagnosis; explain the content of cluster analysis in this context; assess the level of information support for diagnosing innovative development of enterprises using the method of multidimensional statistical analysis.*

Research results. *The article presents practical measures for diagnosing and rating the innovative development of enterprises of districts and cities of leaders and outsiders of Dnipropetrovsk region. Based on multidimensional statistical analysis, the level of statistical support of the innovative potential of development of Dnipropetrovsk region is assessed.*

Conclusion. *Worked out proposals on building up of information support of innovative development of enterprises. The level of information support for innovative development of enterprises in the region is assessed using the method of multidimensional statistical analysis (cluster analysis). Thus, the cluster analysis of the Dnipropetrovsk region by the level of information support for innovative development of enterprises showed a high degree of disagreement between cities and districts by this index. In particular, the Dnipro, Kryvyi Rih, Kamyanske and Dniprovskiy district have high indexes, and the Vilnohirsk, Ternivka, Pershotravensk, Pokrov, Marhanets and others – low indexes. Developed program of diagnosing the innovative development of enterprises in the regions of Ukraine, which includes measures of economic, social and innovative nature.*

Keywords: *diagnosis, innovative development of enterprises, information support, investments, innovative activity.*

Problem statement and its connection with important scientific and practical tasks. *Constantly growing hyperinterest in innovation, not least caused by high expectations and, at the same time, the truth about the characteristics of their nature as a product or service that will benefit and improve quality of life, the result of combining the most valuable resources – knowledge, intelligence, wisdom, experience, creative gift, abilities, freedom, time and information. To characterize the innovation space of any region, it is important to explore and assess the potential of enterprises.*

Analysis of recent publications on the problem. *Many scientists and practitioners paid attention to the question of diagnosing of innovative development of Ukraine's enterprises. But in the regional context, such studies have been conducted much less. Ways of solving these questions are largely disclosed in works by V. Geets, E. Libanova, A. Gritsenko, O. Makarov (in the national report on the state of the innovative country, scientists highlighted the problems of modern business, entrepreneurial and resource potential) [1], O. Amosha, S. Ilyashenko, P. Hryenko, N. Hladynets, S. Onyshko, I. Paderin, L. Fedulova, L. Frolova (the innovative activity of Ukrainian enterprises was studied), V. Gordienko, A. Galchynsky, M. Melamed (the sectoral structure of the economy was assessed, the disproportion of the economy and the need for digital transformations were proved), R. Schiller, M. Miller, N. Foss (studied the practical aspects of the features and principles of investment) and others [1-5].*

Selection of previously unsolved parts of the general problem. *There are very few practical studies in Ukraine that concerned the cluster analysis of diagnostics of innovative development of enterprises in different regions with the help of statistical monitoring and control.*

Formulation of research objectives (problem statement). *The purpose of the study is to provide recommendations for the development of information support for diagnosing the innovative development of enterprises in Dnipropetrovsk region. The specified goal was concretized in following research tasks:*

- determine the meaning and objectives of diagnosis;*
- explain the content of cluster analysis in this context;*
- assess the level of information support for diagnosing innovative development of enterprises using the method of multidimensional statistical analysis.*

An outline of the main results and their justification. *In Forbes, companies are ranked by their innovation premium: the difference between their market capitalization and the net present value of cash flows from existing businesses. The difference between them is the bonus given by equity investors on the educated hunch that the company will continue to come up with profitable new growth. To be included,*

firms need six years of public financial data and be among the world's 500 largest publicly traded companies by market capitalization. Forbes include only industries that to invest in innovation, excluding industries that have no measurable investment in R&D (banks and other financial services, energy and mining firms don't make the list). Nor do, whose market value is tied more to commodity prices than innovation. We will try to conduct a similar ranking of domestic enterprises in the regional dimension. Forbes use something called the Innovation Premium to compile the list. It is calculated first by projecting the cash flows a company produces from its existing businesses without any growth and look at the net present value of those cash flows. Forbes compare this base value of the existing business with the company's current total Enterprise Value: Companies with an Enterprise Value above their base value have an innovation premium built into their stock price [2].

We will try to conduct a similar ranking of domestic enterprises in the regional dimension by refining the system of indicators for assessing the innovative activity of enterprises of Ukrainian scientists P. Hrynko, N. Hladynets, S. Onyshko [3-5]. The scientists identified four blocks of indicators:

- evaluative and effective (cost-effectiveness ratio of innovative products, coefficient of innovation saturation of investments, coefficient of product innovation, Tobin coefficient, outsourcing efficiency ratio, profitability ratio of innovations, share of capitalized profit, coefficient of scientific return, rate of return on innovative assets, profit growth rate, cost-effectiveness ratio, share of own funds in the total amount of innovation resources, volume of innovative products per employee, risk ratio of innovation activity, turnover of innovation resources, level of innovation of resources, return on intangible assets);

- organizational and structural (share of innovative assets, customer refresh rate, coefficient of innovative activity of personnel, share of online sales, the share of costs for the development of the partnership network, customer loyalty ratio, technology update rate, share of advertising costs, level of administrative costs etc.);

- administrative (share of persons with higher education, management efficiency ratio, management innovation ratio, the coefficient of reliability of the management structure, staff development coefficient, the share of labor costs, staff turnover ratio, quality factor of the social package, coefficient of efficiency of execution of administrative decisions);

- information technology (the ratio of staff with computer hardware and software, coefficient of development of new equipment, coefficient of completeness of information, software consistency ratio, the rate of use of cloud computing in the enterprise, the cost ratio of information technology, coefficient of business digitalization development, the coefficient of development of the Internet).

For the study was selected one of the most developed regions of Ukraine. According to the Regional Doing Business-2020 study, Dnipropetrovsk region was included in the top 10 most comfortable regions for doing business in Ukraine and took 10th place in the rating. This region was highly praised for setting up a business, obtaining construction permits [6-7].

One of multidimensional statistical analysis methods was applied to diagnose the innovative development of enterprises of districts and cities of Dnipropetrovsk region, the hierarchical cluster analysis (Data clustering). Its basic task is to discretize a sample into subsets (clusters) so that every cluster consisted of similar objects and objects included in different clusters differed substantially.

According to the cluster analysis requirements:

- selected objects must be dimensionless;
- objects have near-normal distribution;
- objects meet the requirement of stability, that implies an absence of random factor influence on their values;

- a sample is homogeneous;

- objects do not correlate.

In research followed the basic stages of cluster analysis:

- data for clustering is sampled;
- features for objects evaluation are defined;
- level of objects similarity is estimated.

Clusters are joined in groups of objects by applying the method of intergroup connections.

The clusters' characteristics by the level of the innovative development of enterprises of districts and cities of Dnipropetrovsk region in 2019 are provided in table 1.

The factor analysis preceded the cluster analysis in this research, so the sample does not require any adjustments – the requirements are accomplished automatically by procedure of factor modeling.

Taking into account the level of accuracy of the received multidimensional linear model, it was determined that taking into account such factors as coefficient of innovation saturation of investments (the ratio of innovation to total investment); coefficient of innovative activity of employees (the ratio of rationalization proposals to the number of employees); share of persons with higher education per 1000 persons (the ratio of persons with higher education to the total headcount); the ratio of staff with computer hardware and software per 1000 persons.

Table 1

Description of clusters by the separate statistic indexes of innovative development of enterprises of districts and cities of Dnipropetrovsk region (cluster average)

Clusters	Districts and cities of Dnipropetrovsk region	Coefficient of innovation saturation of investments	Coefficient of innovative activity of employees	Share of persons with higher education per 1000 persons	The ratio of staff with computer hardware and software per 1000 persons
Cluster 1	Vilnohirsk (city), Ternivka (city), Pershotravensk (city), Pokrov (city), Marhanets (city)	0,03	0,02	0,24	0,31
Cluster 2	Zhovti Vody (city), Synelnykove (city), Verkhnodniprovsky, Sofiyivsky, Tomakivsky, Tsarychansky, Shirokivsky, Yurievsky, Apostolovsky, Pavlogradsky, Petrykivsky, Petropavlovsky, Pokrovsky, Pyatihatsky, Synelnykovsky, Mezhevsky, Nikopol	0,031	0,022	0,33	0,55
Cluster 3	Nikopol (city), Pavlograd (city), Novomoskovsk (city), Solonyansky, Novomoskovsky, Kryvyi Rih, Krynychansky, Magdaliniivsky, Vasylkivsky	0,04	0,1	0,37	0,65
Cluster 4	Kryvyi Rih (city), Dniprovskyi, Kamyanske (city)	0,05	0,11	0,44	0,84
Cluster 5	Dnipro (city)	0,07	0,30	0,62	0,93

Source: data of the Main Department of Statistics in Dnipropetrovsk region [8-10]

In this case, the distribution of districts and cities of the region among clusters in 2019 was mainly determined by the indexes mentioned above. As a result, the most districts and cities were included in the cluster 2 – 17 (49%), cluster 3 – 9 (26%), cluster 1 – 5 (14%), cluster 4 – 3 (9%) and cluster 5 – 1 (2%). It represents the moderate degree of primary indexes value homogeneity.

Cluster 1 has a low level of information support for innovative development of cities and districts of Dnipropetrovsk region and includes five cities. It is characterized by low indicators of the ratio of innovation to total investment and the ratio of rationalization proposals to the number of employees.

Cluster 2 has a level of information support for innovative development of cities and districts of region below average and includes seventeen units.

Cluster 3 is characterized by the average level of information support for innovative development of cities and districts of Dnipropetrovsk region and includes three cities and six districts.

Cluster 4 is characterized by the level of information support for innovative development of cities and districts of Dnipropetrovsk region above average and includes the cities of Kryvyi Rih and Kamyanske and Dniprovskyi district.

Cluster 5 – with a high level – includes only Dnipro city. The fact that there was only one city in 2019 is explained by the greatest indexes of the ratio of persons with higher education to the total headcount and the ratio of innovation to total investment.

Furthermore, the cluster analysis of diagnostics of innovative development of enterprises showed a low level of development of innovation infrastructure of Dnipropetrovsk region and very slow growth rates; a high degree of disagreement between cities and districts on the relevant indicator.

The measures of theoretic and practical nature are offered to increase the information support of innovative development of enterprises level.

The measures of theoretical nature should include development of an informative space of a region based on an informative policy that pursues such strategic aims as increase of regional management efficiency by introducing and expanding of ICT; enabling population to access information resources (broadening choice options and human liberties); augmentation of cultural and scientific potential of a region (development of the cultural industry); transformation of regional information resources into a strategic resource of region's development; support of the social environment, etc.

However, as the amount of regional initiatives aimed to stimulate economy development increase, we observe the slow pace of development of the basic elements of information infrastructure in regions (hardware, personnel potential, new knowledge formation). In our judgment, this situation resulted directly from an unsatisfactory management (in particular, creation of the improper system of goals and functional system) at both the state and regional levels and, as a result, implementation of imperfect strategic state and regional programs.

We offer to develop a program of diagnosing the innovative development of enterprises in the regions of Ukraine for regions-leaders and regions-outsiders:

For the first:

- impelling to form clusters primary oriented towards not only innovations' stimulating but also creating zones for active collaboration of research institutions, businesses, authorities and SRI;
- facilitate socio-economic development for a region, efficient and economical utilization of natural resources, priority development of ecologically conscious manufacturing;
- development of innovative sector of economy, fulfillment of high scientific and educational potential of a region;
- active involvement into the information and telecommunication network of on-line education institutions, museums, hospitals, libraries and other socially important organizations through creation of regional data communication networks;
- development of electric communication networks in a region including communication networks of third and further generations;
- encouragement of business activity in a social sphere including development of a system of regional charity, investment and venture funds in social sphere;
- developing conditions for commercialization and implementation of scientific researches' and pilot projects' results and expansion of scientific data exchange as well;
- improvement of specialists training quality and implementation of remote and continuing education for state workers in information and telecommunication technologies industry.

For others:

- creation of specialized organizations network in regions - business-centers, incubators, industrial parks able partly compensate the absence necessary financial resources for the entrepreneurs;
- work up a regional development mechanism as an activation of interregional relations (it is limited only by directions of frontier collaboration stimulation yet);
- diversification of smokestack industry and institutional structure of production by means of efficient development of non-commercial industries and enhancement of a role of small business in economy;
- providing of an appropriate telecommunication infrastructure in rural areas;
- realization of information-infrastructural projects with the involvement of mass media, civil groups with relevant orientation, authorities and business-elite;
- rising of psychological motivation in social policy realization on the basis of joint participation of different layers of society, in particular active public awareness campaigns in local mass media and communication of principles, aims and tasks of socio-cultural policy;
- support of common usage of information technologies, creation of integrated information environment of education;

– restructuring of a network of elementary and secondary level vocational education institutions involving resources of business interested in relevant personnel, implementation of mechanisms of co-funding enterprises – customers of shots.

Conclusions and perspectives of further research.

1. Worked out proposals on building up of information support of innovative development of enterprises.

2. The level of information support for innovative development of enterprises in the region is assessed using the method of multidimensional statistical analysis (cluster analysis). Thus, the cluster analysis of the Dnipropetrovsk region by the level of information support for innovative development of enterprises showed a high degree of disagreement between cities and districts by this index. In particular, the Dnipro, Kryvyi Rih, Kamyanske and Dniprovskiy district have high indexes, and the Vilnohirsk, Ternivka, Pershotravensk, Pokrov, Marhanets and others – low indexes.

3. Developed program of diagnosing the innovative development of enterprises in the regions of Ukraine, which includes measures of economic, social and innovative nature.

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