Zhatkanbayev E.,
Abilgaziyeva A.B.

Stages of formation of innovation infrastructure: developed countries' and Kazakhstan's experience

In the rapidly developing world economic progress and development of the state as a whole is largely driven by the innovative potential of the country. In turn, the innovation infrastructure, which settles the direction of innovative development of the country, is a very complicated structure, the formation of which took more than a decade and still continues to sophisticate its elements. This article is closely studying the phenomenon of innovation and rapid development of its elements in the North Atlantic region, on the «homeland of innovations». This paper is based on the studies of Sh.Kungand and D.A.Kartsev: history and development of innovation infrastructure, general dynamics of the geographical spread of a new knowledge. Studies of Minat and Kovalev laid on the basis of this article, they outlined the three main stages of emergence of innovative infrastructure and development in the framework of the chronology of scientific and technological development, which describe not only emergence of individual elements, but also influence of the state regulations to them.

Key words: innovation infrastructure, innovation infrastructure development, science parks, business-incubators, innovations, venture capital.

Жатканбаев Е.Б.,
Абильгазиева А.Б.

Инновациалық инфрақұрылымның қалыптасу кезеңдері: дамыған мемлекеттер және Қазақстан тәжірбиесі

Қарқынды дамып келе жатқан әлемде экономиканың жақсаруы мен тұтастай мемлекеттің дамуы елдің инновациялық әлеуетінің негізінен де шарттасады. Өз кезегінде, елдің инновациялық даму бағытын белгілейтін инновациялық инфрақұрылымның қалыптасуы өте күрделі үрдіс. Инновациялық инфрақұрылымның бірнеше он жылдықтан астам тарихы бар, сонымен қатар, қазіргі күні де қарқынмен дамып келеді. Қазіргі уақытта ғалымдар инновациялардың Солтүстік Атлант аймақтарында қарқынды дамуының құбылысын зерттеуде және инфрақұрылымының элементтерінің пайда болу кезеңдерін қарастыруда. Ғалымдардың арасында Ш.Кунг пен В.Н.Карцев инфрақұрылымның тарихы мен дамуын зерттеген және жаңа білімнің географиялық таралуының жалпы динамикасын қарастырған. Бұл деректерді В.Н.Минат пен Ю.Ю.Ковалев егжей-тегжейлі толықтырған және ғылыми және технологиялық даму хронологиясы шеңберінде инновациялардың дамуы негізгі үш кезеңнен тұратынын айқындаған. Ғылыми мақалада жеке элементтердің дамуына сипаттама берілген, сондай-ақ мемлекеттік атқарушы органдардың әсері зерттелген.

Түйін сөздер: инновациялық инфрақұрылым, технопарк, бизнес инкубатор. инновациялық инфрақұрылымның қалыптасуы, венчурлық қаржыландыру.

Жатканбаев Е.Б.,
Абильгазиева А.Б.

Этапы формирования инновационной инфраструктуры: опыт развитых стран и опыт Казахстана

В динамично развивающемся мире экономический прогресс и развитие государства в целом во многом обуславливается инновационным потенциалом страны. В свою очередь, инновационная инфраструктура, которая задает направление инновационному развитию государства, весьма сложная структура, формирование которой заняло более десятков лет и продолжает интенсивно развиваться. Данная статья изучают феномен быстрого развития инновации и элементов его инфраструктуры в североатлантическом регионе, т.е. на «родине инновации». В статье рассматривается подход Ш. Кунга и Д.А. Карцева, которые изучили хронологию развития элементов инфраструктуры, проследили общую динамику географического распространения новых знаний. В основу статьи легли исследования ученых В.Н. Мината и Ю.Ю. Ковалева, которые выделили в рамках хронологии научно-технического развития основные три этапа, которые не только описывают развитие отдельных элементов, но и влияние государственных регулирующих органов на них.

Ключевые слова: инновационная инфраструктура, этапы формирования инновационной инфраструктуры, технопарки, бизнес-инкубатор, венчурное финансирование

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Zhatkanbayev E., *Abilgaziyeva A.B.

Al-Farabi Kazakh National University,
Kazakhstan, Almaty
*E-mail: aizhan.abilgaziyeva@gmail.com

STAGES OF FORMATION OF INNOVATION INFRASTRUCTURE: DEVELOPED COUNTRIES' AND KAZAKHSTAN'S EXPERIENCE

Economic growth in the XXI century was largely driven by scientific-technological progress and intellectualization of the manufacturing sector. According to the Global Innovation Index report the share of new technologies, products and equipment containing new knowledge and solutions, in developed countries account is about 70 to 85% of GDP growth [1]. Over the past twenty-five years the world economy shows a high level of intensity of inter-state movement of goods, technology and information, as well as growth of cooperation in the sphere of high technologies.

From the middle of the XX century scientific and technological progress deeply penetrate into various sectors of the economy, providing a significant improvement of the objects of labor. Constantly growing needs of humanity in the intensification of innovation lead to the emergence of knowledge-based methods and techniques to commercialize the technology as technological cooperation, transfer of technology, the concentration of research and development in the certain areas, and the overall integration of innovation. A key role is played by the formation of a full-fledged innovative environment with a developed infrastructure. Stimulating innovation to become the backbone of forced social and economic development of the regions and the state as a whole, by achieving synergy effects from the integration of science, education and industry.

According to the classic definition by Lundval and Nelson, «Innovation is a complex process involving a variety of actors: such as businesses, manufacturers of new knowledge, technology centers, which are connected by a variety of relationships, thus creating innovation infrastructure.» [2] The father of such approach should be considered K. Freeman, who in the late 80s. has introduced the concept of a national innovation system as «a complex system of economic entities and public institutions involved in the creation of new knowledge, storage, distribution, transformation to a new technology products and services consumed by society.» [3]

The review of the literature of Europe, North America and South-East Asia can help to learn and organize some basic points made in different years by different authors on the subject of innovation infrastructure emergence. The fact is that in some cases they are

almost identical, but some aspects are based on a different interpretation of the events.

So, Sh.Kung and D.A. Kartsev works mostly cover countries of the North Atlantic region. They identified the following stages of the development of innovation infrastructure elements in the region: 60 – 70 yy. of XX century, a decade when the majority of technology parks emerged in their «homeland» – in the United States and the emergence of the innovation process support structures in Western European countries – Britain, France and Germany. Then, in the 80 – 90s, began to form a «second generation» of technology parks in the US and Western Europe, there were parks and in countries where none existed before, such as Japan, China and other Far East countries, as a result, the previous diversity of « science parks « filled with new varieties [2].

However, this scientific approach did not take into account all prerequisites for the formation of innovation infrastructure in the North Atlantic region. Previous approach did not include the first experimental forms of integration of science and industry, embodied in a number of companies in Western Europe and North America in the late nineteenth century. This omission was largely eliminated in the works of V.N.Minat and Y.Y.Kovalev, who proposed to allocate the development of scientific and technological complex of the region into three basic stages [3, 4]. According to their approach first stage should define the processes of industrialization in developed countries at the late 19th and the first half of 20th century. The Industrial Revolution brought this period to a new form of the organization of applied research – industrial research centers and laboratories, in large enterprises prototype construction departments, which later laid the beginning of the industry science aimed at practical development. According to historical records, in 1878 the American company «Bell telephone company,» founded the first in the history of industrial laboratories in the United States. In Germany in 80s of the 19th century was organized the first Research Institute in the field of heavy engineering industry – «Keiser-Wilgelm geselschaft».

The second stage originated after the Second World War, and is characterized by a completely new forms of organization of science, based on the state defense orders. For the first time, these experiments have been tested and successfully implemented in Palo Alto (California, USA) based on the Stanford University of Technology. There, in 1951, opened the world's first scientific industrial park, later renamed as the «Silicon Valley». It was created for the implementation of the latest scientific and technical achievements in the field of electronic and aerospace industries.

The third stage is closely related to the diversification of different types of innovation and the emergence of new levers for implementation of scientific knowledge and high technology production. Since 1975 have been emerged new forms of innovative activity support as business incubators, innovation centers and innovation zones. A key aspect of this period was emergence of large-scale unions and associations merged into a single national network of various forms of innovative entrepreneurship. The most important associations that have emerged during this period include [5]:

• European network of Business Innovation Centres (EBN – European Business & Innovation Centre Network);

• British Association of Science Parks (UKSPA -The UK Science Park Association);

• Association of German business incubation centers and technologies (ADT – Arbeitsgemeinschaft Deutscher Technology);

• Association of Business Incubators Britain (UK Business Incubation);

• Technopolis Association of France (France technopole association);

• Association of University Research Parks of North America (USA and Canada) (AURRP);

• International Club Technopolis (ITC);

• National Association of Business Incubators US (NBIA). [2]

In the mid-80s. business incubators stared closely interact with the system of higher education and public research organizations in order to tap the enormous potential accumulated in the walls of these institutions and the commercialization of scientific research. Since the mid 90s, this model of business incubators was transformed into a technology incubator scheme. They began to build in the industrial parks near the universities and research organizations, and «nurture» high-tech companies, within certain industrial and technology clusters. Such as biotechnology, information technology, electrical technology and so on.

In turn, funding of scientific research is a base of innovation infrastructure, which provides the resources to support entire innovation process cycle: from research work to implementation and production of innovative products. It is based on state support of innovative activity of the governmental and local budgets, the business sector funds and individual investors. The elements of financial infrastructure

include: state development institutions, second-tier banks, venture capital funds, the various budgetary and non-budgetary funds, and others.

Global experience shows that the effective development of innovative economy is achieved through venture financing. This type of financing is becoming a kind of link connecting scientific and technical ideas with the sphere of production and consumption. It promotes innovation, greatly simplifies the access of innovation companies to sources of financial resources, increases the level of commercialization of scientific and technical products.

Current funding systems and state support of innovation activity formed by the legislations enacted in the mid-twentieth century by the US government. Before World War II, investments in the form of venture capital was primarily the sphere of influence of wealthy individuals and families. Only after 1945 did «true» private equity investments begin to emerge, notably with the founding of the first two venture capital firms in 1946: American Research and Development Corporation(ARDC) and J.H. Whitney & Company. One of the first steps toward a professionally managed venture capital industry was the passage of the Small Business Investment Act of 1958. The 1958 Act officially allowed the U.S. Small Business Administration (SBA) to license private «Small Business Investment Companies» (SBICs) to help the financing and management of the small entrepreneurial businesses in the United States. [8] In Europe, as compared to US venture financing started later – by the end of 1970's. In 1983 was created the European Private Equity and Venture Capital Association. Today there are more than 500 active members in 30 participating countries.[9]

By the end of the twentieth century, the production of high-tech products has become a whole industry of industrialized countries that contributed to the abrupt increase in the number of local entities innovative orientation. In 1996 there were more than 600 technology incubators only at the United States.[6] Today in the world there are more than 10,000 such organizations. A striking example of this can serve «Silicon Valley», a huge cluster, which is conducting research in the field of artificial intelligence and software.

Thus, formation of innovation infrastructure in the North Atlantic region is the result of the authorities' response to the need to reorient the economy to the industrial-innovative development path in order to accelerate regional economic growth through support for innovative entrepreneurship. By analyzing the composition of the innovation infrastructure facilities around the world, it is safe to say that a certain set of these organizations corresponds to the main stages of the innovation chain (from idea to commercialization of the product) at the level of regions and throughout the country as a whole. Nowadays, innovation infrastructure consist of following organizations

• scientific and research parks, performing the functions of conducting scientific research, the selection of commercially promising projects, building a team that can bring to them the finished product design;

• technology parks which involved in the commercialization of technologies developed;

• business incubators which provide space as well as access to the resources of the newly created small innovative enterprises;

• venture capital funds which provides the funding and resource support for the entire innovation cycle.

In Kazakhstan, the development of innovation infrastructure has dynamic character. Formation of infrastructure as a key element of the national innovation system, has its roots from adoption of the «Kazakhstan-2030» Development Strategy in 1997. It was the beginning of large-scale social and economic reforms in the country aimed at achieving long-term objectives primarily at development and competitiveness the domestic economy. In the same year enacted a law «On State Support of Small Business,» which have identified concepts such as: innovation, small business infrastructure, venture capital firms. Later, on July 3, 2002 enacted law «On innovation activity», defining the basic principles, forms and directions of realization of the state innovation policy. Subsequently, there was adopted the Law «On state support of innovation activity» in 2006, which identified importance of the development of the systems as «innovation infrastructure», «science park (Technopark),» «innovative project» «innovation grant». In 2003 it was developed and approved Strategy of Industrial and Innovation Development of Kazakhstan for 2003-2015 on the basis of which has adopted a program on formation and development of the national innovation system of the Republic of Kazakhstan for 2005 – 2015. [7]

Formation and development of innovative infrastructure in Kazakhstan is entirely supported by «Center for Engineering and Technology Transfer» JSC (CETT), whose sole shareholder is «National Innovation Fund» JSC, established in 2003. Since 2011, both joint-stock companies were merged into «National Agency for Technological

Development» JSC (NATD) [7]. The merger was carried out in order to optimize performance and eliminate redundant functions. It is assumed that NATD will act as a single operator in Kazakhstan for coordination processes in the field of innovation development of the country, providing a variety of measures of the state support to participants of the innovation system.

Currently, innovative infrastructure in Kazakhstan is consisting of 8 science parks. Their founders were JSC «CETT». 2 bln. tenge was provided from the republican budget for the formation of the statutory capital of the regional science parks. Also, elements of national innovative infrastructure are 4 construction bureaus, 21 commercialization offices and 5 regional commercialization offices and 2 international centers of technology transfer . Governmental support was provided to 577 companies and innovators were identified about 4,000 ideas and developments since 2010.[7]

Almost all infrastructure organizations in Kazakhstan have been created to provide various services for beginners and developing innovative projects not only to improve their viability, as well as to improve the competitiveness of the market. It can be concluded that in order to create innovation infrastructure is not only the realization of the full innovation cycle in a particular area, but also promote the development of businesses at different stages of its life cycle, which contributes to the development of national and regional economy as a whole.

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