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Entrepreneural Ecosystems of the Leading Universities

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***Abstract* – The article is devoted to the analysis of the markers of productive ecosystems of the world's leading universities. Educational and motivational function, information and financial support, prototyping and development of the experimental base, expert support of scientific and inventive creativity, development and testing of entrepreneurial skills of young people, within the framework of strategic partnerships and technology promotion systems, are implemented within ecosystems.**

Keywords – technological entrepreneurship, ecosystem, international ratings of entrepreneurship, markers

I. INTRODUCTION

The term “technological entrepreneurship” does not have an unambiguous interpretation. It is determined by various authors based on the scope of their scientific interests and their research objectives. A review of the special literature shows that by now, a number of positions have been formed. They associate technological entrepreneurship with the following categories, processes, terms: small business enterprise owned by an engineer or a scientist; problem solving or order fulfilment for a certain technology; the creation of new industries, finding new applications of existing technologies or the practical application of existing scientific and technical knowledge; cooperation for technological change.

Technological entrepreneurship today is characterized by the following figures and facts, which make it possible to see both the development potential of this area, providing fundamentally new approaches to the economic and technological development of the country, and significant difficulties in its implementation:

- In Russia, there are about 700 technology start-ups at different stages of development (Comment: the figure is comparable to the results of the business initiation in the field of technology 2–3 developed ecosystems in the countries-technological leaders);
- 6 startups account for 1 million people in the urban population (Comment: the indicator is ten times lower than in Silicon Valley);
- 62 % of all technological startups in Russia accounted for B2C-startups (Comment: in technology entrepreneurship, the share of B2B sector should be decisive!);
- The number of startups in the technology entrepreneurship ecosystem is dominated by e-commerce (15 % of start-ups) and financial technologies (13 %), with the main financial services being mobile payments and lending;
- The most rapidly developing areas of e-commerce and content, in the future, the palm will move to technologies from the category of "smart home" and industrial applications;
- 5 % – the share of entrepreneurs participating in the development of new products or services and the total number of technological entrepreneurs in Russia (Comment: a dangerously low proportion of technological entrepreneurs);

- R & D expenditures in Russia make up 1.1 % of GDP, while in countries with a developed business ecosystem they reach 2–4 %;
- The main direction of investment in R & D is the development in the field of IT and communication technologies (over the past five years, these developments accounted for 1.3 to 3.7 % of the total investment in R & D) (Comment: artificial intelligence and enterprise management, biotechnology, retail, energy and carbon processing technologies, cellular technologies in the food industry, production of environmentally friendly products, computer security, education, transport, financial services, healthcare, robotics, virtual p Realism is today the most sought-after sectors of the development of technological entrepreneurship in the world!);
- Russia ranks 26th in the list of 190 countries in terms of business comfort, according to the World Bank's Doing Business Index;
- Russia has relatively low indicators on the valuation of the results of inventive activity and intellectual property.

It is obvious that youth technology entrepreneurship is currently one of the key drivers for the leading economies of the world. Being the part of technological entrepreneurship formed within the framework of university ecosystems, it is based on the key competencies of leading universities (first of all, technical ones). Each element requires a strategic action, initiative, solution, as well as a synergistic result provided by the management of the environment for the development of youth technology entrepreneurship on the part of the state, regional authorities and managers of university ecosystem initiators.

II. LITERATURE REVIEW

Analyzing technological entrepreneurship in relation to universities, it seems correct to emphasize the role of these organizations as the main producers of scientific knowledge and new technologies. Without cooperation with them business will be deprived of both ideas and human resources. Given this circumstance, let us formulate the following definition: technological entrepreneurship is a market- and risk-oriented organizational integration of science and business, based on research, experimental and inventive activity in the direction of the development, production and market testing of new technologies.

The presence of alternative views on the definition of the phenomenon of entrepreneurship in many cases led to heterogeneity in the interpretation of "technological entrepreneurship". One of the first researchers who gave such a definition, became Wainer and Roberts. They described technology entrepreneurs as "individuals who have typical entrepreneurial qualities, but also have features that allow them to create technology enterprises." Jones Evans clarifies what is meant by the "establishment of a new technology venture" [6]. In the same series, the definitions of Kriewall and Mekemson should be highlighted, which introduce the concept of "entrepreneurially minded engineer" [15].

Highlighting the concept of human resources in the early 2000s made a change in the alignment of accents in the modern definitions of technological entrepreneurship. In particular, the need for special skills and competencies of such an entrepreneur is noted. It is a high-level potential strategy, that is, there is a decision-making strategy, that is, that it can be used as the leading strategy, that it can lead. Developing this idea, Claudio Petti defines technology entrepreneurship as "a combination between two individual concepts – technology and entrepreneurship, which leads to "recognition, discovery and even creation of entrepreneurial opportunities for technological improvements" [5]. It is also worth highlighting the definition of Bailetti, who conducted an analysis of 93 articles on technology entrepreneurship, and on the basis of this offered his own definition of: " "and capturing value for a firm" [13].

The presence of special knowledge and skills attracted the attention of researchers to the study of the role of universities in the development of technological entrepreneurship. Universities are a pool of trained, skilled graduates. A number of studies on entrepreneurial intent technology and science students confirm that university teaching environments are among the most influential factors that affect the entrepreneurial career [4]. In addition to entrepreneurial learning, a university can become a source of entrepreneurial resources needed to launch a new business. Entrepreneurial intentions are strongly influenced by the perceived barriers and support factors in the entrepreneurship-related context. Therefore, universities need to enhance educational, economic, research and resource programs on entrepreneurship that these barriers can eliminate [12].

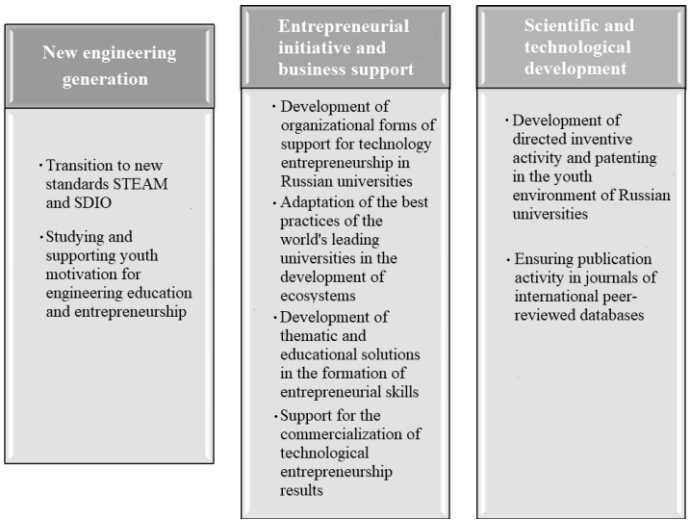

Fig. 1. Comprehensive methodology for study and development of youth technology entrepreneurship

III. METHODOLOGY

In contrast to ordinary business activities, youth technology entrepreneurship cannot be initiated only by an entrepreneurial

plan. It requires an already established readiness and motivation of the youth engineering audience, assistance from the university science and partner business systems.

As a rule, this support is formed by an ecosystem – a dynamic economic model of interaction between universities, business structures, regional government and public organizations. Its goal is to transfer knowledge, enhance research processes that are ahead of the development of technology and innovation.

The main markers of the effectiveness of technology entrepreneurship have already identified. It is patent, publication activity in journals of international peer-reviewed databases and the dynamics of university grant support. The point of interest is the analysis of markers of a productive ecosystem, as the only possible environment for long-term, sustainable in time, youth technology entrepreneurship.

In Russian universities, technological entrepreneurship is structured, functionally developed and institutionalized in different ways. These differences determined the motivation to study the functions and markers of ecosystems of world's leading universities.

As part of the execution of the state task of the Ministry of Science and Higher Education of the Russian Federation on the theme “Organization of socially significant events in the field of education, science and youth policy in order to organizational and technical, informational and analytical support for the implementation of the road map for the development of technological entrepreneurship, based on higher education institutions and scientific organizations" team of the scientific center of technological forecasting and entrepreneurship analyzed the ecosystems of the world's leading universities.

World, regional and national university ratings, related to entrepreneurship, commercialization and innovation, were used to sample the study of international experience of ecosystem development. In view of the importance of US universities in this direction, the ratings of the USA, Europe and the Asia-Pacific region were analyzed separately (to maintain the balance).

Five ratings were used for the study of American universities:

- The World's Most Innovative Universities – 2017, compiled by Thomson Reuters;
- The Best Universities for Technology Transfer – 2018, compiled by Milken Institute;
- Top 25 undergraduate/graduate schools for entrepreneurs – 2018, compiled by The Princeton Review together with Entrepreneur;
- Best Colleges for Start-Ups – 2018, compiled by www.bestcolleges.com;
- Top 50 universities producing VC-backed entrepreneurs – 2018, compiled by PitchBook, reputable company in the field of financial analysis and software.

These ratings use different criteria in their methodology for evaluating universities:

1. The World's Most Innovative Universities – 2017

This rating is based on the publication activity of the universities (in journals indexed in the Web of Science database) and their patent activity.

2. The Best Universities for Technology Transfer – 2018

The rating takes into account the number of patents, received by the university, licenses, income from licenses and the number of startups.

3. Top 25 undergraduate/graduate schools for entrepreneurs 2018

A large number of criteria are used: availability of training courses in business and entrepreneurship, as well as in technology entrepreneurship, availability of entrepreneurship competitions (New Venture Competition, Hackathon, Start Up Weekend), the number of enterprises opened by graduates in the last 5-10 years and the amount of funding attracted by them, etc.

4. Best Colleges for Start-Ups – 2018

Availability of entrepreneurship training programs or business centers; the number of visible startups created by graduates; amount of offered support (financial, mentoring, etc.)

5. Top 50 universities producing VC-backed entrepreneurs – 2018

Generally, the rating considers the volume of venture financing which was attracted by companies created by graduates of the university.

IV. Results and Discussion

In each ranking, the first 15 universities were selected. According to the results of the analysis of the functioning conditions of the ecosystems of the world's leading universities and the conditions of supporting technological entrepreneurship, the following markers were formed:

- patent activity, including the participation of young people, and availability of patenting culture: the participation of students and undergraduates was represented in more than 80 % of the patented result of the inventive activity of the university;
- multidimensional expert support for technological and entrepreneurial initiatives: each student can get access to free counseling from at least 100 university specialists within the framework of existing business support structures; weekly and individual consultations for students with participation of company founders and experts; annual conferences with the possibility for student who won business competitions to have face-to-face meetings with the founders of well-known companies; 1 (one) mentoring program may include up to 115 advisers and 30 mentor partners;

- high level of entrepreneurial fertility of the environment: on average, at least 80–90 startups are created annually in universities; from 900 to 1000 companies are annually created by students and graduates, for example, at MIT (Massachusetts Technological University);
- global, permanent and at the same time dynamic system of entrepreneurial education: each student gets access to the global programs and online business courses; technology entrepreneurship programs and courses are updated daily; the universities conduct weeks of total entrepreneurship studies and 4-month spring and autumn venture capital initiatives; consulting services become free for winners of business competitions and hackathons;
- elective courses on entrepreneurship are offered to the student of the bachelor program; international internships at startups in New York, Tel Aviv, Shanghai;
- permanent unlimited access to an equipped workspace: the access for students and mentors to the shared equipped workspace is carried out in the 365/7/24 mode; at the university, up to 2000 m^2 is allocated for innovative space, and not less than 500 m^2 for laboratory space;
- unlimited funding for entrepreneurial initiative, inventions and technological performance of young people: awards for students, who have won entrepreneurial competitions, range from 100 to 300 thousand dollars; 10-year financing for entrepreneurial activity at the University of Michigan constitutes $ 1.7 billion; up to 150 thousand dollars are allocated annually for the expertise of innovations; for the survey of potential customers in the programs of commercialization is allocated annually up to 150 thousand dollars.

Furthermore, the activity of leading universities was classified into several groups of functions, actions and decisions. As for structural decisions it could be a mandatory participation of universities in government programs to support technological entrepreneurship (for example, programs adopted in the People's Republic of China – Torch, 863, 973, aimed at improving the innovation ecosystem, distributing scientific and technical resources, promoting technological innovation and transformation, promoting integration of economy, science and technology, transformation of the sectoral structure and strengthening of regional innovation abilities) or participation in inter-university network programs (such as the PowerBridgeNY program, funded by the New York State Office of Energy Research and Development (NYSERDA). PowerBridgeNY has two centers that work together as a whole. One center is led by representatives from Columbia University, the other one is led by Tandon School of Engineering at New York University (NYU).

Concerning the organization the following measures can be adopted: development of structures within the university's educational space, providing intra-and extra-university resources – trust organizations (Martin Trust Center for MIT Entrepreneurship), student associations (Sloan Business Club, TechX), mentor networks (Stanford Angels & Entrepreneurs). Nontrivial solutions, focused on the implementation of one function or focused on acting as hubs to coordinate diverse entrepreneurial activities, form the list of influential and well-known business structures outside the universities.

It also important to highlight the instrumental solutions like enhancing the role of the student`s community in initiating and organizing major events (Aalto Entrepreneurship Society, Cambridge University Technology & Enterprise Club); providing global access to accumulated knowledge (STVP Entrepreneurship Corner – a free online archive of learning resources, open to support “educators around the world,” created as part of the Stanford technology venture program); approaches for organization of training programs (using the experience of failures to develop an empirical progress in the work on Techprim – an analysis of not only positive, but also negative experience during the course of training at Harvard University programs), etc. Leading universities use original solutions.

Therefore, as part of the analysis, a base was formed for analytic multivariate comparison of the results of ecosystem formation in Russia and abroad, as well as for finding unique and approbation solutions in the field of integration of science, education, business and regional environment.

V. CONCLUSION

Analysis of the activities of foreign universities in the field of technology entrepreneurship support showed that, despite the presence of a certain list of established formats, forms, tools – business incubators and accelerators, technology transfer centers, competitive programs, entrepreneurship courses, mentoring programs – leading universities also use original solutions.. The original decisions are based on consideration of the national, regional, sectoral, and organizational context, on the use of available resources, competencies, and opportunities. “Blind” copying of best practices cannot lead to planned results. A variety of unique trajectories of leading universities in the support of technology entrepreneurship, the selected foci of attention clearly indicate the need for a variable approach to the use of accumulated international experience, since it is obvious that there is no universal option.

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