Promotion of Additive Technologies with the Help of a Virtual Technology Park for the Development of Technological Entrepreneurship in the Region

Larisa Shakhovskaya[1][a], Elena Goncharova[2][b]
[1]Department "Economics and entrepreneurship" Volgograd State Technical University, Volgograd, Russia
[2]Department "Economics and management" Volzhsky Polytechnic Institut (branch) VSTU, Volzhsky, Russia

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Abstract: The article discusses the role of innovative infrastructures in the promotion of scientific and technological projects. The main factors of this process in modern conditions of digital economy development are described. The authors state the basic features of commercialization of the 3D technology from the point of view of research activities efficiency and promotion of its results in the market. The peculiarities of functioning of various innovative infrastructures in conditions of digitalization of the Russian economy taking into account innovative factors are analyzed. The article also justifies the creation of a virtual technopark as an infrastructure for support and promotion of 3D technology in the markets of different levels.

1 INTRODUCTION

Global and national market of 3D technologies and other related technologies for production of new materials used in layer-by-layer printing is currently developing rather intensively. Top trends of this process were considered in the Decision of a meeting of presidium of Council at the President of Russia for modernization of economy and innovative development of September 24, 2014.

In particular, it is offered to three structures: To provide to Minpromtorg, the Ministry of Education and Science, the Ministry of Economic Development development and submission for statement to Government of the Russian Federation of the project of a national technological initiative "New production technologies", including in the field of development of the automation equipment and robotization, the domestic software in the sphere of maintenance of lifecycle of creation of industrial products, additive technologies, other directions of industrial technologies and providing them with materials. In addition the Ministry of Education and Science together with Minpromtorg of Russia and the interested federal executive bodies and the organizations within updating of the priority directions of development of science, technologies and the equipment in the Russian Federation and the list of the critical technologies of the Russian Federation approved by the Presidential decree Russian Federation of July 7, 2011 No. 899 to prepare offers on addition of the priority directions the "new production technologies" direction, and the list of critical technologies – technologies of robotics, additive technologies, technologies of digital production, and also technologies of designing of designs and materials.

To three structures: To provide to the Ministry of Education and Science, Minpromtorg and the Ministry of Telecom and Mass Communications of the Russian Federation to the Government of the Russian Federation offers on development of system of life-long education in the field of bases of intellectual technologies, information technologies and computer modeling, mechatronics, robotics, additive technologies and materials science, including development of approximate main educational programs for the general education organizations, the professional educational organizations and the educational organizations of the higher education.

[a] https://orcid.org/0000-0002-3700-2435
[b] https://orcid.org/0000-0001-9817-4102

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2 METHODOLOGY

The study methodology is based on the use of systems approach methods, retrospective, forward-looking and functional analysis, and scientific comparison. Increasing the efficiency of the processes of interaction between science and industry in the field of promoting additive technologies, both at the level of a particular region and in relation to the country as a whole, determines the directions of digitalization of the economy. A systematic analysis of this issue suggests that the direction of the use of digital technologies in the economy deserves special attention.

3 RESULTS OF THE STUDY

The Decision suggests the interaction of innovation infrastructure, participants, technology platforms, funds of support and development of innovative activities, such as "SKOLKOVO", joint-stock company "Rusnano", the Russian Foundation for basic research, the Russian Foundation for technological development, the Russian scientific fund, the Russian direct investment fund, the Foundation for Assistance to Small Innovative Enterprises in scientific and technical sphere in the direction of support of new production technologies, including robotics, digital manufacturing, additive manufacturing and technologies for designing structures and materials, within the existing instruments of financial and non-financial support of economic subjects. The Decision also suggests the development of new support tools, providing if necessary, the appropriate changes in normative legal acts (Goncharova and Shakhovskaya, 2020).

The development of this type of market is connected to the emergence of new preferences among consumers, primarily in the industrial sector. Changes are associated with the search for less costly technologies compared to traditional and expensive. Alternatively, this type of consumers' demand can be satisfied through replacing the traditional technologies of manufacturing parts, objects and components with the additive technology (layer-by-layer printing) and digital fabrication with the aim of energy and resource saving.

Presently relevant are the ways for enhancing the effectiveness of innovation activity, commercialization of scientific ideas and developments, because in the future the intellectual property market might become the core element of the innovation economy. One of the main prerequisites of this process is the development of mechanisms of technology commercialization (Goncharova, 2015a).

The promotion of new products on the market is the process of introducing the results of scientific work – new knowledge as an economic resource in the Russian market as a whole and in its individual segments (Belik et al., 2020).

For scientific and technical developments this process can be characterized as the complex of the interconnected actions differing in the following features:

- technical complexity requires during creation of products of costs of skilled scientific work, any scientific knowledge is made once, but the potential of its use is many-sided and in time isn't limited therefore it is necessary to consider the potrebitelny cost of work on its creation and process of further use of the technical knowledge pledged in it;

- uniqueness of products causes difficulties of exact quantitative measurement of effect of scientific and technical products at the time of implementation;
- availability only of high-quality differences between analogs;
- each type of knowledge bears in itself special scientific information, therefore, the scientific and technical products personifying original knowledge on the content are specific and unique;
- various degree of readiness of this product for industrial development cause uncertainty of costs of the material, human, financial, information, temporary resources necessary for implementation of an innovation, and it, in turn, complicates process of determination of the price of scientific and technical products;
- successful implementation of a technological innovation depends on innovative opportunities of consumers.

Feature of the Russian business comes down to the fact that at the moment investments in organizational and managerial innovations, in streamlining of business processes give big return. Investments in management lead to bigger economy of expenses today, than investments into traditionally understood innovations. The labor productivity surplus from the correct joining of divisions, from cost reduction turns out more, than from investments into science, the equipment, Research and Development.

The organization of information exchange of schools of sciences and the entities for integration

strengthening shall become one of the key moments of marketing development of Research and Development. The most perspective forms of stimulation of innovative development of regions are based on creation of new innovative structures, such as science and technology parks, technopolises, free economic zones. On increase of degree of complexity technopark structures it is possible to arrange as follows: incubators, technological parks, technopolises, regions of science and technologies (Jafari-Sadeghi et al., 2021).

The effectiveness of the commercialization processes for scientific and technical products of higher education institutions can be enhanced by means of creating an innovative infrastructure with the specifics of functioning in the field of marketing management – a regional Technopark.

Technopark as a way of interaction between research institutions, universities and industry can be created from a network of independent elements of the infrastructure – business incubators (Korchagina and Korchagin, 2019). The leading universities of the region can organize their own business incubators for assisting small innovative enterprises engaged in the development of priority scientific directions.

The virtual Science and technology park is a specialized platform on which the research, industrial enterprises, the organizations and educational institutions representing the knowledge-intensive, high-technology and innovative products are provided. The standard virtual platforms stands of the entities of participants providing use of means of audiovisual display of various advertizing and marketing information, and also technical documentation can be a basis of an exposition. The virtual platform, in fact, is an action for identification and representation of technologies which development in production will provide to the entities and entrepreneurs of the city and region competitive advantages in the goods markets and will allow to advance scientific and technical products effectively.

Creation of regional virtual science and technology park based on several small innovative enterprises in case of higher education institutions, with participation of the Volga business incubator is offered (Martin-Rojas et al., 2019). The virtual science and technology park based on VPI is considered as the information space with marketing orientation promoting interaction of the small innovative enterprises of the region at distance, it will unite various higher education institutions, scientists, i.e. the same researcher will be able to participate in several projects, developments and can be not only at the level of the region.

In this regard, the creation of virtual Technopark on the basis of the Volzhsky Polytechnic Institute can emphasize its role of basic unit of the "3D technologies Centre ".

The goal of the center is to develop new production technologies in Volzhsky and the Volgograd region, such as "closing technology", 3D technologies, digital manufacturing, additive technology, technology for designing structures and materials. The application of 3D technology is associated with the design and manufacture of parts and basic plastics and polymers, rapid prototyping and three-dimensional printing, industrial design, small-scale production of exclusive products, creating layouts and models.

The main objectives of the Center are aimed at strengthening industrial and innovation capacity, developing a local engineering base where various 3D printing devices and components can be manufactured; training engineering and technical personnel on the profile of the Centre together with the VPI (branch) VSTU; R&D on the profile of the Centre and VPI (branch) VSTU; popularizing and introducing technologies and the Centre's products to enterprises and organizations in Volzhsky, Volgograd and the Volgograd region; improving and deepening the process of import substitution in the region (Mayes et al., 2020).

To construct science and technology park as a physical object investments, on floor spaces, rooms, transport are necessary and if to create virtual science and technology park based on VPI i.e. it will represent information space, to unite small enterprises of the region at distance, investments less, on registration of the domain, the hosting, creation of the website will be required here, the virtual science and technology park will unite various higher education institutions, scientists, i.e. the same researcher, for example, can participate in several projects, developments and can be not only at the level of the region. To become the user of science and technology park, the entrepreneur needs to be provided with virtual office. Further it is necessary to create a virtual exhibition, and as a result – to sign real agreements and to receive real money.

The science and technology park placed in information space will promote consolidation of various innovative infrastructures which are territorially isolated, will allow the same researchers to participate in several projects of various organizations, will increase efficiency of innovative activities within the region. Forming of science and technology park in the region will allow to solve the existing problems and to increase the economic and innovative capacity of the area.

Creation of science and technology park causes emergence of a number of benefits which are of great importance for region economy: reasonable investment of capital, provided by the regional power on development of an entrepreneurship; emergence of new workplaces, consolidation in one infrastructure of several technologies of business, and at last, ordering of transport flows. Symbiosis of several technologies in links of one economic chain is an important consequence of creation of science and technology park: scientific development, implementation of prototypes, cooperation of small, large and medium business, marketing researches, exposition and exhibition opportunities and potential implementation. The virtual science and technology park created based on higher education institution in the region will promote strengthening of interaction of the main market subjects in the direction of commercialization of innovations, to positioning and promotion of scientific and technical products in the Volgograd region and beyond its limits and to increase thereby the economic and innovative capacity of the area.

VPI (branch) VSTU possesses several operating (functioning) printing devices – 3D printers, designed and created by members of VPI (branch) VSTU and small innovation enterprise at the University of MIP OOO "ZABA". The devices were manufactured by teams of direct executors of the project and assembly works, constructors of the new 3D printers, specialized departments, long-term scientific schools and unique technologies for creating new consumables for 3D printers, as a result of many years of scientific, educational, methodical and laboratory work on mechanical engineering and 3D modeling conducted at VPI (branch) VSTU.

In terms of virtual Technopark functioning the task of import substitution in the production of 3D equipment can be carried out by promoting innovative products of VPI with further commercialization in the form of direct production of 3D printers by the Centre for the purposes and under the order of the enterprises of the city and the region. In addition, the Centre can carry out training and retraining of qualified specialized engineers for the needs of enterprises and organizations of the city and the region.

Such is the laboratory of educational-methodical complex developed and applied at the Volzhsky Polytechnic Institute. It has been designed both for professionally-oriented training programs and for educating about the opportunities for the computer technologies application, spheres of their application, experience with manufacturing, materials and manufactured items.

The target audience for the complex are educational institutions of higher professional education and vocational educational institutions (colleges, polytechnics), studios of computer-aided engineering at schools and youth centers.

The laboratory complex includes: a device for three-dimensional printing, 3D printer with the size of 180x210x345мм; consumable kit, the tutorial on 3D modeling and computer graphics; training materials and other corresponding tutorials (Najjari et al., 2020). Also, the complex may optionally include a laptop with preinstalled software such as Kompas-3D or AutoCAD.

The proposed product (FDM technology) performs the following functions: rapid prototyping and 3D printing; limited production of exclusive products; creating layouts and models; modeling and reconstruction; home application.

The main technical characteristics of goods which are profitable determining competitive advantage in the market:

- positioning accuracy: 0,05 mm;
- minimum thickness of a layer: 0,05 mm;
- size of the working field: 210x210x400 mm;
- nozzles for a seal: 0,2-0,8 mm;
- plastic types for a seal: ABS, PLA, polycarbonate, Neylon, PVA;
- power consumption: 350-500 Watts;
- overall dimensions: 350x350x600 mm;
- weight: 18 kg / ON for work in a set.

As competitive advantages at cost of services it is possible to give the following examples:

1) 3D - a seal from microreactor metal on DMLS technology (Direct Metal Laser Sintering - direct metal laser agglomeration): the microreactor for oil processing. The cost of the microreactor constituted about 500 dollars that is 10-15 times cheaper than the similar microreactors (produced by traditional methods).

2) process of traditional production is a welding, a tokarka, a combined design. (cost of $5000-7500 apiece). 3D - a seal from plastic on FDM technology (Fused Deposition Modeling – modeling by a melting method): details for household appliances, small mechanical engineering, exclusive details. The cost of unit of a detail is about 10-30 times cheaper than the similar details produced by traditional methods.

The following potential customers and partners in the regional market might be interested in the product: JSC "Volgogradneftemash", OJSC "CCB "Titan", LLC "INTEHSERVIS", VNTK (branch) VSTU, Volzhskiy plant of metal constructions,

Volzhsky shipbuilding ship-repair plant, Volzhsky plant of household appliances "VolTek", VSMU – the Department of stomatology and anatomy and other enterprises of small engineering.

As for a competitive environment, in the domestic market the situation develops for benefit of the VPI Center. Competitor analysis allows to generalize information.

MNTTs (Tomsk) made one of the first domestic 3D printers. Recently there are no messages on continuation of works (http://mntc.ru).

In Moscow production 3D of Picaso Builder printers is performed by the 3D Picaso company which was created in 2012 based on LLC Scientific and Production Enterprise Intellektualnye Informatsionnye Sistemy (NPP IIS) [http://picaso-3d.ru].

In Nizhny Tagil the Center of Information Technologies (LLC TsIT) Limited liability company makes 3D Chameleon printers [http://reprap-russia.org/].

The Maket-City company from Kursk makes 3D printers under the name Lumen [http://cnc.maket-city.ru].

The Print & Play project from the Novosibirsk Campus performs small-lot production of 3D printers of own design under the name of SibRap.

The Moscow RGT (develops and makes the equipment with numerical program control) produced at the end of last year the PrintBox3D One model

The STANKIN-AT company – the private enterprise in case of MSTU "to STANKIN was sold recently by the first Prusa Mendel.

Considering the concept of business model the authors propose interaction with potential partners on the basis of the virtual technopark (Parameswar et al., 2019). This interaction on the economic and legal terms will be effective in the framework of the virtual technopark as an innovative infrastructure, created on the basis of VPI (branch) VSTU (Rath et al., 2019).

MIP "TsEBE" is ready to perform the following actions for the partner:

1. Development, designing and production of details and nodes on the 3D-printer by FDM method.
2. Designing and production of the 3D-printer, under the specified sizes of the working field.
3. Delivery technical (*laboratorny educational and methodical) turnkey complex.
4. Development, designing and production of the 3D device - a seal from metal on technology of metal laser agglomeration of DMLS.
5. Research and Development on receipt of the innovative polymeric materials applicable as account for 3D - seals by a melting method on FDM technology.
6. Designing and production of the extruding device for direct production of consumable materials (bar).
7. Distribyyuterstvo, partner agreement, joint business.

The partner in turn provides for MIP "TsEBE":

1. Investments (grant) into Research and Development on designing and production of the 3D device - seals from metal on technology of metal laser agglomeration of DMLS.
2. Investments (grant) into Research and Development on receipt of the innovative polymeric materials applicable as account for 3D - seals by a melting method on FDM technology.
3. Investments (grant) into Research and Development and production of the extruding device for direct production of consumable materials (bar).
4. Services of the distributor.

4 CONCLUSIONS

The analysis of own benefits and shortcomings allows to draw the following conclusions:

- benefits are the potential of project participants (availability of higher education, profile knowledge and skills, availability of academic degrees, profile publications and materials) existence of schools of sciences and technology of the main partners of the project on designing and production of new polymeric materials;
- treat shortcomings: insufficient knowledge at the regional level of new world technical tendencies, lack of the state and/or private investment support and partnership, lack of the sufficient knowledge base about laser technologies.

The operation of the 3D technologies Centre and training based on the virtual technopark at VPI (branch) VSTU will strengthen the position of competitive advantages of machine-building companies in the city and region.

The creation of a virtual technology park is a key factor in the development of digital technologies in the region, as it allows ensuring rational investments in the development of entrepreneurship, new jobs, the symbiosis of several technologies in the links of one economic chain, the interaction of major market actors, and increasing the economic and innovative potential of the region's economy.

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