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INNOVATION INFRASTRUCTURE AS A FOUNDATION FOR BUSINESS PROCESS DEVELOPMENT

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Abstract. Innovation infrastructure is most often associated with research activities and high-tech production. From a strategic point of view, innovation infrastructure ensures the process of realization of new or improved products, processes or production methods, thus creating the basis for highly efficient activities. In this sense, the formation of innovative infrastructure is extremely important for Ukraine as a basis for the development of high-tech industries and increasing the efficiency of business processes. *Methodology*. The article presents the authors' method of calculating the formation of innovation infrastructure as a basis for the development of effective business processes. According to it, it is a set of objects that create conditions for innovation and the presence of such objects can conclude the formation of innovation infrastructure. The proposed methodological approach consists of three blocks, including target block, preparation unit, evaluation and diagnostic unit. In this case the object of evaluation is innovation infrastructure. Therefore, the evaluation process should determine the level of innovation infrastructure formation. *Results*. On the basis of the scores of the indicators of formation of innovation infrastructure, on the one hand, it is proposed to determine a generalized score of formation of innovation infrastructure by oblasts, and on the other – an integrated specific score by provision of its facilities. Thus, the main indicators for assessing the formation of innovation infrastructure are the number of technology parks, the number of industrial parks, the number of science parks, the number of business incubators, the number of innovation centers, the number of free economic zones (with intellectual property units), the number of regional science centers. The correspondence of separate objects of innovation infrastructure with the stages of innovation process provided by them is given. It is determined that technology parks provide generation, transfer and development of knowledge, innovation centers – generation and transfer of knowledge, business incubators – acquisition and use of knowledge. Taking into account this comparative characteristic, the weight coefficients of each object of innovation infrastructure are determined. On the basis of concretization, the average score of formation of innovation infrastructure in oblasts is determined, which corresponds to the integrated score of formation of innovation infrastructure of Ukraine. *Practical implications*. The rating of the effectiveness of innovation infrastructure by oblasts was calculated. The top five leaders are: Kharkiv, Zaporizhzhia, Lviv, Dnipro, and Kyiv Oblasts and the city of Kyiv itself. The efficiency rating of the leading oblasts almost completely coincides with the indicator of innovation infrastructure development, with the exception of Donetsk Oblast, which has a better indicator of development than efficiency, and Zaporizhzhia Oblast, on the contrary, has an efficient infrastructure despite its low development.

Key words: innovations, innovation infrastructure, innovation process, business processes, research base, technology parks.

JEL Classification: O10, O20, O30

1. Introduction

Innovation infrastructure is most often associated with research and high-tech production. In the strategic aspect, innovation infrastructure provides the process of implementation of new or improved products, processes or production methods, thus creating the

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basis for highly efficient activities. In this sense, the formation of innovation infrastructure is extremely important for Ukraine as a basis for the development of high-tech industries.

Accordingly, there is an objective need for the creation and development of innovation infrastructure, which can fundamentally influence the restructuring of the economy and accelerate the development of the country as a whole. It can organize and combine all necessary human and material resources for the transformation of various parts of the economy in a relatively short period of time. To this end, the state must create conditions for the development of innovation infrastructure, identify the features of its operation, and minimize bureaucratic influence.

2. Analysis of recent research and publications

In the modern conditions of functioning of the globalized economic system, the questions of creation of innovative infrastructure and maintenance of the corresponding business processes arise. This concept is widely used in the economic environment, but has no single universal definition of this term. Hammer and Champy (2007) define a business process as "an organized set of actions in which, based on one or more types of source data, a valuable result for the customer is created".

It is generally believed that the flow of business processes in infrastructure industries, particularly the flow of business processes in the innovation infrastructure, can be interpreted as a systematic sequential execution of logically related and interdependent tasks, the purpose of which is to identify primary suppliers of research and development. As a result, it is necessary to obtain a new technology or product that meets or shapes market needs.

In today's globalized world, new products and services are constantly emerging, and those countries that do not keep pace with global trends and do not allocate sufficient resources to innovative development have no chance of remaining competitive in the global marketplace.

It is worth noting the example of China, the number of patents and innovative enterprises, which has increased many times in recent years, so the country is rapidly moving from the status of a "copying" country to high-tech, creating favorable conditions for innovation (Wei, Xie, & Zhang, 2017) and the development of business processes.

It is important to note that the startups advertised in today's world, which are often confused with innovative companies, are not always based on new technologies, any newly created company can call itself such a term. Therefore, it is important to note that only innovative startups serve as a basis for stable economic development, as evidenced by the study of Colombel (2016) and the focus on such structures should be a priority in the formation of innovation infrastructure.

Innovation infrastructure accelerates the process of innovation and implementation of ideas. It simplifies life both for innovators, for whom it creates all necessary conditions for productive work, and for producers, who have the opportunity to choose the most successful development concepts. The study of Laser and Stachrer (2016) proves the fact that innovative start-ups are more vulnerable in the market than companies created without the use of new technologies, so the importance of innovation infrastructure in creating a favorable environment for high-tech companies is undeniable.

3. Research methodology

In the course of the study, the authors presented their own method for calculating the formation of infrastructure, which will ensure more efficient business processes. The methodological approach to this assessment is shown in Figure 1.

Innovation infrastructure is a set of objects that create conditions for innovation. It is the presence of such facilities that can lead to conclusions about the formation of innovation infrastructure.

The proposed methodological approach consists of three blocks, including:
– Target block;
– Preparatory block;
– Evaluation and Diagnostics block.

The purpose and objectives of the assessment should be defined in the Target block. Determining the purpose of the evaluation is extremely important for its proper structuring and for obtaining the most complete and reliable information about the state of the object of evaluation. In this case, the object of the evaluation is the innovation infrastructure. With this in mind, the evaluation process should determine the level of development of the innovation infrastructure. However, this should not be an end in itself. The goal of its realization should be considered in depth, from a different perspective, in connection with higher-order goals. As the evaluation process is subordinated to the management process, and the achievement of the goal of evaluation of the innovation infrastructure should serve as a basis for ensuring the achievement of the goal of management of its formation in the future.

Thus, it would be appropriate to formulate the purpose of the assessment of the formation of the innovation infrastructure as follows: to create the basis for making managerial decisions on the formation of the innovation infrastructure of

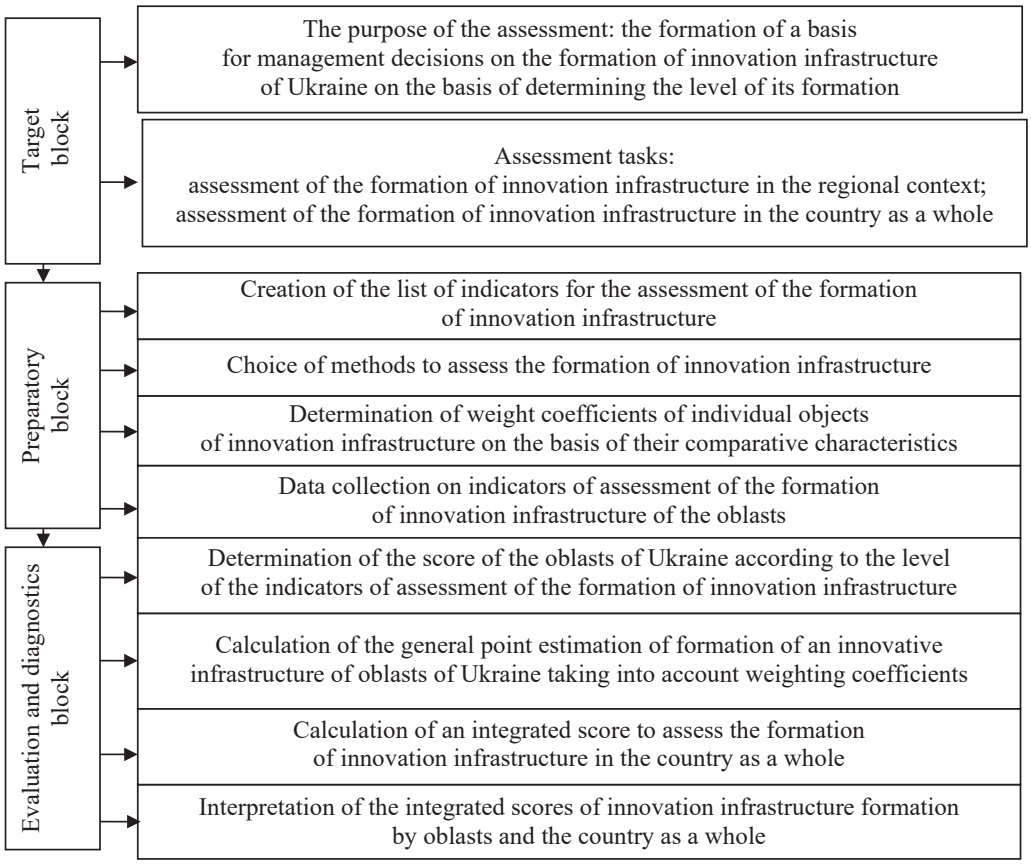

Figure 1. Methodical approach to the assessment of the formation of the innovation infrastructure of Ukraine

Ukraine based on the determination of the level of its formation.

Achieving this goal is facilitated by solving several tasks:

– assessment of the formation of innovation infrastructure in the regional context, which allows to get an idea of the presence of innovation infrastructure in the oblasts of Ukraine and the uniformity of its distribution throughout the country, which depends on the degree of formation of innovation infrastructure in the country;

– evaluation of the formation of innovation infrastructure in the country as a whole, which will allow in the future to trace the relationship between the formation of innovation infrastructure and the results of innovation and to create a basis for management decisions on the formation of innovation infrastructure.

The Preparatory block provides, first of all, for the creation of a list of indicators for the assessment of the creation of innovation infrastructure.

Nazarenko I. (2013), Usmanova M. (2016) believe that the state's influence on innovation and its results should be based on the formation of innovation infrastructure, which is the main tool and mechanism of the innovation economy, through which all methods are used to influence the formation of the environment. Describing the functions performed by individual objects of innovation infrastructure, the authors do not use quantitative indicators that could characterize its formation.

Paying tribute to the research of scientists, it is reasonable to develop a list of indicators for the assessment of innovation infrastructure, which can be the basis for a quantitative rather than descriptive assessment of the level of its formation, the system of which is presented in regional and object terms (Figures 2, 3).

As can be seen from the above figures based on the scores of indicators of innovation infrastructure, on the one hand, it is proposed to determine a generalized score of innovation infrastructure by oblast (Figure 4), and on the other hand, to integrate specific score by providing its objects (Figure 2).

That is, there are two ways to calculate an integrated score assessment of the formation of the country's innovation infrastructure:

– direct way – aggregation of generalized point estimates of innovation infrastructure formation by oblasts;

– alternative way – aggregation of the integrated specified score by providing it with objects.

The relationship between these indicators can be seen in Figure 3.

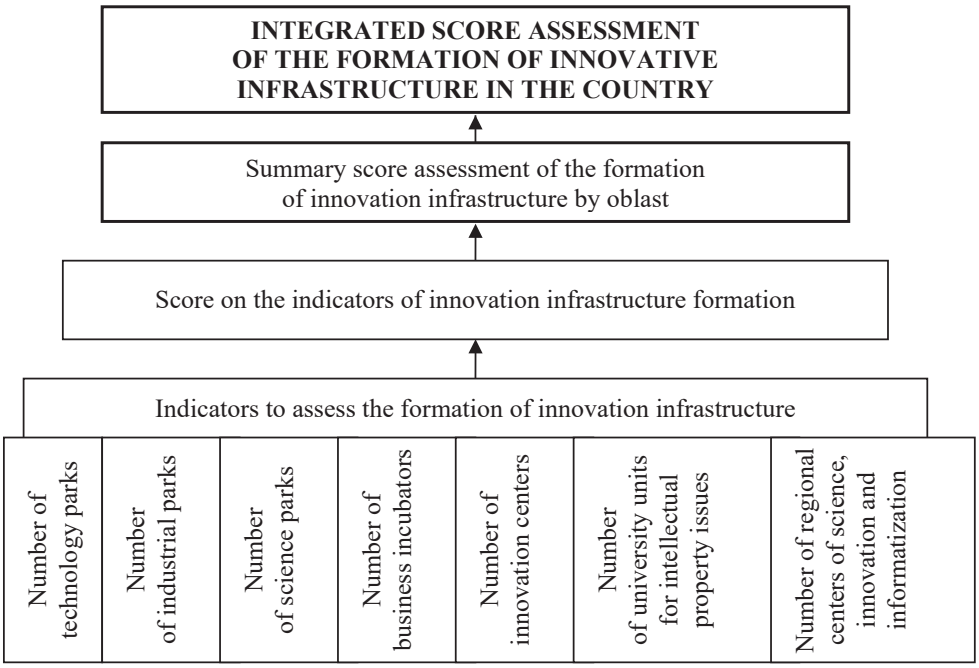

Figure 2. System for assessing the formation of innovation infrastructure (regional section)

Thus, the main indicators for assessing the formation of innovation infrastructure are the number of technology parks, the number of industrial parks, the number of science parks, the number of business incubators, the number of innovation centers, the number of universities (with intellectual property units), the number of regional centers of science, innovation and informatization.

These indicators make it possible to quantify the formation of the country's innovation infrastructure. In this case, the assessment involves the use of several methods, including:

– standardization method for converting the indicators into a single scale from 0 to 1 point;

– expert assessment method for determining the weight of individual infrastructure objects;

– aggregation method for summarizing the obtained scores to obtain generalized assessments of the formation of innovation infrastructure of oblasts and an integrated assessment of the formation

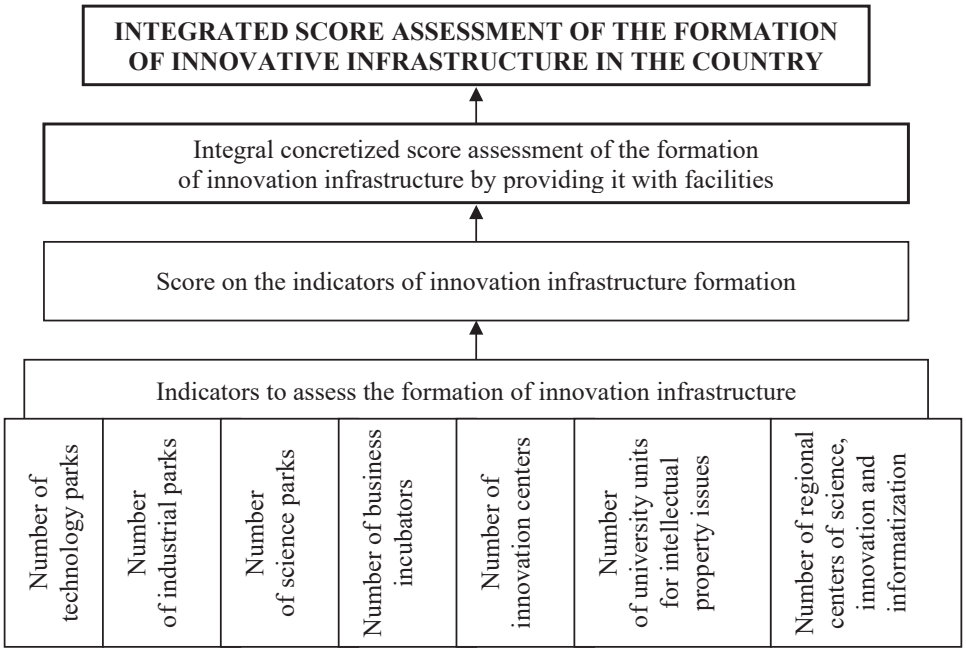

Figure 3. The system of assessment of the formation of innovation infrastructure (specified by objects section)

of innovation infrastructure of the country as a whole.

It should be noted that there are many methods of standardization (normalization, rationing) of indicators, among which the most common are:

– standardization on the maximum or minimum level;
– standardization on the range of variation of data by indicators (the difference between the maximum and minimum level);
– standardization on reference (optimal) values;
– standardization on the standard deviation using the Harrington function.

These methods have advantages and disadvantages that limit the use of these standardization methods in solving certain evaluation problems of an applied nature.

When standardizing the maximum or minimum values of indicators, a score is calculated by dividing the statistical value of an individual indicator by its maximum value (if this indicator has a positive meaningful load) or by dividing the minimum value by its statistical value (if this indicator has a negative meaningful load).

This method is one of the easiest to use, does not require complex mathematical calculations, but has certain disadvantages: first, the one-sided limitation of the values of the indicators to maximum or minimum values; second, if the array of observations is replenished with new values that exceed the maximum or minimum limits, it is necessary not only to calculate the values of the score for new observations, but also to completely recalculate the scores of all previous observations.

When standardizing the difference between the maximum and minimum values of indicators, a score is calculated by dividing the deviation of the statistical value of an individual indicator from its maximum value (if the indicator has a positive meaningful load) or minimum value (if the indicator has a negative meaningful load) by the difference between the maximum and minimum values of the indicators.

This method is also easy to use, but has similar disadvantages as the previous method: first, the bilateral limitation of the maximum and minimum values, and second, if the array of observations is supplemented with new values beyond the maximum or minimum limits, it is necessary not only to calculate the score values for the new observations, but also to completely recalculate the scores of the values of all previous observations.

If it comes to standardization with respect to the reference (optimal) value, it involves calculating the score by dividing the statistical value of an individual indicator by the reference (optimal) value of the indicator (if this indicator has a positive meaningful load) or vice versa, by dividing the reference (optimal) value of the indicator by its statistical value (if this indicator has a negative meaningful load).

This method has an obvious advantage – it does not require recalculation of scores in case of replenishment of the array of observations, because the reference value corresponds to the threshold level of the indicator, the intersection of which is impossible for objective reasons. At the same time, there is a problem of determining the reference level, which is often solved by scientists on the basis of their own experience, i.e., characterized by a high degree of subjectivity.

Standardization using the Harrington function involves calculating the normalized value of an indicator by dividing the deviation of the statistical value of a particular indicator from its arithmetic mean (if this indicator has a positive meaningful load) by the standard deviation of these indicators, and converting the resulting values into points on the Harrington scale.

Like the previous one, this method does not require recalculation of scores of indicators in case of replenishment of the array of observations, and in addition to mine, does not require justification of reference values, ie has a fairly low level of subjectivity. At the same time, the application of

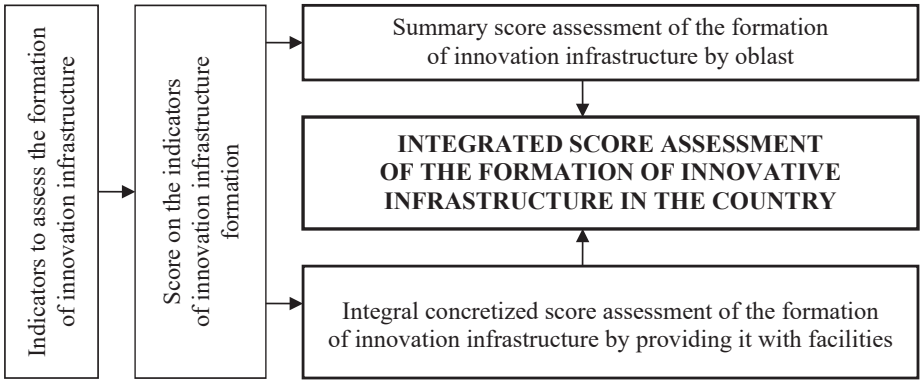

Figure 4. The relationship between the elements of the system for assessing the formation of innovation infrastructure

this method is a rather cumbersome and complex process that requires complex mathematical calculations, which is its obvious drawback. However, the disadvantages of this method are far outweighed by its advantages.

Based on the comparison of different standardization methods, the advantages of the latter are obvious compared to the other three methods, and the disadvantages are acceptable. The element-by-element analysis will provide an opportunity to identify weaknesses in the infrastructure and develop an effective action plan for its development. It is necessary to compare the objects of innovation infrastructure according to the main stages of the innovation process, which are provided by this object of innovation infrastructure. These stages are knowledge generation, knowledge transfer, knowledge assimilation and knowledge utilization (Zhuk, 2015).

4. Empirical results

This section presents the estimation results of the model (for the country as a whole and for each oblast) and the corresponding test statistics used in the estimation. Table 1 shows the correspondence of individual objects of innovation infrastructure with the stages of the innovation process that they provide. As can be seen from the table, technology parks provide knowledge generation, transfer and development, innovation centers – knowledge generation and transfer, business incubators – knowledge acquisition and use.

Organizations that conducted research and development – the generation of knowledge, and departments of universities on intellectual property – the transfer of knowledge.

Taking into account this comparative characteristic, the weighting coefficients of each innovation infrastructure object were determined. In parallel, an expert survey was conducted (experts were specialists from the State Statistics Service of Ukraine and technology transfer departments of universities and research institutes, representatives of the regional state administration, and the Department of Intellectual Property of the MEDT of Ukraine).

Regarding the importance of individual stages of the innovation process, it was found that the importance of knowledge generation is the highest and is 0.4, and the importance of other stages is approximately the same and is 0.2 (Table 2). This is natural, because it is the generation of new knowledge that acquires the highest priority in modern conditions.

Thus, technology parks (0.33) and innovation centers (0.25) have the highest weight. Taking into account these weights, the scores of the indicators should be aggregated into generalized estimates.

Also, within the framework of the preparatory block, data should be collected on the indicators of assessment of the formation of innovation infrastructure in the oblasts. At the same time, data should be collected for several periods (for example, for the last five years) by oblasts of Ukraine.

Within the framework of the block of evaluation and diagnostics it is necessary to determine the scores of the oblasts according to the level of formation. The calculation of such scores is carried out in the following order:

Table 1
Correspondence of innovation infrastructure objects to stages of the innovation process

Innovation Infrastructure Objects	Stages of the Innovation Process			
	Knowledge Generation	Knowledge Transfer	Mastering Knowledge	Using Knowledge
Technology parks	+	+	+	
Business incubators			+	+
Innovation centers	+	+		
University intellectual property departments		+		
Organizations that conducted research and development	+			

Table 2
Alignment of innovation infrastructure facilities with the stages of the innovation process

Innovation Infrastructure Objects	Assessing the importance of objects				Sum	Weighting factor
	Knowledge Generation	Knowledge Transfer	Mastering Knowledge	Using Knowledge		
Technology parks	0.4	0.2	0.2		0.8	0.33
Business incubators			0.2	0.2	0.4	0.17
Innovation centers	0.4	0.2			0.6	0.25
University intellectual property departments		0.2			0.2	0.08
Organizations that conducted research and development	0.4				0.4	0.17
Total	2.4	1				

1. The normalized value of the innovation infrastructure formation indicator is determined:

$$Zi_{jt} = \frac{Xi_{jt} - \overline{Xi_{jt}}}{\sigma\left(Xi_{jt}\right)}, \quad (1)$$

where Zi_{jt} is the normalized value of the *i* indicator of the formation of the innovation infrastructure of the *j* oblast for the period *t*;

Xi_{jt} is the value of the i indicator of the formation of the innovation infrastructure of the oblast *j* for the period *t*;

$\overline{Xi_{jt}}$ – the arithmetic mean of the i indicator of the formation of innovation infrastructure by oblast for the study period;

$\sigma\left(Xi_{jt}\right)$ – standard deviation of the value of the *i* indicator of innovation infrastructure formation by oblast for the study period.

The arithmetic mean of the indicators of innovation infrastructure formation by oblasts is determined by the formula:

$$\overline{Xi_{jt}} = \frac{\sum_t^T \sum_j^J Xi_{jt}}{T \cdot J}, \quad (2)$$

where $\overline{Xi_{jt}}$ is the arithmetic mean of the *i* indicator of innovation infrastructure formation by oblast for the study period;

Xi_{jt} is the value of the i indicator of the formation of the innovation infrastructure of the oblast *j* for the period *t*;

$i = \overline{1;I}$ – the number of the indicator of formation of innovation infrastructure;

$j = \overline{1;J}$ – the number of the oblast of Ukraine;

$t = \overline{1;T}$ – the period number;

I – the number of indicators of the formation of innovation infrastructure;

J – the number of oblasts of Ukraine;

T is the number of years of the study period.

As for the standard deviation of the value of the indicator i of the formation of innovation infrastructure by oblast for the period under study, this indicator should be calculated according to the following formula:

$$\sigma\left(Xi_{jt}\right) = \sqrt{\frac{\sum_t^T \sum_j^J (Xi_{jt} - \overline{Xi_{jt}})^2}{T \cdot J}} \quad (3)$$

where $\overline{Xi_{jt}}$ is the arithmetic mean of the *i* indicator of innovation infrastructure formation by oblast for the study period;

Xi_{jt} is the value of the i indicator of the formation of the innovation infrastructure of the oblast *j* for the period *t*.

2. Scores are determined using the analytical desirability function described by the following formulas:

$$VO\left(Zi_{jt}\right) = \exp(-\exp(-Zi_{jt})),$$

where $VO\left(Zi_{jt}\right)$ is the evaluation of the *i* indicator of the formation of the innovation infrastructure of the *j* oblast for the period.

On the basis of the scores it is proposed to determine the generalized scores of formation of the innovation infrastructure of the oblasts of Ukraine, taking into account the obtained weights:

$$YVO\left(Z_{jt}\right) = \sum_{i=1}^{I} BKi \cdot VO\left(Zi_{jt}\right), \quad (4)$$

where $YVO\left(Z_{jt}\right)$ is the generalized point evaluation of the formation of the innovation infrastructure of the oblast *j* for the period *t*;

$VO\left(Zi_{jt}\right)$ is the evaluation of the i indicator of the formation of the innovation infrastructure of the *j* oblast for the period.

After calculating the overall score of innovation infrastructure formation in all oblasts for this period, it is possible to calculate the integrated score of innovation infrastructure formation:

$$IVO\left(Z_t\right) = \frac{\sum_{j=1}^{J} VO\left(Z_{jt}\right)}{J}, \quad (5)$$

where $IVO\left(Z_t\right)$ is the integrated score of the country's innovation infrastructure formation for the period *t* (direct method of calculation);

$YVO\left(Z_{jt}\right)$ is the generalized point evaluation of the formation of the innovation infrastructure of the oblast *j* for the period *t*.

Table 3

Matrix for the calculation of the integrated score of the innovation infrastructure formation of Ukraine for the period t

Oblast number	Indicator number				Weighted score on the line
	1	2	…	AND	
1	Scores for innovation infrastructure by oblast				Summary scores for innovation infrastructure formation by oblast
2					
…					
.					
Average score by column	Specified integral scoring assessment of the formation of the country's innovation infrastructure through the provision of its facilities of a certain type				Integral score assessment of the formation of the country's innovation infrastructure

In this case, to identify the reasons that influenced the value of the integrated indicator, a specific integrated score of the innovation infrastructure of the country for the period t can be determined due to the provision of its facilities:

$$I\kappa VO(Zi_t) = \frac{\sum_{j=1}^{J} VO(Zi_{jt})}{J}, \quad (6)$$

where $I\kappa VO(Zi_t)$ is the specified integrated score of the assessment of the formation of the innovation infrastructure of the country for the period *t* due to the provision of its objects of the ith type;

$VO(Zi_{jt})$ is the evaluation of the i indicator of the formation of the innovation infrastructure of the *j* oblast for the period.

Specified estimates are combined into a single indicator, taking into account the weights:

$$IVO(Z_t) = \sum_{i=1}^{I} BKi \cdot I\kappa VO(Zi_t), \quad (7)$$

where $IVO(Z_t)$ – integrated score evaluation of the formation of the innovation infrastructure of the country for the period *t* (alternative method of calculation) (Voloshchuk, Stepashko, 2014).

To simplify the calculations and verify their correctness, the matrix method is proposed to be used, which is shown in Table 3.

As can be seen from Table 3, the average score of the formation of innovation infrastructure by oblast based on the specification corresponds to the result of an integrated score of the formation of innovation infrastructure of Ukraine.

As a result of the calculations, the values of the indicators are translated into a scale from 0 to 1, which allows to provide the obtained scores with a qualitative interpretation.

The use of this scale allows a qualitative interpretation of the values of the obtained scores. The Harrington scale is constructed using the desirability function, which has been widely used in various economic studies. One of the ways of implementing the desirability function is the Harrington psychophysical scale, which establishes a correspondence between the qualitative evaluation of the parameter and its quantitative value and has universal application (Lyutyk, 2016).

On the basis of the desirability function, five intervals corresponding to the Harrington scale are formed. At the same time, according to the authors, it is necessary to adjust the linguistic assessment in connection with the determination of the level of formation of the innovation infrastructure (Table 4).

Thus, the scores for each indicator, generalized scores, and integrated scores can be interpreted using the above scale.

A methodical approach to the assessment of the formation of innovation infrastructure, which is based on its integrated assessment and allows to take into account the number of innovation infrastructures, their regional distribution, the importance of individual innovation infrastructures, determined on the basis of their comparative characteristics, and to create a basis for balanced management decisions in the field of innovation infrastructure.

The level of innovation infrastructure formation was studied on the basis of data for 2013–2018.

In general, there is a general underdevelopment of the innovation infrastructure in Ukraine, which received a score of 0.328. The formation of elements of innovation infrastructure is relatively equal, business incubators work best. According to estimates, Kyiv has become the leader in the formation of innovation infrastructure with a score of 0.982 points. Kharkiv Oblast showed a sufficient level of innovation infrastructure with a score of 0.655. The average level of innovation infrastructure development in Donetsk (0.460), Dnipropetrovsk (0.494) and Lviv (0.37) Oblasts.

An insufficient level of innovation infrastructure development is typical for a large number of Ukrainian oblasts: Kyiv (0.322), Vinnytsia (0.318), Sumy (0.304), Zaporizhzhia (0.299), Odesa (0.290), Cherkasy (0.288), Ivano-Frankivsk (0.284), Kherson (0.283), Zakarpattia (0.261), Zhytomyr (0. 258), Poltava (0.255), Volhynia (0.255), Khmelnytskyi (0.254), Ternopil (0.251), Rivne (0.248), Mykolaiv (0.228), Kirovohrad (0.224), Luhansk (0.217), Chernivtsi (0.214). The worst situation is in Chernihiv Oblast (0.196).

Thus, according to the Harrington scale, 1 oblast received a score of "very good," 1 oblast received a score of "good," 3 oblasts received a score of "satisfactory," 19 oblasts received a score of "bad," and 1 oblast received a score of "very bad".

This result is due to the uneven economic development of the oblasts themselves. According

Table 4

Basic and Adjusted Harrington Scale (Harrington, 1965)

Linguistic assessment (basic scale)	Linguistic assessment (adjusted scale)	Desirability Function Value Ranges
Very good	High level of innovation infrastructure formation	0.80-1.00
Good	Sufficient level of innovation infrastructure formation	0.63-0.80
Satisfactory	Average level of innovation infrastructure formation	0.37-0.63
Bad	Insufficient level of innovation infrastructure formation	0.20-0.37
Very bad	Low level of innovation infrastructure formation	0.00-0.20

to Julian Christ, the study of innovation must take into account the coefficients of inequality, which are to compare the behavior of such indicators, to which several axioms apply:
– independence of scale, i.e., homogeneity of income;
– homogeneity of the population involved in the innovations;
– anonymity: personal characteristics other than income do not matter (Christ, 2012).

Another reason is the uneven distribution of high-tech universities, which, according to a study by Ghio Nicollo, are the primary basis for the formation of innovation infrastructure. It demonstrates, using Italy as an example, that the localization of universities contributes to the rapid leakage of innovative start-ups that begin their creation in them (Ghio, Guerini & Rossi-Lamastra, 2016, p. 307).

5. Conclusions

Ukraine has serious problems with the development of infrastructure sectors, in particular, their development is largely determined by the ability of the government to implement systemic institutional changes aimed at reform.

First of all, it is about the implementation of the European integration policy. In particular, it is necessary to create favorable conditions for business development, implement real decentralization of power and complete administrative and territorial reform, ensure further liberalization of foreign economic activity and increase the efficiency of financial resources allocated by the EU to support economic reforms in Ukraine (Stroiko, Bondar, 2017, p. 146).

Summarizing the results of the research, it is worth noting the main findings:

1. The method of calculating the formation of infrastructure for the effective flow of business processes is based on three blocks, including the target block, preparatory unit, evaluation and diagnostic unit. A list of indicators for the evaluation of the innovation infrastructure has been developed, which can be used as a basis for carrying out not a descriptive, but a quantitative assessment of the level of its formation.

2. Based on the scores of the indicators of formation of innovation infrastructure, on the one hand it is proposed to determine a generalized score of formation of innovation infrastructure by oblasts, and on the other – an integrated specific score by providing its facilities. For example, the main indicators for assessing the formation of the innovation infrastructure are the number of technology parks, the number of industrial parks, the number of science parks, the number of business incubators, the number of innovation centers, the number of free economic zones (with intellectual property), and the number of regional science centers. The correspondence of separate objects of innovation infrastructure with the stages of innovation process provided by them is given. It is determined that technology parks provide generation, transfer and development of knowledge, innovation centers – generation and transfer of knowledge, business incubators – acquisition and use of knowledge. Taking into account this comparative characteristic, the weight coefficients of each object of innovation infrastructure are determined. On the basis of concretization the average score of formation of innovation infrastructure in oblasts is determined, which corresponds to the integrated score of formation of innovation infrastructure of Ukraine.

3. A methodical approach to the assessment of the formation of innovation infrastructure, which is based on its integrated assessment and allows to take into account the number of innovation infrastructures, to determine their comparative characteristics, as well as to create a basis for sound management decisions in the formation of innovation infrastructure.

4. The rating of the effectiveness of innovation infrastructure by oblast was calculated. The top five leaders are: Kharkiv, Zaporizhzhia, Lviv, Dnipropetrovsk, Kyiv Oblasts and the city of Kyiv itself. The efficiency rating of the leading oblasts almost completely coincides with the indicator of innovation infrastructure development, with the exception of Donetsk Oblast, which has a better indicator of development than efficiency, and Zaporizhzhia Oblast, on the contrary, has an efficient infrastructure despite its low development.

References:

Christ, J. (2012). Innovative Places, Research Clustering and Co-Agglomeration in Europe. *In Innovative Places in Europe: Research Clustering, Co-Patenting Networks and the Growth of Oblasts,* pp. 117–218.

Colombelli, A., Krafft, J., & Vivarelli, M. (2016). To be born is not enough: The key role of innovative start-ups. *Small Business Economics,* vol. 47 (2), pp. 277–291. Available at: www.jstor.org/stable/43895737

Ghio, N., Guerini, M., & Rossi-Lamastra, C. (2016). University knowledge and the creation of innovative start-ups: An analysis of the Italian case. *Small Business Economics,* vol. 47 (2), pp. 293–311.

Hammer, M. (2007). Reengineering of the corporation: Manifesto of revolution in business. Moscow: Mann, Ivanov and Ferber, 288 p.

Harrington, E. (1965). The Desirability Function. Industrial Quality Control, pp. 494–498.

Leitner, S., & Stehrer, R. (2016). R&D and non-R&D innovators during the global financial crisis: the role of binding credit constraints. *Latin American Journal of Economics,* vol. 53 (1), pp. 1–38. Available at: www.jstor.org/stable/90003531

Lyutyk, T. (2016) Harrington's desirability function as a tool for integrated assessment of innovation and scientific-technological components of economic potential. *History of science and biography,* vol. 4. Available at: http://nbuv.gov.ua/UJRN/INB_Title_2016_4_11

Nazarenko, I. (2013). Development of innovation infrastructure of Kharkiv oblast. *Bulletin of Khmelnytsky National University. Economic sciences,* vol. 3 (2), pp. 113–117. Available at: http://nbuv.gov.ua/UJRN/Vchnu_ekon_2013_3%282%29__26

Stroiko, T., & Bondar, V. (2017). Transport infrastructure of Ukraine: the modern realities and development prospects. *Baltic Journal of Economic Studies,* vol. 3, no. 2, pp. 141–146. DOI: https://doi.org/10.30525/2256-0742/2017-3-2-141-146

Usmanova, M. (2016). Theoretical principles of innovation infrastructure formation in Ukraine. *Bulletin of the Eastern European University of Economics and Management. Series: Economics and Management,* vol. 1, pp. 74–84. Available at: http://nbuv.gov.ua/UJRN/Vsuem_2016_1_11

Vinogradova, O. (2005) Business process reengineering in modern management: monograph. Donetsk: DonDUET them. M. Tugan-Baranovsky, 195 p.

Voloshchuk, R., & Stepashko, V. (2014). Nonlinear normalization of statistical indicators for the problem of constructing integral indices. *Inductive modeling of complex systems,* vol. 6, pp. 47–54. Available at: http://dspace.nbuv.gov.ua/handle/123456789/83993

Wei, S., Xie, Z., & Zhang, X. (2017). From "Made in China" to "Innovated in China": Necessity, Prospect, and Challenges. *The Journal of Economic Perspectives,* vol. 31 (1), pp. 49–70. Available at: www.jstor.org/stable/44133950

Zhuk, M. (2015). Ensuring the functioning of innovation infrastructure in terms of deepening integration. *Efficiency of public administration,* vol. 44, pp. 64–72.

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