Print ISSN: 1738-3110 / Online ISSN 2093-7717
http://dx.doi.org/10.15722/jds.16.3.201804.5

A Study on the Distribution of Information and High Technology Clusters : Kazakhstan's Experience

Anel A. Kireyeva*, Nazerke A. Abilkayir**, Alexandr A. Tsoy***

Received: January 15, 2018. Revised: February 19, 2018. Accepted: April 15, 2018.

Abstract

Purpose – This study aims to identify of prospective areas for the formation of information and high technology clusters, and propose the new distribution of Kazakhstan's regions according to the innovative development and the ability to perceive IT products.

Research design, data, and methodology – The application of scientific methods in this research will allow to systematize the available data, from both a theoretical and empirical perspective. In addition, the authors proposed methodological approaches, which have a three-tiered gradation: macro-level, meso-level and micro-level.

Results – This study confirms the importance of using of proposed methods and its application for real data in order to the formation of IT and high technology clusters. Further, the obtained results allowed identifying of the distribution of Kazakhstan's regions by innovative development and specialization with using of HHI indexes.

Conclusions – According to the results of this theoretical and empirical study proved that distribution of the regions of Kazakhstan and results of HHI indexes shows the power of the agglomeration effect. In addition, according to the conducted survey, we conclude that in Kazakhstan there are sufficient organizational and economic opportunities, trends and conditions for the formation of IT and high technology clusters.

Keywords: Regional Development, Distribution, Innovation, Information Technology, Green Economy.

JEL Classifications: O31, R11, R12.

1. Introduction

Today many countries, including Kazakhstan, recognizes the importance of innovations and their sources. Actually, from the innovations depends on the future success of business, and many countries recognize the importance of promoting high technology that will ensure the transition to a new stage of industrial revolution "Industry 4.0". "Industry 4.0" involve the use of new methods of organizing innovation processes. Such countries, like USA and EU allocate large funds for the implementation of concept "Industry 4.0" (particularly for the development of IT industry, high and green technologies). These countries see concept of "Industry 4.0" mainly from the point of view of increasing performance and application of energy saving technology (i.e., green IT). This will lead to the formation a new competitive environment and to fundamental changes in many regional and cluster polices.

In Kazakhstan, clusters formed based on the old industrial specialization of the regions or by integration of similar production chain of enterprises. Such cluster policy is strongly reminiscent of planned policy, and sometimes even on mechanisms of path dependency. All this requires the establishment of necessary balance in the combination of the two approaches – smoothing and stimulating of the state is able to reduce the impact of negative factors and to accelerate the development of high technology.

In this context, it becomes apparent that to achieve the effect of implementation of the concept "Industry 4.0" required forming of new platform. The role of such new platform can take of IT and high technology clusters. Today, the successful functioning of IT and high technology clusters,

* First and Corresponding Author, Institute of Economics of the Ministry Education and Science of RK, Kurmangazy 29, 050010 Almaty, Kazakhstan.
Tel: +7-701-690-0466. E-mail: anele19@mail.ru
** PhD Student, KSPH, Utepov 19a, 050060 Almaty, Kazakhstan. Tel: +7-701-880-06-24. E-mail: abilkaiyr.nazerke@gmail.com
*** Director, JSC Ayattranstrade, Kabdolova 16, 050062, Almaty, Kazakhstan. Tel: +7-727-328-75-74, E-mail: alt-kct@mail.ru

creating a unique opportunity to own markets in the era of information revolution and the global digital space. Unfortunately, the basic directions of spatial priorities for development of IT and high technology clusters in Kazakhstan has not investigated yet. Thus, this research will try to expand the conceptual and methodological views in this area

The reference theoretical and methodological source of this research are scientific and practical developments of foreign and national scientists in the field of management of processes of spatial economy, development of IT, digital and green technologies. The study of these sources made it possible to develop the theoretical context and methodological support of this study.

New trends of spatial development of innovations, digital and green technologies in most cases have a single scientific or industrial base. Moreover, the successful development of high-tech sectors can guaranteed if the scientific base allows building a regional policy not specialized type, but differentiated type. Problems of spatial development according to the differentiated approach studied in the works of foreign scientists such as Romer (1986), Krugman (1991), Granberg (2000), Rogers (2002) and Zubarevich (2009). The development of information technology (IT) and increasing role of information society considered in the works of the following scientists Lu (1999), Wever (1999), Stam (1999), Gruber (2001), Singh (2008), and Kireyeva (2016). The development of energy efficient technologies and green economy investigated in the works of the following scientists Bobylev (2009), Zakharov (2009), Porfiriev (2012), and Yessekina (2015).

However, in last scientific researches this important problem have not considered as a separate research. Therefore, the proposed scientific research is especially important now. Since, this study aims to identify of prospective areas for the formation of IT and high technology clusters, and propose the new distribution of Kazakhstan's regions according to the innovative development and the ability to perceive IT products.

The study divided into the following sections. The section 2 proposes to consider the theoretical aspects of the formation of IT and high technology clusters. Section 3 sets out the methods of scientific research. Section 4 presents analysis and estimation results. Section 5 is a concluding part.

2. Theoretical Background of the Formation of IT and High Technology Clusters in the Spatial Context

In scientific literature widely recognizes the fact that development of “high-tech” technologies, in developed and developing countries, need to identify the driver, i.e., “growth pole” for have well-thought-out regional policy (Krugman, 1991; Fujita & Mori, 1997; Fritsch & Mueller, 2004; Zubarevich, 2009; Kireyeva & Nurlanova, 2013). The tools and mechanisms for realization of effective regional policy are different.

The concept of potential “growth poles” developed originally for the sectoral structure of the economy, i.e., its basis was the idea that the leading sectors are able to extend their capacity in backward regions. Some scientists described polarization of the space around “growth poles”, which based on the effect of dominance (Krugman, 1991; Fujita & Mori, 1997). This theory of “growth poles” actively influences the surrounding space, activating it and changing in accordance with their own interests. This principle applies not only to individual economic agents, but also between different sectors of industry. According to Granberg (2000), “growth poles” and “axes” of development form a spatial frame of economic growth for more developed regions.

Other researchers considered clusters as “growth zones” or “growth poles”, which can be geographically concentrated and typically inside the agglomeration area (Steiner, 1998). The clusters are not only related and supporting industries. Rather related and supporting institutions, which become more competitive based on their association (Bergman & Feser, 1999).

Further, the concept of growth poles developed and distributed to other elements of the economic space. The study of “diffusion of innovations”, which to provide a multiplier effect on the development of the agglomeration and located geographically close territories. The main growth factor in the theory of agglomeration effects is accumulation of industrial activity in certain regions, which gives a prize to companies by increasing their size or from positive externalities (Romer, 1986; Zubarevich, 2009). They attributed of the emergence of agglomerations to the random factor or connected with the concept of increasing returns to scale. In the framework of theory of “diffusion of innovations” noted that any development arising in “growth pole”, extended to the periphery (Rogers, 2002; Kireyeva, 2016). Diffusion of innovations is a process by which an innovation transmitted through distribution of information by channels. Thus, “growth pole” and periphery at any spatial level connected by flows of distribution of information.

Some scientists note that “growth pole” is agglomeration, which concentrated geographically allocated intense innovation processes (Bespalov, 2005; Gerganov, 2013). They noted that those centers and habitats of economic space, where there are enterprises of the leading industries or cluster structures become poles of attraction of factors of production, since they ensure the most effective use of them (Bespalov, 2009). This leads to the concentration of active companies and the formation of “growth poles”. Thus, “growth pole” created in order to boost economic activities in backward periphery areas.

More researches focus on the impact on the spatial

structure of the information technology (IT), green economy and high-tech industries (Lu, 1999; Wen, 2003; Kireyeva 2016). An important place occupied researches in the field of explain the nature of the relationship between the factor of high-tech production and agglomeration. Thus, most of the leading experts in the field of cluster development agree that concept of "growth poles" should include a set of four elements (Saxenian, 1993; Storper, 1997; Steiner, 1998; Broekel & Brenner, 2011):

- Geographical and resource conditions of the territory;
- The presence of rapidly developing industry in the region (the most promising and least costly for a particular site).
- Stable functioning of the enterprise (for basic industries in the region) and the availability of infrastructure;
- The presence of various development programs in the region (implemented in the region and suitable for further development).

Some scientists note that the transition to a green economy based on "growth poles" is possible subject to compliance with the following principles (Bobylev & Zakharov, 2009; Porfiriev, 2012):

- Eco-efficiency (maximization of the useful properties of goods and services while minimizing the impact on the environment throughout the life cycle of products);
- Resource efficiency (management decisions, taking into account the need to preserve natural resources);
- Unity (the coherence of all subjects of the national economy, participating in the development process: business, education, health, etc.);
- Training and formation of environmental culture in the business and among the population.

In addition, some researchers argued that active involvement of state and local government through a range of mechanisms in relation to cluster policy have a positive impact on spatial processes of high-tech clusters (Lu, 1999; Wever & Stam, 1999; Kireyeva, 2016). Further, scientists in several publications noted that the state's role in supporting the development of high technology clusters based on "growth poles" should be for the long term. The promotion of "growth poles" is impossible without state assistance, including for the purposes of lifting depressed regions to the average level that requires special attention.

In the 2000s, appeared relevant scientific works dedicated to the dissemination of mobile communication in different countries (Gruber, 2001; Kshetri & Cheung, 2002; Comer & Wikle, 2008; Singh, 2008). Among these works, special importance is given to the distribution processes in developing countries (India, China, Eastern Europe), which have large consumer markets and a high rate of absorption of new IT products. It should be note that the distribution of linkages and IT products leads to increased standard of living in the most deprived areas and leads to the leveling of regional development (Gruber, 2001; Kshetri & Cheung, 2002).

At the same time, scientific works devoted to the modeling of cluster process IT development and green economy in the CIS countries are very rare (Bobylev & Zakharov, 2009, Yessekina, 2015; Kireyeva, 2017). Although the saturation level of IT in Kazakhstan is one of the highest in the CIS. Almost in all regions of Kazakhstan developed IT products, but the maximum level and pace of diffusion in the propagation period differed significantly. In the changing industrial environment of "Industry 4.0" is planned full integration of the digital ecosystem, which will use green IT. For example, use embedded power saving IT products to reduce energy consumption and increase uptime.

In this regard, to achieve the effect of the implementation of the concept of "Industry 4.0" requires the formation a new policy of regional development, taking into account the priorities for the transition of Kazakhstan to a "green" economy. However, it is very important to develop of innovations based on the principles of "green economy", which focused on the distribution of information and high technology between actors.

It should suggest hypotheses that the most of important tools is to establish regional policy through the creation of IT and high technology clusters, which play a very important role as "growth poles" – to provide a multiplier effect on the development of the agglomeration and located geographically close territories or periphery. It is advisable to start the development by finding potential "growth poles", which can play the role of translators of high technology in the broad periphery. These functions can take of IT and high technology clusters as growth poles, aimed at the distribution of high technologies and knowledge on the wide periphery based on the principles of "green economy".

The aim of this research is to identify of prospective areas for the formation of IT and high technology clusters in Kazakhstan, and propose of the new distribution of Kazakhstan's regions according to the level of innovative development and the ability to perceive IT products. The solution to the aim of this research requires development of scientifically methodological approaches for identification and formation of IT and high technology clusters. The chosen methodological approaches will allow for a reliable and formal analysis of the dynamics of innovation and IT processes in the regions on the way to Industry 4.0. Therefore, in the next section of this study we offer methods.

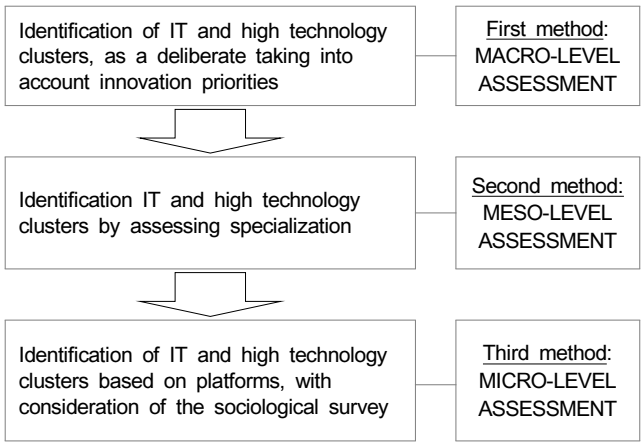
3. Methods

In this study, we used some scientific methods of research, method of strategic planning and managing. The scientific method investigates phenomenon, acquiring new knowledge, or correcting and integrating previous knowledge (Goldhaber & Nieto, 2010). These scientific methods intended to be as objective as possible, to reduce biased

interpretations of results. There are some difficulties in the understanding of the declared methods. However, these scientific methods often presented as a fixed sequence of steps, they better considered as general principles (Gauch, 2002).

In foreign practice have gained experience in the identification and formation of high-tech clusters, which allows detecting the location criterion of IT and high technology clusters strengths and weaknesses. Very often, such clusters are set up as “growth poles”, which aimed at the distribution of intellectual technologies and knowledge on the wide periphery.

Thus, the proposed methodological approaches are integrated and formalized, covering all stages of the planning of IT and high technology clusters. The use of these approaches allows to take into account all possible positive factors and negative factors hampering cluster development. Further, it seems appropriate to present in visual form all of methodological approaches (<Figure 1>).



Source: compiled by the authors.

<Figure 1> Methodological approaches for the identification and formation of IT and high technology clusters

The above-mentioned methodological approaches for the identification and formation of the IT cluster proposed to divide into two main groups:

- Quantitative evaluation involves the calculation of the indicators according to the available statistics from the available resource base. The main purpose in the quantitative evaluation is to identify promising regions for further clusterization. Quantitative evaluation involves the analysis of the dynamics of innovation and IT processes based on a set of indicators.
- Qualitative evaluation involves gathering information from various experts in conducting case studies and statistical data processing. Qualitative assessment identify regions prospective for clustering based on surveys and expert assessments. A study is credible if interviews conducted directly with representatives of authorities and business structures (Markov et al., 2009). Methodological approaches qualitative assessments allow more objectively and accurately identify weaknesses in the planning and implementation of cluster policy.

It should conclude that we identified methodological approaches, which have a three-tiered gradation: macro-level, meso-level and micro-level. In our research under the three-tier gradation should understood as a set of methods for contributing and defining the prerequisites for their further planning.

3.1. The Method Macro-Level Assessment of the Possibilities of the Formation of IT and High Technology Clusters

The result of this analysis is the new distribution, i.e., a bar rank of the regions in which they are the combination of the selected parameters are equidistant from each other. Each of them assigned an ordinal grade or a number corresponding to its place in the overall ranking. The most preferred object, usually assigned to the first position. Based on rating and sampling the absolute values of the indicators grouped.

The basis of our study indicated the need of formation of “growth poles” taking into account of innovation processes. The purpose of the rating analysis of the regions is to determine their potential. The emphasis of the analysis will focus on the identification of innovative benefits. A great influence on the innovative competitiveness of the region have a huge number of factors: manufacturing, resource, investment, social, consumer, environmental. Each factor includes a set of indicators determining the impact on innovation attractiveness of the territory.

In the framework of our research in the context of existing evaluation methods, we proposed integrated assessment methodology that takes into account the territorial factors. The proposed methodology is calculation a composite integral index of investment attractiveness, which influenced by many individual factors and measured by appropriate indicators.

The next step in the calculation is that for the lead region, the corresponding parameters of other regions calculated according to the formula below:

$$C_X=(I_X/Imax)*100\% \quad (1)$$

where X is the number of region;
I_X is the index value for region X;
Imax is the index value for the master region;
K_X is the percent age ratio of the parameter value in the X-th region to the leading region.

It should be note that the rating level of innovative development of region lies in the range from zero to 100%. Accordingly, the higher value of region is causing the higher

region's place in the ranking of innovative development.

3.2. The method of Meso-Level Assessment of the Possibilities of the Formation of IT and High Technology Clusters

Today Kazakhstan IT-market have the convergence of communication networks based on new types of devices and technologies. The demand of convergent services mainly due to the rapid transition to a new industrial revolution “Industry 4.0” is constantly increases in the world. Kazakhstan’s technological platforms are inferior to the advanced experience of developed countries, including China, USA and EU. These countries have advantages that are associated with the presence of mainly supported by the government an adequate infrastructure base, a stable institutional infrastructure and a favorable investment climate. For some countries, especially for the newly industrialized economies of Asia (Taiwan, Korea, Singapore) – cluster approach become “growth pole” by enhancing national economic model based on the transition from an export-oriented policy to a new policy of development of IT and high technologies. It is very important to establish cooperation and develop of innovations, which focused on the distribution of information and high technology between actors.

Therefore, many developed countries began to develop a comprehensive program for integration of information systems in various sectors, i.e., centralize multiple virtual data centers, and using the capabilities of IT industry (Storey, 2006).

The world practice proves that strategic directions of building high-tech clusters are:

- Conduct research, development and commercialization of the results;
- Development of IT infrastructure and creation of IT industries, supporting the development of green IT;
- Increasing the technological level of the domestic system of social assistance (e.g., development of new regional centers of high medical technologies);
- Carrying out training, retraining and advanced training of scientific personnel and specialists;
- Assistance in development of cooperation with the technological platforms, the formation of consortia, and the implementation of joint educational programs.

In recent years, in Kazakhstan increased a number of innovative technologies appears in the field of social healthcare. For example, in some regions of Kazakhstan used of new technologies to facilitate the work of practicing doctors and the lives of their patients. Actively used mobile diagnostic devices that help to regulate the ratio of the number of doctors and patients, especially in those regions where there is a significant lack of medical institutions. In addition, the electronic passport of the health of citizen of the Republic of Kazakhstan is one of the components of the health information systems platform, through which it is possible to ensure the continuity of medical care, the automated collection of complete and accurate information

Nevertheless, the healthcare market cannot be without active introduction of IT and digital technologies. It is require the introduction of computerized physician order for medication ordering and electronic prescription to patients could gain online access to their medical records. These new types of medical services especially needed in such a large country as Kazakhstan.

Therefore, the key factor in the success of digital transformation is the development of IT culture at many institutions and responding to the development of human capital (skilled IT specialists). Branch enterprises need to have open access to the elements of “Industry 4.0” – mobile devices, the cloud, augmented reality (smart gadgets), geolocation (location), advanced interaction interfaces of the individual and the computer, 3D printing, personification of the client profile.

Some scientists argue that specialization and concentration (activities in the regions), in fact, represent two sides of the same process (Aiginger & Rossi-Hansberg, 2006; Rastvortseva, 2013). Thus, specialization is the result of regional division of labor, which reflects the degree of concentration of certain industry in any territory (i.e., the distribution of its shares in the regions). In our research study, we decided to consider the data of IT industry in the regional context. The agglomeration effect is economic benefits of territorial specialization, which contributes to the emergence of competitive clusters, which concentrates the economy in this area (Mirolyubova, 2013).

We suggest that a comprehensive sampling of the potential of IT and high technology clusters should made using modifications of indicators for assessing sectoral specialization taking into account territorial specificity, i.e. the diversity of the regions of Kazakhstan. This will allow identifying the most promising regions (“growth poles”) to embed of IT and high technology clusters based on the study of various statistical data. As a methodological assessment tools for industry specialization, we offer to use the following indexes:

1) Herfindal – Hirshman Index (HHI) – is a measure of the specialization in the region and shows the influence of agglomeration economies in the region. For calculations, we use the aggregated index of HHI (IJHHI), which reflected the level of specialization of the region in IT industry. Please see below formulas (2) and (3):

$$IJ_{HHI} = (V_{IT}/V_{GRP}*100\%)^2 \quad (2)$$

Where J – region;
V_{IT} – gross value added of IT industry in the region;
V_{GRP}–gross value added of the region;
IJ_{HHI}–index HHI for J-th region for the IT industry.

2) Aggregated index of HHI (IHHI) represent an average of individual indices of each region:

$$I_{HHI} = \sum^{n}(IJ_{HHI})^2 \quad (3)$$

Where n – number of regions;
IJ_{HHI}–index HHI for J-th region for the IT industry;
I_{HHI}–aggregated index of HHI.

3.3. The method Micro-Level Assessment of the Possibilities of the Formation of IT and High Technology Clusters

At this stage, it is assume assessment of particular microclimate on the identification and formation of IT clusters, involving the analysis of possibilities of clustering infrastructure. The aim of this methodological approach is to study of organizational and economic opportunities of the formation of IT and high technology clusters in the near future.

As the methodological tools of evaluation, we have decided to allocate:

1) Sociological research and data processing (questionnaire) – it is assumed the assessment is required to obtain a complete picture of the functioning of public opinion on the organizational and economic opportunities of the formation of IT and high technology clusters (needs, interests and orientation). Sociological information will be obtain through questionnaire survey, which is easy to quantitative analysis and interpretation after data processing. As part of our research will be a sociological survey conducted by questionnaire respondents of infrastructure facilities of Kazakhstan.

2) To identify the factors external and internal environment, opportunities and threats for the formation of IT and high technology clusters based on infrastructure facilities using the method of strategic planning and managing. The method of expert evaluation is widely used in the study of strategy and management (for example, SWOT-analysis). In our study, will be proposed strengths, which will provide opportunities for the establishment of clusters, as well as weaknesses that will negatively affect their appearance.

4. Analysis and Results

The main aim of this assessment is to determine the level of innovation and IT development for each region of Kazakhstan to justify the need and the formation of clusters. Today, in Kazakhstan increased territorial differentiation, which increasingly exacerbating the problem of interregional economic dimensions. Thus, in our scientific study, we try to identify and assess of the territory's potential should be carried out in stages. This will clarify the potential of the region to form IT and high technology clusters at an early stage. In General, qualitative assessment of the regions of Kazakhstan is impossible without the use of basic statistics and macroeconomic indicators.

Further, it seems expedient to make an assessment using the previously proposed methodological tools. In the result, the distribution of innovations over information and high technology clusters will be highlighted. The complete results and the statistical details of the analysis can be found in <Table 1>.

<Table 1> Distribution of regions of Kazakhstan in terms of innovative development in 2011 and 2016

No.	Region of Kazakhstan	Rank, in 2011	Rank, in 2016
1	Akmola	11,25	23,59
2	Aktobe	17,47	17,98
3	Almaty	10,55	18,05
4	Atyrau	31,34	46,49
5	East Kazakhstan	13,75	32,02
6	Zhambyl	13,36	24,02
7	West Kazakhstan	10,89	21,56
8	Karaganda	25,69	30,28
9	Kostanay	18,70	25,48
10	Kyzylorda	26,08	15,57
11	Mangystau	13,27	41,83
12	Pavlodar	29,17	29,30
13	North Kazakhstan	10,65	25,74
14	South Kazakhstan	34,94	27,00
15	Astana city	26,07	57,83
16	Almaty city	51,93	76,05

Source: Statistical Yearbook of the Republic of Kazakhstan by the Committee for statistics (2017)

The distribution of Kazakhstan's regions in terms of innovative development allowed us to draw the following conclusions.

Firstly, the region leader in 2016 – Almaty city, which forming about 18,2% of nationwide capacity. It should presented as a hypothesis that Almaty city is the financial, economic and research center, which generates knowledge for other industrial regions. Thus, Almaty city acts as a "growth pole" that have a multiplier effect on the development of the metropolitan area and geographically close areas.

Secondly, Astana city in 2016 engaged second place (with rank 57,83), which connected with the preparation and holding of the international specialized exhibition "EXPO-2017". This exhibition has become a powerful breakthrough in the innovative development and green economy of Kazakhstan. In particular, works carried out in three main projects:

- The project "Astana Green City" – in the field of energy efficiency and renewable energy (low carbon development);
- The project "Astana Mobility" – in the field of renovation

and improvement of the quality of transport infrastructure and logistics;

- The project "Welcome to Astana" – in the field of unification of the infrastructure of tourist business and services in accordance with international standards.

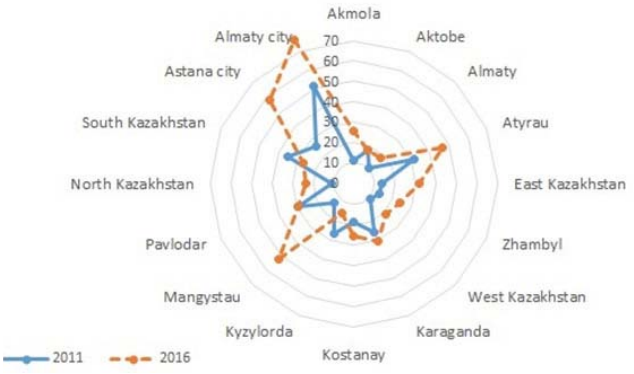
Thirdly, according to the rating of indexes of innovative development in 2016 - medium specialized five regions of Kazakhstan: Atyrau, Mangistau, Karaganda, East Kazakhstan and Pavlodar.

The implementation of e-health in the Republic of Kazakhstan by 2020 should provide an opportunity to obtain timely, relevant, reliable information that provides a safe, fair, quality health-oriented system for the patient. The main element in the development of e-health will be the electronic health passport, which ensures the storage and exchange of data on the health of the patient, and the implementation of the set goals of the health system aimed at improving the accessibility and quality of health services and improving management at all levels.

From 2018, a pilot project is expect to transition to paperless management of medical records in three regions of Kazakhstan: Astana, Karaganda and North-Kazakhstan. In addition, in 2018, the introduction of the electronic health passport began in Kazakhstan. It will contain all the information about the patient: early transferred diseases, chronic diseases, possible allergic reactions to medicines, test results.

The classification of all regions of Kazakhstan, depending on the distribution of the indexes of innovative development can see in <Figure 2>.

The distribution of the regions of Kazakhstan according to the indexes of innovative development shows that there is some promise for bringing together innovative enterprises and creation of conditions for formation. We should conclude state that in the regions of Kazakhstan there is a potential for the development of the innovation sector and the opportunity to create a successful cluster project.



Source: compiled by the authors.

<Figure 2> Distribution of structural of innovative development of Kazakhstan's regions in 2011 and 2016

Further, we calculate indexes of specialization (HHI). Thus, we identify which regions are most promising for the formation of IT and high technology clusters. This index is widely shows the effect of the agglomeration process. Initial data for calculation taken from the statistical compilations of Kazakhstan. The complete results of the distribution of Kazakhstan's regions by HHI indexes can be found in <Table 2>.

<Table 2> The distribution of Kazakhstan's regions by HHI indexes of specialization in 2011 and 2016

Region of Kazakhstan	HHI indexes of specialization	
	2011, in shares	2016, in shares
Akmola	0,0001	0,0001
Aktobe	0,0771	0,0031
Almaty	0,0003	0,0001
Atyrau	-	-
West Kazakhstan	0,0001	-
Zhambyl	0,0001	0,0001
Karaganda	0,0012	0,0046
Kostanay	0,0001	-
Kyzylorda	-	-
Mangystau	-	-
South Kazakhstan	-	0,0009
Pavlodar	-	0,0016
North Kazakhstan	0,0053	0,2514
East Kazakhstan	0,0001	0,0001
Astana	0,0013	0,0211
Almaty	0,0825	0,0482
Aggregated HHI	0,1681	0,3313

Source: Statistical Yearbook of the Republic of Kazakhstan by the Committee for statistics (2017)

The distribution of Kazakhstan's regions by HHI indexes allowed drawing the following conclusions.

Firstly, according to the calculations, the most specialized region in the field of IT – is Almaty city. This is due to the fact that in Almaty city are more number of IT companies (Logycom, Asia Soft, Real Soft, etc.), and also has the best utilization of IT by the population, research capacity and high level of educated population. In particular, in Almaty city works JSC "International IT University", which actively engaged in research in the field of digital and green IT. It should note that in Almaty city in 2016 (according to the HHI index), the level of development of IT has slowed down a bit compared to the same period in 2011. This is primarily due to the drop in the national currency and the decline of sales in the consumer sector.

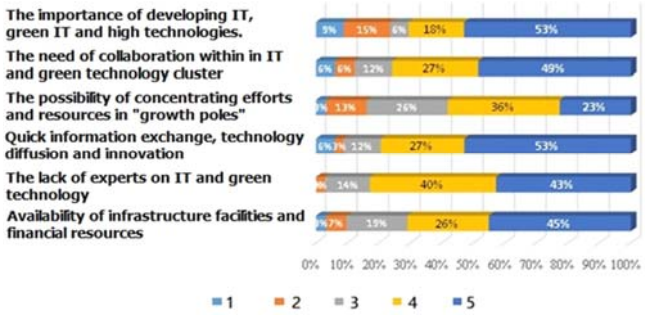
Secondly, according to the calculations of medium specialized in the IT-industry are the three regions of Kazakhstan – Astana city, North Kazakhstan and Karaganda.

This is because the national company JSC Kazakhtelecom is actively engaged in the implementation of projects to create the backbone of IT network.

Thirdly, aggregated indices HHI show that the situation on IT-market of Kazakhstan is improving in 2016 (aggregated index HHI = 0,3313) compared to the same period in 2011 (aggregated index HHI = 0,1681). This is logical, as the total volume of production in IT sector for 2016 has increased almost in 2 times in comparison with the same period in 2011.

In sociological survey involved: 426 enterprises engaged in R&D, 260 companies in the IT sector, 37 companies in the development of green energy. The answers to the questionnaire provided 68% of the respondents. To analyze the factors influencing the possibility of implementing and adapting the cluster in the development of joint project between IT and high technology in 2016, we have conducted expert interviews within sociological research. The majority of the experts considered the possible formation of IT and high technology clusters in Kazakhstan.

The results of survey regarding the prospects of the formation of IT and high technology clusters (needs, interests and orientation) in Kazakhstan presents in <Figure 3>.



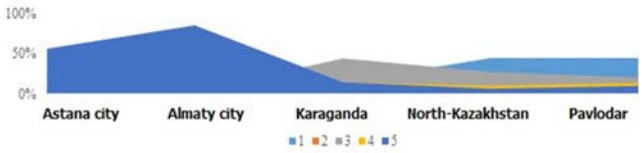
Source: compiled by the authors

<Figure 3> The results of survey regarding prospects of the formation of IT and high technology clusters

According to the presented data, it is see that about 74.3% of respondents rated the importance of the formation of IT and high technology clusters for 4 and 5 points (respectively). Should pay attention to the fact that the majority of experts noted the importance of developing the IT, green IT and high technologies by 5 points (53%). In addition, a large number of respondents noted the importance of rapid exchange of information, technology and innovation by 5 points (53%). The lowest degree of attractiveness among respondents the possibility of concentration of efforts and resources in “growth poles”, because not all regions of Kazakhstan have the potential for development.

The final part of the questionnaire aimed at the study of organizational and economic opportunities of the formation of IT and high technology clusters in the regions of Kazakhstan. Therefore, the task of the next set of questions survey was to identify which of the regions of Kazakhstan is the most promising for formation of IT and high technology cluster.

It is noteworthy that for the survey we chose regions that received high grades in sections 3.1. and 3.2. Thus, we selected five regions of Kazakhstan is Almaty city, Astana city, Karaganda, North Kazakhstan and Pavlodar. <Figure 4> shows the most promising regions of Kazakhstan for the formation of IT and high technology clusters.



Source: compiled by the authors.

<Figure 4> The most promising regions of Kazakhstan for the formation of IT and high technology clusters.

As a result, clearly defined two regions, which the most sought after preference for the formation of IT and high technology clusters among the respondents - Almaty and Astana cities. Further, the respondents identified the following regions – Karaganda, North Kazakhstan and Pavlodar.

Further, it is propose to consider the analysis of the possibilities and limitations of the formation of IT and high technology clusters based on infrastructure of Kazakhstan. The analysis will identify strengths and weaknesses (<Table 3>).

The results of the SWOT analysis allowed drawing the following conclusions:

Firstly, it is necessary to improve legal policy (adoption of amendments to existing legislation, to resolve the problems of enforcement in the sphere of protection of intellectual property rights and technology commercialization and the development of normative legal acts).

Secondly, the promotion of small and medium enterprises in the development and assimilation of innovation (preferential loans scientific research, the development of venture financing).

Thirdly, deliberate development of IT and high technologies through support from the state In particular, the development and introduction of complex decisions for automation of technological and business processes; production of multimedia technologies and electronic products; creation and development of telecommunication systems, storage centers and data processing; provision of services for development of computer-aided design and manufacturing processes, etc.

<Table 3> SWOT-analysis opportunities and constraints the formation of IT and high technology clusters

Strengths	Weaknesses
1. The presence of techno parks, techno poles, research laboratory, research institutes and universities. 2. A strong digital Foundation that enables companies to make full use of digital technology for competition and innovation (digital TV, data centers, e-Commerce platform, digital payment system, etc.). 3. The possibility of using new alternative sources of energy, the emergence of "green technologies". 4. Understanding of system objectives and key directions for the development of digital technology and green IT. 5. Support to the economic development of the region and making as the leader among digital cities. 6. Creation of conditions for social development (education, healthcare, etc.).	1. Insufficient level of competition, the monopolistic nature of many sectors in the IT field, the opacity of procedures, equipment procurement and resource allocation. 2. Not perfection of legal policy in the field of management of the IT and green technology. 3. The low level of state support to fundamental and applied research in the field of IT. 4. Structural distortions of the IT market in the direction of equipment and hardware, to the detriment of software and IT services. 5. The shortage of qualified personnel, engineers and middle managers, scientific personnel. 6. Difficulties during the interaction between members of cluster. 7. The lack of modern tools of implementation of development of innovations and bring them onto the world market.
Opportunities	**Threats**
1. The demand for digital technologies, IT-products and IT-services are constantly growing in the world. 2. There is an exit on the regional markets (Customs Union, Central and Eastern Asia, the Caspian region, including the Caucasus, Western China). 3. Integration in the global development of IT-solutions based on 3D modeling, robotics, computational linguistics, artificial intelligence, the use of volumes of data (Big Data, Smart Grid), cloud computing and bio-informatics. 4. A stable macroeconomic environment and a favorable institutional environment. 5. The possibility of attracting foreign investment to projects within the cluster. 7. The growth of competencies of cluster members and the transfer of advanced technologies in the interests of transition to "Industry 4.0". 8. The possibility of transition of the domestic companies of IT and green energy to the world market.	1. The global digital market, the high level of global competition. 2. Limited access to investment funds, the lack of development of financial instruments, and the lack of venture capital funds. 3. High investment risks. 4. The lack of transparency and corruption in procurement procedures and resource allocation. 5. Fragmented landscape for IT (for example, the selective use of IT resources, duplication of efforts of cluster participants); 6. Real weak protection of intellectual property and lack of professional services in technology commercialization. 7. The impact of financial crisis on innovative development. 8. The lack of investment for infrastructure development of IT and high technology cluster.

Source: compiled by the authors.

Fourthly, the development of various groups of techno parks (technology parks, techno poles, business incubators and research laboratories). Such infrastructure will provide enhanced concentration of various scientific and technological inventions, and a formalized system of distribution of new technologies and knowledge.

Fifthly, improvement of personnel policy and training, retraining and training of scientific personnel and IT specialists.

5. Conclusions

This research marks a starting point for further research in the field of distribution of information and high technologies using of cluster approach, which aimed at optimizing the production process and rational use of energy. In addition, developed methodological approaches of analysis of innovation development and assessment of the level of specialization of IT-industry of Kazakhstan. It provides some suggestions for improvement of future studies dealing with this subject. In addition, the proposed methodological approaches are integrated and formalized, covering all stages of the planning of IT and high technology clusters. The use of these approaches allows to take into account all possible positive factors and negative factors hampering cluster development. The results obtained in this research can be apply in other countries on the way to "Industry 4.0" (for example, Russia, Belarus, Ukraine and others).

Based on these research findings of this paper, the practical implications listed below:

Firstly, it should be note that the concept of "Industry 3.0" included automation of individual processes and machines. While "Industry 4.0" is smart factory, which aimed at complete digitalization of all production processes and their integration into the digital ecosystem with the use of energy-saving technologies. Keeping with the previous literature, the present research determined by the novelty of the problem, concerning to establish regional policy through

the creation of IT and high technology clusters, which play a very important role as “growth poles” – to provide a multiplier effect on the development of the agglomeration and located geographically close territories or periphery. It is advisable to start the development by finding potential “growth poles”, which can play the role of translators of high technology in the broad periphery. These functions can take of IT and high technology clusters as growth poles, aimed at the distribution of information and high technologies on the wide periphery based on the principles of “green economy”. This work marks the development of IT and high technology clusters realized faster in the regions with the best conditions for the distribution of innovations. However, detailed analysis allow identifying of prospective Kazakhstan's areas that will ensure the transition to a new stage of the industrial revolution Industry 4.0. Thus, we identified methodological approaches, which have a three-tiered gradation: macro-level, meso-level and micro-level. In our research under the three-tier gradation should understood as a set of methods for contributing and defining of IT and high technology clusters.

Secondly, the distribution of Kazakhstan’s regions according to the final indexes of innovative development shows that the country has some promise for bringing together innovative enterprises and creation of conditions for clusterization. Taking into account the realities of Kazakhstani business and the current state of the elements of innovative infrastructure, we can state the fact that in the regions of Kazakhstan there is a potential for the development of the innovation sector and the opportunity to create a successful cluster project.

Thirdly, the distribution of Kazakhstan’s regions by HHI indexes has shown clearly the power of the agglomeration effect. Given the great length and diversity of the territories of Kazakhstan, agglomeration can become “growth poles” knowledge-based economy. However, many IT-companies or business structures that have close ties tend to deployed in certain geographic locations IT and high technology clusters. According to the calculations is clearly defined the most specialized region in the field of IT is Almaty city, forming about 70% of the total sales of IT products. The medium specialized in the IT-industry are the three regions of Kazakhstan – Astana, North Kazakhstan and Karaganda region.

Fourthly, according to the conducted survey, we note that in Kazakhstan there are sufficient organizational and economic opportunities, trends and conditions for the formation of IT and high technology clusters. It is very important that the formation of the IT cluster should happen in a natural way. Based on the foregoing and taking into account the obtained results one can suggest the formation of IT clusters in the following promising areas of Kazakhstan: Almaty city, Astana city, Karaganda and North Kazakhstan.

References

Aiginger, K., & Rossi-Hansberg, E. (2006). Specialization and concentration: A note on theory and evidence. *Empirica*, *33*(4), 255-266.

Bergman, E. M., & Feser, E. J. (1999). *Industrial and Regional Clusters: Concepts and Comparative Applications.* Morganton, WV: Regional Research Institute, West Virginia University.

Bespalov, V. A., Leontiev, V. B., Rygalin, D. B., & Mikitas, V. A. (2005). *Mechanisms of Creation and Functioning of the Establishment and Functioning of the High-Tech Clusters.* Moscow: Moscow Institute of electronic engineering.

Bobylev, S. N., & Zakharov, V. M. (2009). *Ecosystem Services and Economy*. Moscow: LEVKO.

Broekel, T., & Brenner T. (2011). Regional factors and innovativeness: An empirical analysis of four German industries. *Annals of Regional Science, 47*(1), 169-194.

Comer, J. C., & Wikle, T. A. (2008). Worldwide diffusion of the cellular telephone, 1995–2005. *The Professional Geographer*, *60*(2), 252–269.

Fritsch, M., & Mueller, P. (2004). Effects of new business formation on regional development over time. *Regional Studies*, *38*(8), 961-975. Retrieved January 5, 2018 from https://doi.org/10.1080/0034340042000280965

Fujita, M., & Mori, T. (1997), Structural stability and evolution of urban systems. *Regional Science and Urban Economics*, *27*(4-5), 399-442.

Gauch, H. G. (2002). *Scientific Method in Practice*. Cambridge, UK: Cambridge University Press.

Gerganov, D. F. (2013). Cluster networks as the basic structural element in the innovative economy. *Russian Journal of Scientific Publications*, *1*(16), 23-26. Retrieved January 5, 2018 from https://cyberleninka.ru/article/v/klasternye-seti-kak-bazovoe-strukturnoe-zveno-innovatsionnoy-ekonomiki‌ъ

Goldhaber, A. S., & Nieto, M. M. (2010). Photon and graviton mass limits. *Reviews of Modern Physics*, *82*(1), 939–979. Retrieved January 5, 2018 from https://doi.org/10.1103/RevModPhys.82.939

Granberg, A. G. (2000). *Bases of regional economy: textbook for universities*. Moscow: GU VSHE.

Gruber, H. (2001). Competition and innovation: The diffusion of mobile telecommunications in Central and Eastern Europe. *Information Economics and Policy*, *13*(1), 19-34.

Kireyeva, A. A. (2016). A theoretical assessment of the formation of IT clusters in Kazakhstan: Approaches and positive effects. *International Journal of Research in Business and Social Science, 5*(3),

54-65. Retrieved January 5, 2018 from http://dx.doi.org/10.20525/ijrbs.v5i3.286

Kireyeva, A. A. (2017). Identification of prospective areas for the formation of IT clusters in the regions of Kazakhstan: Methodological approaches and its approbation. *Problems of Development of the Territory*, *2*(88), 207-223.

Kireyeva, A. A., & Nurlanova, N. K. (2013). The problems of spatial modernization of the economy and new approaches to way out from crisis: Kazakhstan's experience. *Journal of Distribution Science*, *11*(3), 39-48.

Kshetri, N., & Cheung, M. K. (2002). What factors are driving China's mobile diffusion?. *Electronic Markets*, *12*(1), 22-26. Retrieved January 5, 2018 from http://www.electronicmarkets.org/archive/issues/volume-12/volume-12-issue-1/

Krugman, P. R. (1991). *Geography and Trade*. Cambridge, MA: MIT Press.

Lu, Y. (1999). Regional effects by the construction of Suzhou Industrial Garden. *Chinese Geographical Science*, *9*(4), 342–349.

Markov, L. S., Yagolnitser, M. A., Markova V. M., & Teplova, I. G. (2009). Institutional specifics, cluster models, and development of innovative meso economic systems. *Region: Economics and Sociology*, *3*, 3-18. Retrieved January 5, 2018 from https://elibrary.ru/item.asp?id=13021465

Mirolyubova, T. V. (2013). *Regularities and Factors of Formation and Development of Regional Clusters*. Perm: Publishing House NAT.

Porfiriev, B. N. (2012). Green economy: Worldwide trends and prospects. *Herald of the Russian Academy of Sciences*, *82*(4), 323-333.

Rastvortseva, S. N. (2013). *Development Management Processes of Specialization of Economic Activity in the Regions: Approaches of New Economic Geography*. Moscow: Ekon-inform.

Rogers, E. (2002). *Diffusion of Innovations* (5th ed.). New York: Free Press.

Romer, P. (1986). Increasing returns and long run growth. *Journal of Political Economy*, *94*(5), 1002–1037.

Saxenian, A. (1993). *Regional Networks: Industrial Adaption in Silicon Valley and Route*. Cambridge, MA: Harvard University Press.

Singh, S. K. (2008). The diffusion of mobile phones in India. *Telecommunications Policy*, *32*(9-10), 642–651.

Steiner, M. (1998). Learning with clusters: A case study from Upper Styria. *European Research in Regional Science*, *8*, 211–225.

Storey, D. J. (2006). Public policy measures to support new technology-based firms in the European Union. *Research Policy*, *26*(9), 1037-1057.

Storper, M. (1997). *The Regional World: Territorial Development in Global Economy*. New York: Guilford Press.

Wever, E., & Stam, E. (1999). Clusters of high technology SMEs: The Dutch case. *Regional Studies*, *33*(4), 391-400.

Yessekina, B. K. (2015). Problems of Decarbonization of the Economy of Kazakhstan. *Journal of Asian Finance, Economics and Business, 2*(3), 37-39.

Zubarevich, N. (2009). Regional development and regional policy in a decade of economic growth. *Journal of New Economic Association, 1*(2), 160-174.