

Innovation Clusters as an Important Factor Providing Industrial Potential

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Summary. The aim of the work is to study spatial concentration of knowledge resources and innovative activity of management entities to determine types of innovative industrial clusters in Ukraine and levers of government control of the innovative development of industrial potential.

The foreign experience of innovative industrial clusters creating is analyzed and we define them as basic participants in the article. The model of innovative industrial clusters forming is worked out. The system of indicators of evaluation of the development level of intellectual and economic constituents is offered in order to distinguish innovative industrial clusters in Ukraine. The integral index of the intellectual constituent development is calculated and the ranking of administrative-territorial units is conducted by the mentioned index. The clustering of administrative-territorial units is conducted by the method of indistinct S-averages taking into account indexes of innovative activity, that characterize the state of the economic constituent development. The basic types of innovative industrial clusters are distinguished based on the comparison of levels of the intellectual and economic constituents development. It was defined that an important problem for Ukraine, that is necessary to overcome in the nearest perspective, is absence of the close collaboration among science and business structures. Creation of innovative clusters of the mixed type is considered as the modern basis of the industrial potential development that will assist to transfer innovations, to increase the competitiveness of spatial development and the national economy on the whole. The state, as the third participant of the cluster, should play the role of the regulator of this cooperation. The levers of the state stimulation of the industrial potential development on the innovative basis for certain types of innovative industrial clusters are offered in the article.

Key words: industrial potential, development, innovation, cluster.

INTRODUCTION

The innovative model formation of the economy development in Ukraine determines the necessity to revise priorities of the national economy and sets new requirements necessary for its successful functioning. The national report "Innovative Ukraine 2020" indicates that a strategic priority of the state should be the transition from the reproductive to the innovative type of development [1]. Thus, a key role is given to the industry. Therefore, transition into new quality basis of the development is not possible without the industrial potential development on the innovative basis. Under such conditions, creation of innovative industrial clusters can be considered as one of the strategic tasks of the state, as they alone are able to increase the competitiveness of the national economy and lead it to the way of the economic growth.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Questions dealing with the innovative industry development have become subjects of the research of lots of native and foreign scientists, it is worthwhile mentioning the following: Amosha O. [2], Bubenko P. [3], Gezd P. [4], Geyets V. [5], Zhalila J.[6], Illyashenko S. [7], Malerba F. [8], Odrekhivsky M. [9], Petrova I. [10], Porter M. [11], Parkhomenko V. [12], Serra F. [13], Fedulova L.[14], Hulsink V.[15], Chesbrough G. [16], Chukhrai N. [17], She B. [18].

The influence of clustering on the innovative way of the development and structural transformation of the national economy is studied in the works [19, 20, 21]. Porter M., in particular, who is considered to be the founder of the cluster theory of the industry organization, pointed out that cluster participants become quicker aware of new technologies, i.e. there is a transfer of knowledge that promotes rapid implementation of innovations [11].

According to Ukrainian scientists, the cluster approach to the industry organization can become the effective means of transition of the industrial potential onto the innovative development basis [6]. Conceptions of innovative cluster and mechanisms allowing keeping to innovative cluster politics of the state are looked upon in details in the work of She B. [18]. Parkhomenko V. distinguishes two basic stages, the cooperation of which is necessary to create effective innovative system in the country: making of a creative product and its transition into production [12]. Spatial aspects of the innovative development of the industrial potential in Ukraine are researched in the works [22, 23].

The analysis of scientific works gives basis to indicate that modern researchers mostly pay attention to certain separate aspects of the innovative activity development, formation of innovative clusters that does not allow integral perception of innovative development of the industrial potential on cluster basis that is determined by certain factors of the innovative atmosphere formed in the country.

OBJECTIVES

The aim of the work is to study the spatial concentration of knowledge resources and innovative activity of management entities to determine types of innovative industrial clusters in Ukraine and levers of government control of the innovative development of the industrial potential.

THE MAIN RESULTS OF THE RESEARCH

Innovative industrial clusters are known to have been functioning successfully in the developed countries of the world since 1990s. These are hi-tech valleys in the east of

the Netherlands, Silicon Valley in Bangalore, the cluster of optical equipment in Tokyo, biotechnological in Boston and auto manufacture in Detroit. The experience of innovative entrepreneurship, spreading of knowledge and forming of clusters in Europe and the United States is especially useful for Ukraine that has decided to choose the innovative way of development today. Taking into account foreign experience [8, 19, 24, 25], the basic participants of the innovative cluster are the following:

1. Universities that generate new knowledge, implementing it in creative projects;
2. Business structures that convert creative initiative into actual products by launching production process;
3. State organizations that create favourable atmosphere to spread knowledge and implement innovations.

Working out of new ideas, accumulation of intellectual resources are the integral features of the 21st century and the guaranty of the economy intellectualization. Therefore, the formation of innovative clusters should take place on the basis of the cooperation of two constituents: intellectual (knowledge resources) and economic (management entities). It is more appropriate to speak about creation of innovative industrial clusters on the basis of scientific research establishments in Ukraine today. However, taking into account world tendencies, active work is now carried out towards the expansion of the scientific activity in educational establishments that can be considered as the potential centres of the development of new ideas and support of cooperation with the management entities (Fig.1).

We suggest to carry out the research of the spatial concentration of the intellectual and economic constituents taking into account the indicators which characterize the development of scientific and educational activity and the innovative activity of the management entities (Table 1).

Table 1. Indicators of the innovative industrial clusters formation

Cons-tituent		Indicators	Calculation method	Conventions
Intellectual	Scientific	1.1. Share of researchers in the number of economically active population, %	$S_r = N_r/N_{ep}$	S_r – share of researchers in the number of economically active population, %; N_r – number of researchers, persons; N_{ep} – number of economically active population, persons.
		1.2. Number of scientific establishments, units.	$N_{se} = \sum SE$	N_{se} – number of scientific establishments, units.
		1.3. Share of scientific and scientific technical works in gross regional product, %	$S_{stw} = E_{stw}/GRP$	S_{stw} – share of scientific and scientific technical works in gross regional product, %; E_{stw} – expenses for scientific and scientific technical works, millions of grynias; GRP – gross regional product, millions of grynias.
	Educational	1.4. Share of students of higher educational establishments of the I-IV levels of accreditation in number of population, %	$S_s = N_s/N_p$	S_s – share of students of higher educational establishments of the I-IV levels of accreditation in number of population, %; N_s – number of students of higher educational establishments of the I-IV levels of accreditation, persons; N_p – number of population, persons
		1.5. Number of educational establishments, units.	$N_{ee} = \sum EE$	N_{ee} – number of educational establishments of the I-IV levels of accreditation, units.
Economic		2.1. Share of industrial enterprises, that implemented innovations %	$S_{ie} = N_{ie}/N_e$	S_{ie} – share of industrial enterprises, that implemented innovations, %; N_{ie} – number of industrial enterprises, that implemented innovations, units; N_e – number of industrial enterprises, units.
		2.2. Share of industrial enterprises, that implemented market innovations, %	$S_{mi} = N_{mi}/N_e$	S_{mi} – share of industrial enterprises, that implemented market innovations, %; N_{mi} – number of industrial enterprises, that implemented market innovations, units.
		2.3. Technological innovation of industrial enterprises, units per 1 industrial enterprise	$TI = N_{ip}/N_e$	TI – technological innovation of industrial enterprises, units per 1 industrial enterprise; N_{ip} – number of implemented new technological processes, units
		2.4. Range of innovations of industrial enterprises, units per 1 industrial enterprise	$RI = N_{ip}/N_e$	RI – range of innovations of industrial enterprises, units per 1 industrial enterprise; N_{ip} – number of innovative product items introduced, units
		2.5. Level of innovations transfer, %	$L_{it} = N_{ie}/N_e$	L_{it} – level of innovations transfer, %; N_{ie} – number of industrial enterprises that supplied innovative products outside Ukraine, units

Note: compiled by the author

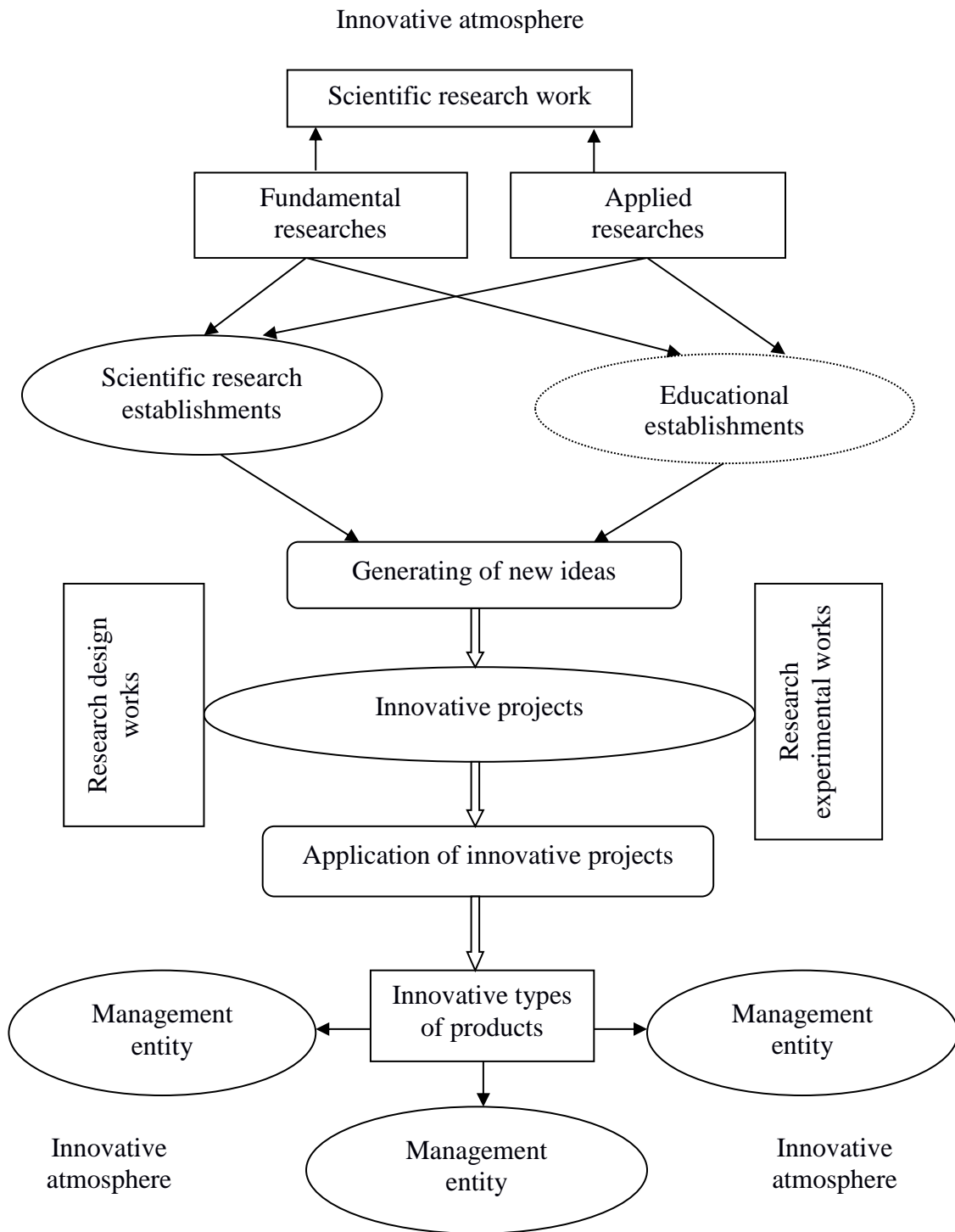


Fig. 1. Model of the innovative industrial clusters formation

To standardize the initial indicators characterizing intellectual constituent, it is possible to use the following formula (1):

$$i_{ij} = n_{ij} / n_{max}, \quad (1)$$

where: i_{ij} – partial indexes in view of indicators; n_{ij} – meaning of j indicator for i region; n_{max} – max value of the indicator.

The integral index of the level of the intellectual constituent development in view of regions of Ukraine is counted as an average arithmetic of the partial indexes.

According to the results, received due to ranging from administrative-territorial units by the calculated integral index, the most favourable situation has developed in Kyiv that becomes the leader by all calculated indexes (Table 2).

Table.2. Level of the development of the intellectual constituent in the administrative-territorial units in Ukraine

Administrative-territorial units	Partial indexes					Integral index of intellectual constituent development	Rank of administrative territorial units
	S_r	N_{se}	S_{snv}	S_s	N_{ee}		
Vynnytska	0,021	0,062	0,046	0,228	0,211	0,113	14
Volynska	0,015	0,033	0,041	0,139	0,195	0,085	23
Dnipropetrovska	0,154	0,190	0,505	0,515	0,286	0,330	3
Donetska	0,106	0,066	0,083	0,168	0,045	0,094	19
Zhytomyrska	0,013	0,030	0,037	0,198	0,188	0,093	20
Zakarpatska	0,028	0,033	0,095	0,139	0,128	0,084	24
Zaporizka	0,074	0,085	0,482	0,238	0,308	0,237	5
Ivano-Frankivska	0,026	0,059	0,062	0,158	0,211	0,103	16
Kyivska	0,078	0,085	0,155	0,228	0,128	0,135	10
Kirovogradska	0,036	0,049	0,123	0,168	0,128	0,101	17
Luganska	0,017	0,056	0,059	0,119	0,068	0,064	25
Lvivska	0,127	0,223	0,242	0,416	0,368	0,275	4
Mykolaiivska	0,058	0,082	0,581	0,158	0,218	0,219	7
Odeska	0,086	0,161	0,183	0,396	0,353	0,236	6
Poltavska	0,051	0,066	0,047	0,188	0,256	0,121	12
Rivnenska	0,012	0,039	0,022	0,149	0,241	0,093	21
Sumska	0,068	0,049	0,235	0,158	0,256	0,153	9
Ternopil'ska	0,015	0,036	0,029	0,198	0,286	0,113	15
Kharkiv'ska	0,380	0,544	1,285	0,683	0,504	0,679	2
Kherson'ska	0,036	0,052	0,093	0,198	0,195	0,115	13
Khmelnyska	0,010	0,026	0,028	0,188	0,195	0,090	22
Cherkaska	0,033	0,066	0,159	0,158	0,241	0,131	11
Cherivetska	0,042	0,066	0,266	0,168	0,256	0,160	8
Chernigiv'ska	0,028	0,049	0,105	0,168	0,150	0,100	18
city Kyiv	1,000	1,000	1,000	1,000	1,000	1,000	1

Note: compiled and calculated by the author according to [26].

The leading role, among Ukrainian regions, in the accumulation of scientific potential belongs to Kharkiv'ska region where the integral index of the intellectual constituent development makes 0,679. Favourable conditions, taking into account the knowledge imperative, have also developed in Dnipropetrovska (0,330), Lviv'ska (0,275), Zaporizka (0,237), Odeska (0,236) and Mykolaiiv'ska (0,219) regions. Chernivetska, Sumska, Kyiv'ska, Cherkaska, Poltav'ska, Kherson'ska, Vynnytska and Ternopil'ska regions have almost the same level. The lowest level of indicators is observed in Volyn'ska, Zakarpatska and Luganska regions, their integral indexes

are 0,085, 0,084 and 0,064 correspondingly. The received results indicate quite high level of the spatial asymmetry of the intellectual constituent formation, that doesn't contribute to dissemination of innovations through Ukraine but leads them to concentrations in certain separate regions.

To examine the economic subsystem, it is offered to use indicators which characterize innovative activity of industrial enterprises. However, relative characteristics were used in calculation that allowed analyzing market, technological and range of innovation of the industrial potential and define the level of the innovation transfer.

In order to form innovative industrial clusters, the research of the corresponding statistic data was carried out in 25 administrative-territorial units with the help of the method of indistinct S-averages [27], the main advantage of which is the ability to find optimal spatial cooperation. The peculiarity of this method is that S value is defined beforehand taking into account the object of the research and is identified by the expert method. We offer to divide innovative industrial clusters into four groups, each of them differs by the level of innovative activity ($C=4$). The offered system of indicators forms the database that creates matrix in size (Eq. 2).

$$l \times n, \quad (2)$$

where: $l = 1,25$ – number of administrative-territorial units, $n = 1,5$ – number of indicators which characterize the object of the research (table 1).

The method of indistinct S-averages is based on the assumption that every administrative-territorial unit can refer to several groups with the certain degree of belonging. To define the final result, matrix is constructed of the dimension $c \times l$:

$$M = \begin{bmatrix} m_{11} & m_{12} & \dots & m_{1l} \\ m_{21} & m_{22} & \dots & m_{2l} \\ \dots & \dots & \dots & \dots \\ m_{cl} & m_{c2} & \dots & m_{cl} \end{bmatrix}, \quad (3)$$

where: M – matrix of the degree of belonging, – degree of belonging of j administrative-territorial unit to i cluster.

Thus, the following conditions should be observed:

1. Parameters should be within the limits of 0-1.
2. Every administrative-territorial unit should have a degree of belonging to each of the clusters.
3. All administrative-territorial units can not belong to one cluster.
4. There cannot be an empty cluster.

The quality of the received results is determined by J (criterion of variation) by the formula provided in the work [28].

The received matrix of the degrees of belonging of each administrative-territorial unit to a certain cluster is shown in Table 3.

Table 3. Matrix of the degree of belonging of the spatial concentration of the economic constituent to four clusters

Administrative-territorial units	Number of cluster			
	1	2	3	4
Vinnyska	0,07	0,03	0,84	0,06
Volynska	0,04	0,02	0,13	0,81
Dnoproetrovska	0,03	0,02	0,12	0,82
Donetska	0,06	0,05	0,17	0,72
Zhytomyrska	0,09	0,04	0,72	0,15
Zakarpatska	0,16	0,15	0,28	0,41
Zaporizka	0,19	0,71	0,07	0,03
Ivano-Frankivska	0,42	0,24	0,24	0,10
Kyivska	0,07	0,04	0,44	0,45
Kirovogradska	0,61	0,25	0,10	0,04
Luganska	0,09	0,07	0,21	0,62
Lvivska	0,42	0,15	0,36	0,08
Mykolaiivska	0,50	0,29	0,15	0,07
Odeska	0,21	0,08	0,59	0,11
Poltavska	0,30	0,22	0,37	0,11
Rivnenska	0,03	0,02	0,13	0,82
Sumska	0,25	0,43	0,18	0,14
Ternopil'ska	0,29	0,28	0,24	0,19
Kharkiv'ska	0,30	0,55	0,10	0,05
Kherson'ska	0,24	0,64	0,08	0,04
Khmelnitska	0,05	0,02	0,82	0,10
Cherkaska	0,71	0,13	0,13	0,03
Chernivetska	0,72	0,11	0,13	0,04
Chernigiv'ska	0,12	0,05	0,73	0,11
city Kyiv	0,42	0,40	0,13	0,05

Note: compiled and calculated by the author according to [26].

Division of administrative-territorial units into clusters is made on the value of the degree of belonging, i.e. the higher the value of is, the higher degree of belonging to certain cluster. Taking into account the indexes of innovative activity of industrial enterprises, the biggest cluster is the first one consisting of 8 administrative-territorial units. Administrative-territorial units belonging to the first cluster (Ivano-Frankivska, Kirovogradska, Lvivska, Mykolaivska, Ternopilska, Cherkaska, Chernivetska regions and city Kyiv) concentrate the basic relative share of industrial enterprises which implement innovations. However, the inner structure of the cluster is too complex because the degree of the regions belonging ranges from 0,29 (Ternopil area) to 0,72 (Chernivtsi area), which explains the high variation of other indexes. The second largest cluster is the fourth one that includes 7 administrative-territorial units (Volynska, Dnipropetrovska, Donetska, Zakarpatska, Kyivska, Luganska, and Rivnenska regions), that are characterized by a high level of innovation transfer due to the specific of industrial potential development of these regions. The second cluster consists of Zaporizka, Sumska, Kharkivska and Khersonska regions that today play the leading role in the industrial potential development on the innovative basis and are characterized by high indexes of market innovation. The third cluster (Vinnytska, Zhytomyrska, Odeska, Poltavska, Khmelnytska and Chernigivska regions) is characterized by the lowest indexes of innovative activity of the industrial enterprises because of the specific specialization of these regions.

Comparing the indexes of intellectual and economic constituents development, it is possible to distinguish the following types of innovative industrial clusters:

- active, characterized by high innovative activity of industrial enterprises and level of the intellectual constituent development;
- passive, with the low level of development of the intellectual constituent together with the low innovative activity of industrial enterprises;
- contractive, with the high level of the economic constituent development and low level of development of the intellectual one;
 - counter-passive, characterized by well-developed intellectual constituent but unsatisfactory state of the economic one.

The formation of mixed clusters (counter-active and counter-passive) can be considered as the prosperous direction of the industrial potential development, as an active interregional cooperation will assist in dissemination of innovations and growth of the competitiveness of the area economy. Joining of the developed areas with the depressed ones will allow balancing the level of innovative development.

Establishing of spatial relations between them should result in exchange of modern technologies, skilled workforce and knowledge.

Thus, the state must play the role of a regulator of this cooperation, as there are administrative-territorial units that are characterized by the high level of development of the intellectual constituent and the low innovative activity of management entities and vice versa. It proves the absence of the established collaboration between scientific establishments and industrial enterprises, that is an important problem for Ukraine, that should be overcome as soon as possible. One of the reasons for this phenomenon is that most establishments conduct research due to the grants received from the European Union, thus working for the benefit of foreign recipients, but not of the state. Hence, the role of educational establishments in activation of innovative activity should grow as well, that is scientific work should be carried out not in the last turn but by the active collaboration with business structures with the aim of conducting purposeful scientific researches.

Today, the basic factors that hamper the development of innovative potential of administrative-territorial units are absence of the actively operating national innovative system; absence of the relevant financial support of scientific and technical studies; absence of the motivation of innovative activity; absence of the risk management system [23, 29]. Therefore, the state, understanding importance of the innovative development for the increase of the competitiveness of the national economy, must serve as a stimulator of this process introducing relevant tax advantages, subsidizing, credit mechanisms and other financial stimuli, as well as take an active part in creation of an appropriate institutional environment.

So, at present, Public innovative financial credit institution and Fund of small innovative business support with the aim of sponsorship of innovative clusters participants have been created in Ukraine.

An important step of the state on the way of stimulation of the innovative development was to make amendments in 2012 to the Law of Ukraine "On the government control of activity in the field of technologies transfer", according to which public money allotted to the development of new technologies can remain at organizations-developers' disposal [30].

Let's note that tax incentives are widely used in the leading countries of the world to develop intellectual constituent of an innovative cluster. So, tax credits and privileges are widely used in the USA to carry out scientific research works, the innovative tax credit is established in France for small and midsize businesses, and favourable tax treatment of research establishments is set in neighbouring Poland. In many countries of the

European Union, the direct state financing of scientific research works ranges between 30-50%. Regular revision of tax advantages results in the development of strategically important types of industrial activity and growth of the national economy competitiveness.

Respective conditions are being created for the development of economic constituent of innovative clusters as well, in Sweden, in particular, interest free loans are widely given on realization of innovative projects. State financing on competitive basis, taking into account strategic meaningfulness of the projects, is typical for Great Britain. Funds of introduction of innovative developments are created in Germany, Switzerland, the Netherlands and France in order to minimize risks of innovative enterprises. Direct budgetary financing of active innovative enterprises is used in many countries of the European Union. It is necessary to point out that, in the USA, the assistance to get the patents on inventions makes 50% of the expenditure incurred and favourable tax treatment is used to receive the security documents.

Based on scientific works analysis [31, 32, 33, 34], taking into account the distinguished types of innovative clusters, it is reasonable to divide levers of government control into three groups:

- encouraging (investments into innovations, training of skilled workforce, setting of favourable mechanisms of taxation for innovative types of activity, direct financing of scientific research works, creation of funds of introduction of innovations, etc.);
- promotional (development of bank and financial infrastructure to maintain positive changes in a long-term prospect, export crediting and insurance, projects competitive financing);
- regulative (establishing cooperation between science and business, budgetary loans, creating a demand for hi-tech products (state order)).

Encouraging levers should be widely used in clusters of the third type, to induce the development of the innovative enterprise in the region. Promotional levers create conditions to increase the scales of innovative activity in active innovative clusters. Regulative levers assist in the transfer of innovations from active innovative into innovative passive regions, that will result in achieving positive social effects, such as: decrease of unemployment level, reduction of interregional migration and development of social infrastructure units.

Main advantages to be likely expected from creation of innovative industrial clusters are

1. Establishing of the balanced cooperation between science, business and the state that will promote the rapid transfer of knowledge and their embodiment in innovative projects;

2. Creation of integration environment increases flexibility of the innovative enterprise and diminishes its risk, as well as the amount of transactional expenses incurred by companies.

CONCLUSIONS

The results of the conducted research allows us to make the following conclusions:

- 1) innovative industrial clusters serve as a spatial form of industrial potential development under modern conditions, that is successfully used in the highly-developed countries of the world;
- 2) the basis for their formation are the scientific research and educational establishments (centres of knowledge) that accumulate intellectual potential of the region and act as generators of new ideas;
- 3) as a result of the analysis of cooperation between intellectual and economic constituents it makes sense to distinguish four types of innovative industrial clusters. We suggest to consider the formation of innovative clusters of the mixed type as the modern basis of the industrial potential development, where innovative-passive regions join with innovative-active ones in order to transfer innovations;
- 4) the state, as the third participant of the cluster, must act as a regulator of innovative development by using encouraging, promotional and regulative levers depending on a type innovative cluster. The creation of innovative atmosphere will promote an introduction of innovations.

REFERENCES

1. **Geyets V.** Innovative Ukraine 2020: National report. Kiev: NAS of Ukraine. 336. (in Ukrainian).
2. **Amosha O. 2005.** Innovative way of Ukraine: problems and solutions. Economist. Vol. 6, 28-32. (in Ukrainian).
3. **Bubenko P.T. 2015.** Innovation component of modern regional development. Collection of scientific papers of National Technical University "KPU". № 2, 18-22. (in Ukrainian).
4. **Gedz M. Y. 2014.** Innovative Potential of Regions of Ukraine. Economy: realities time. № 2, 208-212. (in Ukrainian).
5. **Geyets V. 2014.** Institutional conditionality of innovative processes in the industrial development of Ukraine. Economy of Ukraine. №12 (637), 4-19. (in Ukrainian).

6. **Zhalila J.A. 2014.** Innovative industrial development as part of the structural transformation of the economy of Ukraine: Analyte. ext. Kiev: NISR. 152. (in Ukrainian).
7. **Ilyashenko S.M. 2011.** Problems and prospects of market-oriented management of innovative development: Monograph. Sumy: ITD "Printing House" Papyrus ". 644. (in Ukrainian).
8. **Malerba F. 2004.** Sectoral Systems of Innovation: Concepts, Issues and Analysis of six Major Sectors in Europe. Cambridge: University press. 508.
9. **Odrekhivsky M.V. and Yatsyshyn V.P. 2013.** Problems of innovative development of Ukraine (based on the views of Ivan Franko in progress). Scientific Bulletin of University of Bank Business of National Bank of Ukraine. № 3, 75-80. (in Ukrainian).
10. **Petrova I.L.** Innovation activities: incentives and obstacles: Monograph. Kiev: Dorado. 320. (in Ukrainian).
11. **Porter M. E. 1990.** The Competitive Advantage of Nations. New York: Free Press, 896.
12. **Parkhomenko V. D. 2014.** The structure of innovative activity in Ukraine. The role and importance of intellectual property in innovative development of economy: Materials of the International Scientific Conference. Vol.6, 6-9. (in Ukrainian).
13. **Serra F. 2008.** Open and closed industry clusters: The social structure of innovation. globADVANTAGE. № 24, 1-29.
14. **Fedulova L.I. 2013.** Innovative vector of industry development in Ukraine. Ukraine's economy. № 4, 15-23. (in Ukrainian).
15. **Hulsink W. J. and Dons. J. M. 2008.** Pathways to High-Tech Valleys and Research Triangles: Innovative Entrepreneurship, Knowledge Transfer and Cluster Formation in Europe and the United States. Springer-Verlag New York Inc. 311.
16. **Chesbrough H. W. 2006.** Open Innovation: A New Paradigm for Understanding Industrial Innovation. Oxford: Oxford University Press, 2006. 400.
17. **Chukhrai N.I. 2008.** Innovative development of Ukraine: main barriers and directions of overcoming them. Scientific Bulletin of the National University "Lviv Polytechnic". № 633, 761-767. (in Ukrainian).
18. **She B. 2012.** Theories and Practices of Innovative Cluster Construction. Science Press. 214.
19. **Khmara M. 2013.** Cluster approach to the strategy of innovative development of foreign countries. Scientific Bulletin of Kyiv National University named after Taras Shevchenko: International Relations. Vol. 1 (40), 51-54. (in Ukrainian).
20. **Kuzmin O. and Zhezhuha V. 2010.** Clusters as a factor of innovative development of enterprises and territorial formations. Economics of Ukraine. №2 (579), 16-17. (in Ukrainian).
21. **Kulishov V. 2013.** Cluster - the basis of innovative development of economy. Innovative Economy. № 2, 3-6. (in Ukrainian).
22. **Drachuk YU. Z. and Trushkina N.V. 2016.** The comparative analysis of the innovation potential of industry in the regions of Ukraine. Bulletin of Economic Sciences of Ukraine. № 1, 31-44. (in Ukrainian).
23. **Miklovda V.P., Kubin N.Y. and Moshak S.I. 2015.** Opportunities and obstruction of innovative potential of Zakarpattya as a factor of regional competitiveness. Economy industries. №1 (69), 31-39. (in Ukrainian).
24. **Husenko A. 2013.** Development of industrial and innovation clusters in Europe: Status and Prospects. Bulletin of Social and Economic Research. Vol. 1 (48), 202-208. (in Ukrainian).
25. **Oleynichuk-Merta A. 2010.** Development of innovation in the countries of Central and Eastern Europe. Bulletin of the National University "Lviv Polytechnic". № 684, 10-13. (in Ukrainian).
26. Open statistical basis of the State Statistics Service of Ukraine. Access mode: [http:// www.ukrstat.gov.ua](http://www.ukrstat.gov.ua). (in Ukrainian).
27. **Bublyk M.I. 2015.** Technogenic damage to the national economy: economic evaluation and basis for public regulation: Monograph. Lviv: Publishing Lviv Polytechnic National University, 420. (in Ukrainian).
28. **Taraskina A.S. 2013.** Fuzzy Clustering on the modified method of C-medium and its use for processing microchip data. Problems of intellectualization and quality of automation systems. № 13, 217-228. (in Ukrainian).
29. **Fedulova L. 2013.** Regional innovative systems of Ukraine: the state of forming and development in the conditions of integration calls. Kyiv: Institute of Economics and Forecasting of NASU. 724. (in Ukrainian).
30. On Amendments to the Law of Ukraine "On state regulation of activities in technology transfer: Law of Ukraine on 02.10.2012 №47. Access mode: [http:// www. zakon.rada.gov.ua](http://www.zakon.rada.gov.ua) (in Ukrainian).
31. **Kuzmin O., Shpak N. and Pyrog O. 2016.** Model of sustainable development of the national economy of Ukraine: assessment of current state and prospects of development. ECONTECHMOD. An international quarterly journal. Vol.5, No.1, 43-50.
32. **Kuzmin O., Pyrog O. and Melnik L. 2014.** Transformation of development model of national

- economies at conditions of postindustrial society. ECONTECHMOD. An international quarterly journal. Vol.3, No.2, 41-45.
33. **Stativka N.V. 2013.** State provision of innovative potential of the region. Access mode: <http://www.kbuapa.kharkov.ua/e-book/db/2013-2/doc/1/01.pdf>.
34. **Verhun B. 2014.** Adapting international mechanism for state support of innovative clusters. Collection of scientific papers of Kyiv National University named after Taras Shevchenko. Vol. 1 No 42, 36-40. (in Ukrainian).