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**SCIENCE CITY: INNOVATION AND EDUCATION (BY THE EXAMPLE OF DUBNA TOWN)**

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**Abstract**

In the article, the study of innovative development directions in Russia was undertaken. Statistical data, regulations have been used and analyses of published literature sources have been carried out. The possibility of creating a national innovation system through the formation of regional innovation-oriented development centers, techno-parks, technopolises, territorial clusters, science cities was investigated. A comparison of the territorial production complexes and regional innovation-oriented centers of development was has been carried out. The selection effectiveness of science centers as the points of innovation growth has been shown. Science cities are also the structure-forming settlements at the state level like megapolises, ancient cities, cultural and religious centers, wildlife sanctuaries and many other things.

**Keywords**

Innovative development — University — Technopolis — Cluster

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## Introduction

In modern Russia, much attention is paid to methods of stimulating the country's innovative development. We have tested different strategic approaches aimed on the acceleration of innovation in the country as a whole, based primarily on government regulation (national innovation system) in some regions, in some municipalities (science cities, special economic zones, closed administrative territorial units CATU)<sup>1</sup>. A number of authors consider the results achieved to be fairly ambiguous<sup>2</sup>. The article discusses the history of various organizational actions of the Russian Government devoted to innovative development in one science city - Dubna. The city is interesting by the fact that back in the Soviet Union, the elements of innovative development, implementation of the fundamental research results into production have been developing. The modern experience of innovation in Dubna is quite successful. The choice of Dubna as the object of research as a point of innovative growth is based on the fact that in the city almost all the options for structural arrangement aimed at stimulation of innovative activities have been tested: designation of science city status, development of the targeted regional program "Technopolis" Dubna", organization of the urban business - incubator, experiment on the pilot project implementation of the National innovation systems practical development, the attempt to establish the Russian programming center and "residence of programmers" construction, creation of the special economic zone of technological-innovation type, organization of nuclear-physical and nanotechnology cluster and a medical and technical cluster of the Moscow region.

It is argued that the successful innovative development of Dubna is largely due to the fact that the city the higher education always developed in parallel to researches. The University "Dubna" creation in 1994 has allowed to solve successfully the issue of obtaining the status of "science city", and then to solve the development issues of programming center, special economic zone of regional clusters. The experience of joint development of the two components "innovative" and "educational" seems to be the key success factor of any science city.

## Materials and methods

The article uses statistics, regulations and analyses of published literature sources. Brief analysis of the existing views on the Russia's innovative development. In various publications, approaches to the country's innovative development have been analyzed in sufficient detail. The authors consider the characteristics of the national innovation system including not only the structures of the system itself (science cities, special economic zones, tech-parks, ventures and investment funds, technology transfer centers), but also such elements as the basic and applied research sector, the training of highly qualified personnel sphere, foreign experience in the formation of techno-parks has been considered with

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<sup>1</sup> A. Yu. "Dubrovsky, The Foundations of Public Management of Innovative Activities", Bulletin of Moscow University. Series 21, Management (State and Society) num 4 (2008): 22-36. From <http://www.jinr.ru/> (13.08.2017); E. A. Nosachevskaya, "On Scientific-Technical and Innovative Potential of Russia", ECO. The Russian economic magazine num 8 (2011): 5-15; S. S. Kirillova and S. V. Rodyukov, "Opportunities to Strengthen the Financial Basis of Municipal Formations with City-Forming Research and Production Complex", Finance and Credit num 16 (2012): 63-67 y O. V. Stulov and N. E. Chevychelov, "Technopark as a Form of Research and Technical Modernization of the Economy", Bulletin of Moscow University. Series 06. Economy num 3 (2010): 100-119.

<sup>2</sup> P. Orekhovskiy, "Innovative Economy in View of Implicit Contract Theory", Society and Economy num 3 (2011): 5-35.



respect to Russian conditions. The Japanese model is described which "involves the construction of completely new cities -the so-called technopolises, which concentrate on their territories the scientific researches in advanced and pioneer industries, as well as high-tech industrial Production. The Japanese technopolis is a city where the concentration of education, science, technology, high-tech business, venture capital gives rise the chain reaction of scientific and business activity of international, global scale." Despite the successes of the Japanese model development of tech-parks, the authors<sup>3</sup> believe that this is not the best way for Russia, since it foredooms it to the "catching-up technological development and deprives them of strategic competitiveness".

The author<sup>4</sup> considers the possibility of establishing the regional innovation-oriented development centers. In article<sup>5</sup> such a regional center is understood as "the geographically localized social economic system established by a group of independent economic entities, enterprises, budgetary organizations, infrastructures, public organizations, the bodies of executive and legislative power and civil society, which are steadily interacting with each other through the exchange of products and services, people, information and providing in the results of this interaction the higher efficiency of the each participant functioning compared to the similar non-systematically organized economic entities." The author emphasizes that it distinguishes "RIODC and innovative clusters, whose activities are limited to the production of innovations in the form of ideas, discoveries, technologies and prototypes". The concept of the regional innovation-oriented development center, as introduced by the author<sup>6</sup> is, in our view, similar to the old Soviet term "regional production complex". In 1969<sup>7</sup> the regional production complexes (RPC) were defined as the "form of territorial organization for the productive forces of the socialist society, most fully meeting their development tasks in the context of the scientific and technological revolution." RPC, as a part of the economy of the economic region (subregion), is the totality of interrelated industrial and agricultural enterprises formed on a certain territory (not always within the boundaries of existing administrative-territorial units) actively involved in the common system of territorial division of labor. The enterprises manufacturing relations, the use of areawide natural and economic resources and conditions, as well as the common resettlement system create the economic unity of RPC" In modern dictionaries<sup>8</sup> the regional production complex is explained as "the totality of economically interconnected, *proportionally developing* industries concentrated on a limited territory and using its resources comprehensively." Regional production complex includes specialized enterprises that complement their production, production and social infrastructure facilities. RPC formation of complex is one of the ways to improve the productive forces siting. Within the RPC framework, the favourable preconditions for the development of organization progressive forms of production — specialization, cooperation, combination, rational use of natural and economic conditions are created. "The optimal combination in the complexes of interconnected industries, the organization and use of a single production and social infrastructure provides savings in capital investment and running costs."

<sup>3</sup> O. V. Stulov and N. E. Chevychelov, "Technopark as a Form of Research and Technical Modernization of the Economy", Bulletin of Moscow University. Series 06. Economy num 3 (2010): 100-119.

<sup>4</sup> V. A. Agafonov, "The Innovative Development Strategy of the Region", Finance and Credit num 45 (2016): 42-60.

<sup>5</sup> V. A. Agafonov, "The Innovative Development Strategy..."

<sup>6</sup> V. A. Agafonov, "The Innovative Development Strategy..."

<sup>7</sup> N. N. Kolossovsky, Theory of Economic Zoning (Moscow: Mysl', 1969), 336.

<sup>8</sup> Dictionaries and encyclopedias on Academic from <http://dic.academic.ru/> (29.10.2017).

The cluster approach in Russia's innovative development strategy has been analyzed. The article<sup>9</sup> conclusions indicate that "one of the most effective forms of the cluster policy implementation is the establishment of public-private partnerships in whose capital the local authorities, commercial partners and institutional private investors can participate and who enter into strategic interaction treaties. The role of the Federal and regional authorities in this case is determined by total support for the projects implemented that do not require significant financial investment as well as by guarantees provision for investments return. The uniform distribution of risks among all members of the cluster can also provide an effective incentive for the development of innovative-oriented cluster structures." It is fairly noted that the catalysts for clustering are such infrastructure systems as special economic zones, business incubators, techno-parks, etc., as well as science cities.

According to classification, given the different levels of economic development of Russian enterprises, the following types of clusters can be distinguished: "centres for innovative development (clusters based on science cities, closed administrative territorial units (CATU), a number of enterprises in the military industrial complex and knowledge-intensive industries); centers of technology transfer or catch-up modernization (the clusters based on the technology of engineering, chemical and petrochemical industries); industrial clusters with traditional technologies (production of traditional materials, woodworking, etc.)." For the purposes of this study, only the first type clusters are interesting.

The proposes a certain model of spatial organization of the Russian economy that proposes the establishment of centers for innovative development within its framework. Such centers would be similar to the existing elements of the national innovation system established at the federal and large modern universities, science cities and a number of CATU. "Spatial development should integrate innovation and education policies. Innovative development can be achieved only through the intensification of urban processes and determining a number of cities and economic regions as the leading subjects of innovation growth (possibly by designating them a special legal status)."

In our opinion, it is fairly noted that the innovative development of Russia should not be based only on the production component. "The use of historical and cultural heritage can give another momentum to innovative development. There are now 478 cities and other settlements in Russia that have received the official status as historical ones. Of these, 252 are small towns (i.e., the historical is every third small town), 80 are medium towns. Almost all of them are characterized by poor infrastructure conditions and houses wear and tear. The creation of tourism and recreational centers based on historical cities could solve these problems." This is natural, because innovations can be developed only if there is a demand for products. The population well-being level should grow to meet the demand for innovative products.

Additionally, indicates CATU, science cities and big business and administrative centers as the points of anticipated innovation growth. All the described options for creating the innovative structure in Russia take into account the so-called "science cities". There is no strict definition of this concept. Russian government awarded 14 municipalities with status of the "science cities"<sup>10</sup>. However, more than 60 municipal settlements are considered

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<sup>9</sup> E. B. Lenchuk and G. A. Vlaskin, "Cluster Approach in Innovative Development..."

<sup>10</sup> "On the Status of the Science Cities of the Russian Federation". Federal Law of April 7, 1999 No. 70-FZ (with amendments and additions)

informally science cities: actually science cities, CATU, science campuses, cities with high intellectual potential falling within the scope of the Law on the Status of Science City<sup>11</sup>. "Today's science cities are very different in scope, nature, activities. More than 200 thousand people live in the largest of them. And in the village like Orevo - about one and a half thousand." In the USSR, the living conditions in all science cities were generally much better than those in the surrounding territories. All of this, along with the interesting and critically important work for the State created the conditions for "brain gain" and provided the scientific organizations and manufacturing enterprises with permanent replenishment of specialists"<sup>12</sup>.

Science cities can be considered as some of the analogues of the technopolises, although in reality they vary greatly in their historical origins and social economic circumstances<sup>13</sup>.

Naturally, the question arises about the success of one or another approach, the evaluation of the effectiveness of the events implemented or planned. Since all approaches to stimulating innovation development rely on the State support, the subjects claiming it, compete with each other. In article<sup>14</sup>, three different methods for quantifying the innovative status of Russian regions were tested. Different methodologies of calculation have brought very different regions to leading position.

The results of the comparative analysis of science cities, a number of big cities and the territory of the Russian Federation as a whole for such groups as "demography sphere", "social sphere", "state of the economy" and "public consciousness", "environment" are presented. The indices total rating on all groups have brought three science cities to the first place: Korolev, Troitsk, Dubna. For comparison, Moscow is on the 7th place. Russia itself is on the 22nd place. The results of the analysis, with all the controversy of the approach used show that the science cities are the territories of the advanced development with living conditions favourable to the population.

The work argues that "the creation of new centers of innovation activity on the empty place tends to fail", and "science cities are the natural site for the creation of powerful innovation incubators".

The justice of this argument is confirmed by the unsuccessful attempt to implement the "Science city" program in the town of Komsomolsk-on-Amur. Komsomolsk-on-Amur is a big industrial, scientific and cultural center in the Far East, the third largest city in the region with a population of 270.4 thousand people. There are big demographic problems - the population constant migration. The Komsomolsk-on-Amur State Technical University (KnaSTU) performs the training of personnel for the high-tech industrial complex of the city. Innovation capacity has been created at the Federal State-Funded Educational Institution of Higher Vocational Education "Amur State Pedagogical University" (AmSPU), which conducts researches in 14 branches of science, on 20 main (priority) scientific directions. At

<sup>11</sup> "On the Status of the Science Cities of the Russian Federation". Federal Law of April 7, 1999 No. 70-FZ (with amendments and additions)

<sup>12</sup> M. Kuznetsov, "Intelligence Plus Innovations", *Znanie-sila* num 6 (2005): 22-31.

<sup>13</sup> E. Balatsky and V. Lapin, "Innovative Sector of Industry", *Economist* num 1 (2004): 20-33 y I. G. Dezhina and S.A. Tsyganov, "Creation of New Technologies or Leap over Abyss", *Bulletin of the Russian Academy of Sciences* Vol: 70 num 4 (2000): 291-294.

<sup>14</sup> G. A. Untura, "Territory of Innovation: Expanding the Range of Possibilities". *ECO. Russian Journal of the Economic* num 11 (2011): 15-30.

first glance, good reasons for success were available. According in 2001, the "goal to create the new "small" regional structure on the basis of Komsomolsk-on-Amur" was set which, on innovative principles, transforms not only itself but also a large part of the Far East production complex. Unlike the "classical science city" based on basic science, there was a need here to develop production that manufacturing high technology products. This predetermined the need to create a special social cultural environment capable to ensure scientific, technological and institutional development, the attractiveness for the invitation and retention of personnel of high qualification in science, high school, high-tech enterprises". At that time, it was impossible to solve this task in conditions of doldrums Far East. In our opinion, the similar task can be achieved only with considerable human supply. The analysis conducted allow making the conclusion that science cities can certainly be points of innovation growth in Russia, but under certain conditions.

The state support is required for development of science cities as territorial elements of the Russian innovation system, which should aim at creating and developing the favourable climate for innovation. Such climate includes a combination of relevant legal, economic, social, information conditions and necessary innovation infrastructures on the territories of science cities. The status of the RF's science city provides indirect advantages, including enhancing the investment attractiveness of the science city's organizations of the scientific and production complex<sup>15</sup>. There is a need to ensure "municipal education infrastructure system functioning as a process based on existing structures aimed at creating new institutions for the social and productive sector and improving the performance of the existing ones"<sup>16</sup>. In article<sup>17</sup>, the authors highlight "two principal projections in the integration regional policy on effective interaction between education, science, business, innovation infrastructure and authorities at the level of the territorial entities of the RF." The first one is the creation of a favourable innovation environment fostering the interaction of participants in the field of mutual interests on personnel training, building value added chains while creating competitive products sold in the domestic and foreign markets. "The second one is the use of the project approach, i.e. identification and support of meaningful breakthrough projects that can form a sustainable core within the framework of the territory innovative development strategy."

Consider the development of the innovation and education component of the science city Dubna.

### **The innovation component of science city Dubna**

In 1956, Dubna town, uniting two banks of the Volga, was formed by the decision of the USSR authorities: the right bank, on which the Joint Institute for Nuclear Research (JINR), the international intergovernmental organization aimed at conducting basic researches in the field of nuclear physics were located, and the left bank where the aviation Complex (now the Bereznyak Engineering Design Bureau "Raduga" and Dubna Engineering plant). Thus, Dubna from the beginning was not a single-industry town: academic science combined with application science. At present, in addition to the above enterprises, the town-forming enterprises are as follows: instrument-making enterprise Tenzor, the Scientific-

<sup>15</sup> I.V. Makeeva, "Economic Conditions for the Development of science Cities", Finance num 2 (2008): 20-22.

<sup>16</sup> P. Kokhno and V. Laptev, "Innovative Clusters", Society and Economy num 2 (2014): 135-155.

<sup>17</sup> V. V. Kuleshov; G. A. Untura and A. V. Evseenko, "Science, Education, Innovative Centers: Regional Aspects of Integration", ECO. Russian Journal of the Economic num 9 (2012): 95-113.

Research Institute Atoll, the Institute of Physical and Technical problems, the Research Institute of Applied Acoustics, the Space Communications Center Dubna, the State Unitary Enterprise Dedal, organizations - residents of the special technical and implementation economic zone Dubna, etc. On the territory of Dubna there are nuclear-physical, nanotechnologies and medico-technical clusters.

Let's note that the innovative nature of the Dubna town was evident in the 1960s of the twentieth century. Thanks to Academician G.N. Flyorov (JINR), who headed the USSR Scientific Council on application of nuclear techniques in related fields, the applied researches on the application of fundamental nuclear science in geology, medicine, material science were developed. Works in these areas are continuing at the present time.

The strategic development of science city Dubna focuses on the preservation and strengthening the status of Dubna as one of the World Science Centers and achieving the status of one of the world's most noticeable territories of innovative development.

The innovative development of Dubna has undergone several stages. The foundation was laid "in the spring of 1993, when by the decision of the Moscow Regional Council of Deputies the Dubna town was recognized as a "priority area for the development of Science and Technology "and was granted a number of tax concessions for the production and marketing of knowledge-intensive products. In November of the same year, the Moscow Regional Council approved the targeted regional program "Technopolis "Dubna" that was prepared by an action group from representatives of the administration, leading enterprises and the city Council. Its purpose is the creation of high-tech knowledge-intensive productions, communications means, assistance for the development of promising small and medium-sized enterprises and firms (the "business incubator" within the science and technology park), the implementation of educational programs. The same year, the first urban social-economic program, funded by the population, was the project "System 12". It provided for the development of communications means and its quality improvement, and was completed by 1995, giving the city additional 5,000 telephone numbers and a wide range of services, the quality of international communication has improved. The next stage - the designation of the RF's science city status in 2001 and the program approval of main directions for its development. As a result, the volume of industrial production and research and development works performed in 2001 was about 2.5 billion rubles. Industrial output has increased by more than 5%, and in small and medium-sized enterprises by 5.6%" <sup>18</sup>.

In 2003, in Dubna, it was decided to implement a pilot project on practical development of the national innovation system elements<sup>19</sup>. In 2004, the creation of the Russian programming center and the "residence of programmers" construction commenced<sup>20</sup>. In the future, on this basis, since 2005, the special economic zone of

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<sup>18</sup> V. E. Prokh, "Targeted Programs as a Form of Development of the City's Research and Production Potential", Problems of Theory and Management Practice num 6 (2002): 68-73.

<sup>19</sup> The Order of the RF President on Implementing the Pilot Project of the Practical Development of the National Innovation System Elements on the Moscow Region's Territory (PR-645 of 16.04.2003)

<sup>20</sup> "On the Implementation of the Investment project for Establishment of the Russian Programming Centre in the town of Dubna of the Moscow region". Resolution of the Moscow Region Government (No.407/26 of 12.07.2004) y "On the Plan of Measures for Establishing the Russian Programming Centre in the Town of Dubna". Decision of the Interdepartmental Commission of the Moscow Region Government on the placement of productive forces on the territory of the Moscow region (No. 2/4-MK of 17.02.2005).

technology-innovative type (SEZ TIT "Dubna") has been developed<sup>21</sup>. The priority areas of development for SEZ were defined as: information technology, nuclear-physical and nanotechnologies, bio-and medical technologies, composite materials, and design of complex technical systems. As of 01.01.2016, SEZ "Dubna" has the following indicators: 100 residents, number of employees-2320, volume of sales in 2015 - 3.2 billion rubles, volume of private investments - 8.4 billion rubles. Plan for 2024: number of residents - 230, annual volume of sales - 40.0 billion rubles, volume of private investments - 42 billion rubles. The nanotechnology center "Dubna" has been created which provides formatting, financial support of the selected promising projects at an early stage of implementation (beginning from R&D). The amount of funding for one project is from 0.05 to 100 million rubles. About 70 projects have been approved and implemented (only 20% of them are based on the developments of Dubna organizations). The mechanism for supporting projects of nanocenter is well-established by State development institutions.

In 2012, the city's organizations in a proactive manner created a territorial cluster of nuclear-physical and nanotechnologies involving the Dubna University. The cluster was supported by the federal budget and the Moscow region's budget<sup>22</sup>. In 2016, the Moscow region's medical and technical cluster was created. The objective is to improve the competitiveness of participants in the health products markets through the development of science, technology and production cooperation, the formation of the staff's general training policy, the establishment of a specialized structure, the interaction on promotion of products to Russian and foreign markets. The medical technical cluster of the Moscow region includes 37 organizations involved in the production, development, medical products delivery and technology services, among whom: 25 are the developers and producers of medical products, 5 are the suppliers of technology services, 5 are the innovative infrastructure organizations, 1 is the University and one is the research center. The tasks of the center are defined as follows: forming a recognizable brand of the cluster; infrastructure development (radiation sterilization, accredited laboratory; establishment of the cluster procedure for securing local approvals; development of the engineering center as a cluster structure for the development of new technologies/ manufacturing equipment; joint exhibits at exhibitions; projects internal evaluation; organization of interaction with state development institutions; PR; involving new participants, including in SEZ "Dubna"; personnel support; electronic catalogue of products and technology services. Key focus areas of the cluster: mobile medicine, diagnostic equipment, radiation medicine. In the period up to 2020, the participants of the cluster is planning to establish 15 new productions with planned performance of 15.9 billion rubles per year in the technology development Special Economic Zone "Dubna".

In Dubna there are the following support structures of innovative development. Two co-working centers (in the Universal Library of JINR and in the Dubna's Congress Centre of SEZ Dubna) are cheap jobs for business start-ups. The Prototyping Center of University "Dubna" is the engineering and production complex specializing in the complete scheme of devices production: from computer-based design to prototyping. The CIS International Center of Nanotechnology is the center for JINR technologies and leading scientific

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<sup>21</sup> "On the Establishment of the Special Economic Zone of Technological-Innovation type on the Territory of the town of Dubna (Moscow Region)". RF Government Regulation of December 21, 2005 No. 781.

<sup>22</sup> "On Rules Approval for the Subsidies Distribution and Provision from the Federal Budget to the Budgets of the Constituent Entities of the Russian Federation for Implementing the Measures Envisaged by Development Programs of Pilot Innovative Territorial Clusters". RF Government Regulation of March 6, 2013 No.188.



organizations commercialization in the CIS countries. Urban business-incubator is the infrastructure and advisory services to the companies during their work starting up.

The current objectives of the innovative Dubna are as follows<sup>23</sup>:

- implementation of projects for the creation of the large experimental installations with record parameters, including the mega-science project NICA, the heavy ion accelerator complex DRIBs III and the formation of international collaborations for basic and applied researches on these installations at the Joint Institute for Nuclear Research;
- development of the large-scale area of innovative development in Dubna using the mechanisms of the technology development Special Economic zone, the medical and technical cluster of the Moscow region, the innovation territorial cluster of nuclear-physical and nanotechnologies;
- creation of the integrated system of human capital formation (human resources) including by improving the quality of education in secondary schools and University "Dubna", improving the system of attracting and retention of promising young and highly qualified scientists and professionals;
- consistent formation of the city comfortable, safe and attractive for living urban environment. Development of urban infrastructure contributing to improvement of transport accessibility, construction of the bridge over the Volga River, lifting of restrictions on electricity and gas supply.

The continuous improvement of the innovation structure has ensured the rapid development of the research and production complex in the structure of the city's economy:

- in 2000, the percentage of the research and production complex (RPC) in total production in the city was 60%, in 2015 it was over 75%;
- the total output of RPC during this period in current prices has increased about 25 times, and at comparable prices approximately 5 times;
- in 2000, the amount of works (services) performed per one employee in the RPC of the city exceeded the similar total amount in the city by 1.76 times, and in 2015 this figure was by 3 times;
- the percentage of products produced by the resident companies of SEZ "Dubna" is increasing: in 2015 it was 8.5% of the total output.

It should be noted that despite the increase in the number of enterprises in the city's RPC, the total number of employees in the city's research and production complex has barely increased during this period, and RPC indicators have been achieved mainly through increase in labour productivity.

At present, about 30% of all employees in the urban economy, work in the city's research and production complex. There are more than 1500 Dr. habil. and PhD in the city. More than 3000 people are engaged in research and commercialization of scientific (scientific and technical) research results.

The main expected increase in employees positions is related to the development of

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<sup>23</sup> M. S. Khozyainov and N. A. Smirnov, "Strategy of Innovative Development of the Science City Dubna", In Collected papers of participants of the VII All-Russian Research and Practical Conference "Modern Continuous Education and Innovative Development", eds Professor A.N. Tsarkov, Professor I.A. Bugakov I. A. (Serpukhov: MOU "IIF", 2017) 254-258.

the technology development Special Economic Zone In the period up to 2024, in SEZ "Dubna", 5700 new employees positions is planned to be created and bring the total number of employees positions in the resident companies up to 8000. Joint Institute for Nuclear Research is planning to provide additional 1000 jobs. Taking into account the need for simple reproduction of personnel in the city's RPC organizations in the amount not less than 250 persons per year, in the next 10 years the annual recruitment of personnel for RPC (including SEZ) will be required in the amount from 650 to 1050 persons per year, from which the specialists with higher and secondary vocational education - from 365 to 605 persons per year.

### **Educational component of Dubna development**

Immediately after Dubna was founded in 1956, its educational components started to be created. On January 1, 1958, a branch of the Moscow Institute of Radio Engineering, Electronics and Automatics was established. In 1961, JINR achieved the opening of two Departments of the Lomonosov Moscow State University in Dubna. These two departments are: the Department of Theoretical Nuclear Physics and the Department of Elementary particles since that time to the present time are successfully operating on the basis of the Research Institute of Nuclear Physics of the Moscow University's branch. In 1991, JINR, MSU and the Moscow Engineering and Physics Institute jointly established the Scientific Training Center (STC) of JINR. In 1993, the Department of the Moscow Institute of Physics and Technology was formally established in JINR, which also was included in the STC, and the first students graduated from it. Since 1993, STC became a structural unit of JINR, which was entrusted with the functions of organization, support and development of independent educational program in the institute<sup>24</sup>.

In 1994, the State University "Dubna" was founded and is now an active participant in all the city's projects.

The development of higher education in Dubna based on the University is not only an end in itself but is also of particular importance for the development of the science city itself. The concentration of young people with a level of development above the average in the town with population of about 50-100 thousand people significantly changes the image of the town, increases its "civilizational" level. It is important that not only the training of specialists for the city-forming enterprises, but also specialists across the classical University's entire spectrum is being carried out: linguists, psychologists, lawyers, economists and other fields. Science cities are not just "factories of knowledge", they are structure-forming settlements at the State level like city-forming enterprises exist at the city level. Science cities are points of intellectual growth for the whole State. Therefore, the maintenance of the science cities system is not only a means of developing science but also the preservation of the accumulated cultural heritage. The preservation of science cities is one of the independent elements of the country's natural integrated development, as well as a number of other elements of the system: big cities, ancient towns, cultural and religious centers, wildlife sanctuaries and many other things. This independent element requires an individual approach to its development. One element of this approach is the development of higher education in the science city. This is not an easy task. Thus, the successful experience of Dubna on the development of University education has been achieved through the coordinated work of the city administration, the JINR top management, the group of Moscow scientists-activists supported by the Moscow region authorities.

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<sup>24</sup> Education in JINR, Electronic resource, <http://www.jinr.ru/> (13.08.2017).

The successful development of the University "Dubna" is largely linked to close interaction with employers.

The university's key partner is JINR. The interaction goes through the basic Departments, JINR STC, and direct links with the JINR laboratories. JINR STC has a good dynamically developing material base. It includes lecture rooms with modern technical facilities for lecturing and presentations, computer classrooms, classrooms for school workshops. In 2006, a new structure was introduced in STC - training laboratories that are established with the joint participation of the base Departments of various Universities, including the University "Dubna" with involvement of international funds and private grants<sup>25</sup>. The classes of the University "Dubna's" students take place in JINR on the basis of JINR STC. The JINR Scientific and Technical Council was held on June 16, 2017 and was dedicated to the university's educational programs synchronization with the JINR's development plans, taking into account the new great projects.

SEZ "Dubna" resident-organizations are the partners for University in several areas: they are employers, consumers of complementary educational services, partners in collaborative research works, as well as ensure the students' traineeship in knowledge-intensive production. For recent years, more than 6,000 people, including about 1,000 from SEZ enterprises have undergone further training and professional development. A successful form of targeted training for graduates in specific areas is the establishment of the university's basic Departments together with the concerned organizations. The Departments have established in the University together with scientific organizations such as JINR, Engineering Design Bureau "Raduga" and others. Thus, the Departments of the fundamental problems of microworld physics, nuclear physics, biophysics, distributed information systems, nanotechnologies and nanomaterials, physical installations have been established together with Joint Institute for Nuclear Research.

Participation in the cluster's program of nuclear-physical and nanotechnologies allowed the University "Dubna" significantly expanding its logistics base and strengthen its links with employers. The subsidy amounted to about 300 million rubles. The Engineering center with two laboratories was established at the University: in the field of thin film technologies and in the field of composite materials. The services on further training and professional development in high nanotechnologies have been deployed at this base; it is also used in teaching and learning processes at the University "Dubna". The Chemical-Analytical center (spectral methods of analysis, electro-chemical methods, chromatography methods) has been organized as the center of collective use for cluster members. The data processing center was organized. The Prototyping center has been established and is actively used to participate in the WorldSkills Russia<sup>26</sup> program.

On the territories of other constituent entities of the Russian Federation, the clusters also form the innovative environment determining the promising economic specializations. In /11/ it is rightly noted that almost all successful innovative clusters are built around research and/or educational centers such as science cities. The example of how to implement a successful cluster in the field of information technology in St. Petersburg is

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<sup>25</sup> Education in JINR, Electronic resource, <http://www.jinr.ru/> (13.08.2017).

<sup>26</sup> M. S. Khozyainov and N. A. Smirnov, "Strategy of Innovative Development of the Science City Dubna", In Collected papers of participants of the VII All-Russian Research and Practical Conference "Modern Continuous Education and Innovative Development", eds Professor A.N. Tsarkov, Professor I.A. Bugakov I. A. (Serpukhov: MOU "IIF".,2017), 254-258.

provided. The cluster is based on the St. Petersburg National Research University of Information Technologies, Mechanics and Optics (ITMO). More than 40 small innovative companies have been established on the basis of University science projects, and successful startups created by students and residents of the ITMO's innovative infrastructure are being implemented. The projects for development of innovation and entrepreneurship and developed innovation infrastructure are focused on the supporting students and staff in their work on creation and development of startups and small innovative companies, which includes: business-incubator, laboratories for prototyping OIYMP and FabLab; Tech-Park, Engineering Center, Joint project labs with corporations (Acronis, SAP), etc. In 2017, the Internet Initiative Development Fund (IIDF) gave the title of the best business-incubator in the country for the largest number of successful projects in IT and the Internet segment.

The importance of education for the successful development of science city is also evident from the experience of the worker's settlement - science city Koltsovo. Its development in recent years has been determined by the regional target program "Establishment of the science technology park in the field of biotechnologies in the science city Koltsovo, for 2011-2015"<sup>27</sup>. Around the basic enterprises, State Research Center of Virology and Biotechnology Vector and Research, Design and Technology Institute of Biologically Active Substances (NICTI BAV ) (the Vector's base for preclinical trials) the innovative business support infrastructure have been created and is developing: the Innovation centre Koltsovo, the Business-incubator, the Biotechnopark with engineering center for collective access and the profession-oriented master course of Novosibirsk State University. Basic Departments have been organized, where the students from the Faculty of Sciences of the Novosibirsk State University, Novosibirsk State Agrarian University and Siberian State Medical University (Tomsk) completed their pre-graduate and graduate internship. Since 1983 in SRC VB Vector, the post-graduate course and two Dissertation Defence Boards are available. Although there are only fifteen thousand people in Koltsovo, there are 7 institutions for supplementary education.

The importance of the regional higher education institutions for innovative development of the region is confirmed by the establishment of the Yugra State University in 2001. The University has been established by decree of the Government of the Russian Federation dated August 20, 2001 No. 1069-p on the basis of the Khanty-Mansiysk branches of the Nizhnevartovsk State Pedagogical Institute, the Siberian State Automobile and Road Academy and Tyumen State Agricultural Academy. Previously, the Surgut University was established in the region (1991)<sup>28</sup>.

A different model is implemented in Sarov (94 thousand inhabitants). Due to the high degree of Sarov's closed nature, the higher education institution has not been established there. It uses almost fully the USSR scheme -graduates from prestigious Universities arrive to work there on invitation receiving additional payments and housing on attractive terms. Sarov does not stand out as a center of innovation<sup>29</sup>. The personnel policy of the science city Dubna is largely based on the University "Dubna".

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<sup>27</sup> D. B. Demytyev, "Budget Financing of Innovative Economic Development on the Subfederal Level", Finance and Credit num 40 (2011): 53-60.

<sup>28</sup> A. Shumeiko, "Priorities for the development of the Khanty-Mansi Autonomous District", YUGRA. Economist num 3 (2011): 63-66.

<sup>29</sup> A. A. Redyushev, "The Way From Arzamas-16 to Sarov", Management in Russia and Abroad num 1 (2005): 45-54.

It is planned to develop the interaction of the research and production complex (RPC) with the University "Dubna" to ensure the best correspondence of the graduates' knowledge and skills to the employers' requirements; raising the prestige of the University "Dubna" particularly with a aim of improving the school leavers quality for University enrollment; the establishment at the University of the boarding school for gifted children; further training and professional development of RPC organization's specialists, including within the framework of State programs for the development of innovative clusters<sup>30</sup>.

The work with the prospective university students has resulted in increasing the number of young people entering the engineering professions over the past two years. First of all this is due to the almost total exclusion of state-financed openings in such fields as "Jurisprudence", "Economics" and "Management". However, two not very good trends should be noted. School leavers have the Uniform State Exam's low score for engineering Specialties: lots of openings but no competition. And the sharp reductions in exam scores among those who want to enter the contractual openings in such fields as "Economics", "Management", "State and municipal administration".

The University "Dubna" is a member of a dozen organizations of the Russian science citation index (RSCI). This is because many members of the University "Dubna" are not only lecturers but the active researchers as well and work in the leading scientific center, primarily in JINR. Is it fair to take into account the research scientist's publication activity in two organizations at a time? It seems fair. After all, the lecturer working intensively in science can give a student a lot more than the person who lives with the past knowledge.

An important form of interaction with employers is the development of further education. The university's innovation belt is based on small, innovative enterprises established primarily by University students. The University develops vocational secondary education as well. Of the 22 among secondary vocational education's courses in the University, 15 courses continues in the direction of higher education. It gives these students the possibility of smooth transition from the training secondary vocational education's courses to the higher education programs.

At present, the State University of Moscow region prepares 7984 students in 126 training programs. In 2016, the State University "Dubna" entered the top 100 among the best higher schools in Russia (65-th place), and in 2017, it improved its position by 9 points, occupying the 56-th places. The leader in the ranking of relevance among Universities in the sphere of management (Economics, Finance, Jurisprudence) according to the results of the project "Social Navigator" made by the media group "Russia today" in 2015 and 2016.

Dubna is constantly working with gifted children: with pupils - school "Dialogue"<sup>31</sup> with students - summer school "Kadry buduschego" (workforce of the future)<sup>32</sup>

Since 1991, the International School for Young Researchers (ISYR) "Dialogue" (Dubna) has been working with gifted children in Dubna and other cities of the Russian Federation. The main objective of the ISYR "Dialogue" is the maximum development of

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<sup>30</sup> M. S. Khozyainov and N. A. Smirnov, "Strategy of Innovative Development of the Science City Dubna", In Collected papers of participants of the VII All-Russian Research and Practical Conference "Modern Continuous Education and Innovative Development", eds Professor A.N.

<sup>31</sup> International School of Young Researchers "Dialogue", from <http://dialogue.df.ru/> (13.08.2017)

<sup>32</sup> Information About School "Kadry Buduschego", from <http://www.vdubnu.ru/> (02.10.2017)

intellectual and creative abilities of children and adolescents, development and testing the methods of individual emancipation and the development of their talents. The "Dialogue" works during the winter and summer school holidays in the form of "sessions". The winter session is usually held based on one of the Dubna schools for several days and is largely a preparation for summer work of the School. The children get acquainted with teachers and each other, learn to work in team, and get a feel for traditions. The summer period of the School "Dialogue" is characterized with a long duration - approximately three weeks. As a rule, the offsite option for the School is chosen - at countryside recreation facilities or camps. The main feature of the summer session is the work of the "projects". The project is a small group (5-10 students), headed by a leader and an assistant to help him. In course of several weeks, the project participants conduct the target-specific academic and research work within the framework of the theme proposed by the leader. Compact accommodation for the "Dialogue's" students during the summer session, joint participation in many activities of the School stimulates the creation of the comfortable, creative, and research atmosphere in projects. The results of the students' work are presented at the reporting conference at the end of the session. The projects classes are held before lunchtime, and the second half of the day contains a variety of developing, cognitive, sport-recreational activities that allow organizing the active rest for children. In addition, in the afternoon, the creative workshops work - one-time classes on the literature, fine arts, etc.<sup>33</sup>.

Since 2009, the SEZ "Dubna", University, the city administration together with other partners have been conducting the students' science and technology schools "Kadry buduschego" (workforce of the future) with participation of students of Russian Universities. Typically, these are 100-120 students who have been competitively selected in their Universities or remotely on the school's website. The sections of the school are as follows: nuclear-physical and nanotechnologies, nanochemistry, information technologies, biomedical technologies, design of complex technical systems, economics and management. That is, there is a clear focus on the priority areas of the Special Economic Zone development. The basic structural unit of the school is a project for each of the sections of the school. The project means a temporary educational organizational structure consisting of the leader with his team and a group of students of the school who conducts research in the selected area of science and/or innovation activities. Practical trainings of students are usually directed to any relevant creative or research task that includes problem-setting, the study of theory dedicated to the subject, the selection of research methods and their practical mastering, collection of own material, its analysis and generalization, research and technical comments, and own findings. At the end of the session, a report on the work done or each project defense is held at the seminar<sup>34</sup>.

The targeted development of all education levels in Dubna is planned. The program includes<sup>35</sup>:

- preservation and development of education system (at all levels) aimed at forming and developing the abilities of children to scientific and engineering creativity, and involving the gifted children and promising young people to Dubna.
- development of measures system on transforming the University "Dubna" in the research

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<sup>33</sup> International School of Young Researchers "Dialogue", from <http://dialogue.df.ru/> (13.08.2017)

<sup>34</sup> Information About School "Kadry Buduschego", from <http://www.vdubnu.ru/> (02.10.2017)

<sup>35</sup> M. S. Khozyainov and N. A. Smirnov, "Strategy of Innovative Development of the Science City Dubna", In Collected papers of participants of the VII All-Russian Research and Practical Conference "Modern Continuous Education and Innovative Development", eds Professor A.N.



University that prepares specialists in the fields relevant to RPC of the science city and typical for the classical University.

- development of measures program aimed at improving the level of humanitarian education of students, including a significant increase in the level of language training (Russian, English and other languages) and the development of inter-ethnic communication culture.
- establishment of a permanent system for training and development of the management personnel reserve based on the experience of the Personnel Reserve School.
- new concept development of the University "Dubna's" Lyceum aimed at the in-depth study of natural sciences and admitting to Lyceum through the competitive selection of senior pupils from the north and north-west regions of Russia with the possibility to live in this lyceum.

Already in 2016, the Youth Innovation Creativity Center was organized. The Center plans to develop scientific- technical creativity and professional orientation involving specialized professionals and Dubna's organizations of the research and production complex and the residents of the Special Economic Zone "Dubna".

The education development program in Dubna is inextricably bound up with its innovative development.

## **Conclusion**

In the article, the study of innovative development directions in Russia was undertaken. Statistical data, regulations have been used and analyses of published literature sources have been carried out. The possibility of creating a national innovation system through the formation of regional innovation-oriented development centers, techno-parks, technopolises, territorial clusters, science cities was investigated. The effectiveness of the science cities selection has been demonstrated as points of innovation not only as knowledge factories but also as structure-forming settlements at the State level like megapolises, ancient cities, cultural and religious centers. The town of Dubna development since its foundation in 1956 was analyzed. The State University "Dubna" established in 1994, its interaction with the Joint Institute for Nuclear Research, other town-forming enterprises of Dubna, the SEZ located entities of innovation type, territorial clusters (establishment of basic Departments, targeted admission) was described. Mutual influence of the University and science city development has been studied as a whole. In the present article, the interpenetrating impact of the research and production complex and educational component development in Dubna has been shown. The development examples of the centers Koltsovo, Sarov, IT cluster in St. Petersburg and the program "Science city" in Komsomolsk-on-Amur were analysed.

On the examples provided, the need for a comprehensive development of science cities as the basis for Russia's innovative development through regional Universities is shown. The development strategy of innovative and educational Dubna for the immediate period has been formulated. Financing for innovative development should aim at increasing the share of private financing for the purpose of which it is necessary to develop cooperation with venture funds, private investors and private investor associations, to form mechanisms of securities placement in stock exchanges, crowdfunding, while maintaining and strengthening the interaction with State development institutions.

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