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Technology commercialization in entrepreneurial universities: the US and Russian experience

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Abstract US universities are leading the way in technology commercialization, while universities in Russia lag far behind. This paper discusses the best American practices, as well as the main issues of technology commercialization at the US universities. As an example, we consider the experience of the University of Maryland, College Park. In the next section, we turn to technology commercialization in Russia, where it struggles for several reasons. In this paper, we propose that Russia can improve its technology commercialization by studying the example of the leading US entrepreneurial universities and implementing proper procedures. And the important overarching point is that Russian universities need to improve their collaboration with industry, and they need to develop new standards of administrative, research, and business activity that will promote innovation and entrepreneurship.

Keywords Technology innovation · Technology entrepreneurship · Technology transfer and commercialization · Entrepreneurial university

JEL Classification O31 · O32

1 Introduction

Today's research university is valued not only as a provider of education and research, but as a center of innovative activity and a generator of new knowledge and technologies. And while education and research remain the most important functions of the research university, some institutions have taken steps to encourage entrepreneurship, to promote

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regional development, and to engage in what is known as technology commercialization (for example, Speser 2006; Shane 2004; Bradley et al. 2013, among many others).

Technology commercialization is the act of turning the research results of a university (ideas, inventions, new technologies) into products that can be sold in the marketplace. The development of technology commercialization is connected with the emergence at universities of new functions—scientific and technical entrepreneurship, business incubation, the creation of new companies, and the implementation of innovative projects.

Who benefits from technology commercialization? All stakeholders in the process: universities, businesses, professors, students, investors, government, society, the local and national economy. The outcome of technology commercialization is especially evident in the United States where there are major research universities (Boston, Silicon Valley, etc.). Technology commercialization activities are increasingly important as a source of regional economic development and revenue for the US universities (Friedman and Silberman 2003).

US universities are leading the way in technology commercialization, while universities in Russia lag far behind. Fortunately, Russia can examine the experience of technology commercialization at leading US universities and implement steps to improve the process.

In Russia, technology commercialization struggles for several reasons. Through recent policy initiatives, coupled with investment in physical infrastructure, Russia has built the components of an innovation ecosystem. But it lacks many things that would encourage technology commercialization such as an entrepreneurial culture and innovative environment, strong project teams and skilled inventors in business, and entrepreneurship education. What is more, as we have learned from our own experience and from conversations with colleagues, in Russia intellectual property is poorly protected and the patent process is a mere formality with little standards, and there is an excessive concentration on formal procedures, on filling out statistical reports and observing indicators, etc. As a result, Russia has yet to find a way to consistently convert the knowledge and technologies developed by its universities into saleable products.

In this paper, we propose that Russia can improve its technology commercialization by studying the example of the leading US entrepreneurial universities and implementing proper procedures. And the important overarching point is that Russian universities need to improve their collaboration with industry, and they need to develop new standards of administrative, research, and business activity that will promote innovation and entrepreneurship.

1.1 Technology commercialization in the United States

In the United States, the successful development of innovations in the last decades of the twentieth century was related to the increased attention of government and universities to the management of intellectual property (IP). The beginning of university entrepreneurship can be attributed to the passage of Bayh–Dole Act (1980), which enabled technology commercialization at US universities.

According to the act, a university became the legal owner of any IP that was created at that university as a result of publicly funded research (Bremer 1998). Before Bayh–Dole, the United States had no uniform policy regarding patents and IP rights when it came to universities. Thus, each government organization had to define its own policy. Generally, the rule was that any IP created at a university using public funds belonged initially to the US government. Operating under the various agency policies, the government had accumulated in its patent portfolio about thirty thousand patents, of which only about 5 % had been licensed; the percentage of inventions that stemmed from those patents that had found their way into commercial use was even smaller.

The law identified the fundamental rules for marketing, licensing, and selling the IP. Moreover, universities established special technology transfer offices (TTO) and offices of technology licensing. Consequently, in the years since Bayh-Dole was passed, there has been a dramatic increase in technology transfer from research institutions and universities to industry and an increase in the efficiency of technology commercialization. The income earned by US universities from licensing increased from $7.3 million in 1981 to $3.4 billion in 2008 (Tieckelman et al. 2010).

University administrators cite technology commercialization as evidence of the increasing contribution of universities to the local/regional economic development, and recognize it as a source of university revenue. In addition, technology commercialization favorably affects curriculum, and a marketing tool to attract students, faculty and additional industrial research support (Friedman and Silberman 2003).

Thus, research universities have become the foundation for successful technology commercialization as well as boosters of the regional economy. The growth points for the US economy were chosen by the government extremely well: universities have all the necessary resources—laboratories, equipment, professors, students, etc. Those resources were supplemented with physical infrastructure, support programs for innovations, and industry involvement in technology commercialization at universities, as well as a high-quality entrepreneurship education and methods for developing the entrepreneurial culture.

Today, US universities have a distinct system of partnership between science, business, government, and sources of capital, clear actions to guide their innovation projects and technology commercialization, and institutes for training a new generation of technological entrepreneurs.

The physical infrastructure as well as the approaches to technology commercialization at US universities is extremely flexible. In Fig. 1, we present the idealized process of technology commercialization at those institutions. Successful R&D begins the process of commercialization. If it results in an invention, the invention is made known to the university's TTO via a completed information form. An expert from the TTO, which coordinates work on the invention, is appointed, and the technology is assessed. If the assessment deems that the invention is not commercially viable, the invention is sent back

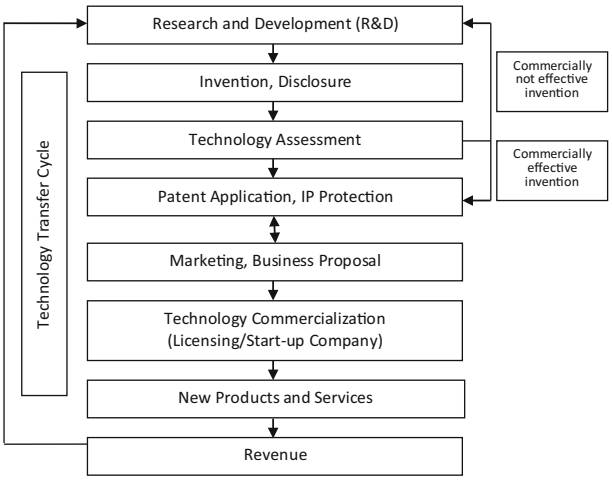

Fig. 1 Technology commercialization stages at US universities. *Source* adapted from office of technology commercialization presentation, University of Maryland, College Park http://otc.umd.edu/sites/default/files/documents/about-otc-2010.pdf

to the R&D process for refinement (if it is not abandoned); if the invention is, on the other hand, judged to be commercially viable, then the assessment determines what kind of IP protection will be sought and if a patent should be applied for, as well as establish the appropriate model of technological commercialization. Because it costs about $10,000 to $25,000 to patent an invention in the United States, universities patent only commercially advanced inventions. Generally, US universities do not have their own patent experts and instead hire outside experts, which has proven to be effective. Experts in TTOs can have a technical or business education, degrees in science, and experience in industry, marketing, and licensing agreements. Thereafter market research is conducted, and a business proposal is prepared. Negotiations with companies interested in the new technology begin, and the commercialization model is completed.

In the United States, there are two basic models of technology commercialization (Carayannis et al. 2014):

1. License agreement with an existing company that is interested in a new technology;
2. Start-up company using the university's IP (the university can license with an existing company, or with a new company started with a technology license).

In both cases, a license agreement between the university and an existing or start-up company is concluded. According to the license agreement, the licensee (the company that obtained the license) pays the licensor (the university) fixed payments—a royalty. If the license agreement is concluded with a start-up company that cannot afford to pay a royalty, often the university becomes the owner of a new company share.

Creating a start-up company at a university has a number of advantages: a university provides necessary administrative and consulting support as well as opportunities for raising capital; in addition, a new company can benefit from the expertise of researchers at a university.

A university's success at creating a start-up company depends mostly on the level of the inventor's skill and talent in technological entrepreneurship and his or her desire to develop a business, an innovative regional ecosystem and the availability of capital, the policy and institutional structure of a university, and its intellectual potential, among others.

According to American practices, 80 % of license agreements are concluded with a licensee who is familiar to the inventor (professor).[1] After signing a license agreement, TTOs control and monitor its execution.

As an example, we can consider the experience of the University of Maryland, College Park (see appendix).

So, the main tasks of technology commercialization and licensing at US universities can be identified as the following[2]:

- Accelerate the transfer of new technologies from universities to the marketplace.
- Provide services (training, counseling, and mentoring) for university researchers and potential business partners.
- Assess the fair market value of IP owned by the university, and determine and negotiate fair terms of transactions and agreements.
- Use best business practices while taking into account the interests of the general public.
- Resolve conflicts among groups of researchers, industrial partners, and the university.

[1] Office of Technology Commercialization presentation, University of Maryland, College Park (http://otc.umd.edu/sites/default/files/documents/about-otc-2010.pdf).

[2] Adapted from AUTM and OTC presentations and materials.

Moreover, the following factors promote enhancing of university technology transfer and the generating more licenses and license income (Friedman and Silberman 2003):

- Providing greater rewards for faculty involvement in technology commercialization (amount of royalty income allocated to the inventor).
- Location of the university in a region with a relatively high concentration of technology firms.
- Clear university mission and objectives in support of technology commercialization.
- Experience of the university's technology transfer office (age of TTO) (see more Friedman and Silberman 2003).

Although some American universities have made great progress in technology commercialization and scientific entrepreneurship, there remain a number of problems. One of the main ones is that inventors do not always disclose inventions to their university's office of technology commercialization in time, which could possibly jeopardize the patent process.

However, as our interviews have shown, inventors deem that the rules and regulations imposed by the Offices of Technology Commercialization (OTC) limit their freedom in scientific research.

The disclosure of university faculty invention is a major problem, and it is actively discussed by experts in technology commercialization. For instance, the paper (Panagopoulos and Carayannis 2011) proposes the approach how university can achieve full disclosure by allowing faculty scientists to self-license their invention in return for some form of non-pecuniary ''insurance'', just in case they fail in self-licensing their technology (see more Panagopoulos and Carayannis 2011).

Another problem is the fact that universities tend to be excessively decentralized. Too much decentralization can cause entrepreneurial projects to lose their integrity and synergy, and may result in a loss of control over intellectual property. At the same time, universities should not rush to centralize their operations too much, as excessive centralization of management can constrain initiatives and dampen the entrepreneurial spirit of students and professors.

Also innovations, especially during the initial stage of development, can get stalled and may not come to fruition due to lack of resources. This initial stage is a risky and perilous time for a developing innovation. The key role in this process plays marketing. Marketing efforts enable the survival of early stage innovations. These issues are explored in the paper (Schoonmaker et al. 2012).

But despite those problems, technology commercialization at US universities has been successful overall.

For example, commercialization at the University of Maryland alone generates around $1 million a year (Table 1) for the Office of Technology Commercialization, not to include returns to the various companies.

The US universities afford an excellent example for Russian universities to follow.

1.2 Technology commercialization in Russia

Let us now turn to technology commercialization in Russia. Russia is good at research, and her science and research fields remain world class (American Councils for International Education 2014). Russian scientists and inventors are known throughout the world.

The Russian government has actively financed R&D in recent years: expenses for R&D were 1.48 % of GDP in 2013 (Global R&B funding forecast 2013, Battelle R&D

Table 1 Office of Technology Commercialization main results (University of Maryland, College Park)

Issue	2008	2009	2010	2011	2012	2013	2014
Invention disclosures	132	137	156	118	134	136	197
Patents	25	25	17	40	28	38	37
Licensed technologies/license agreements	15/12	20/17	29/13	33/14	30/13	40/18	30/21
Revenue*, $K	1820	1105	941	920	969	848	1032
Sponsored research, $M	401	518	545	472	502	–	–
Start-up companies	2	4	4	2	4	8	3

* Collected in license, option, and royalty income + patent reimbursement income

OTC, University of Maryland, College Park

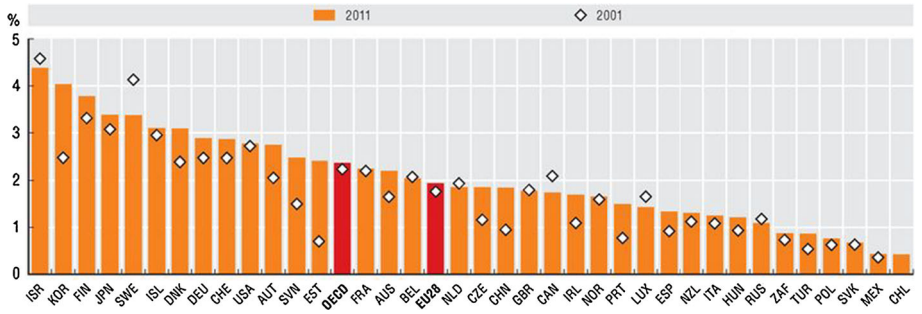

Fig. 2 Gross domestic expenditure on R&D, 2001 and 2011 as a percentage of GDP. *Source* OECD, Main Science and Technology Indicators Database, www.oecd.org/sti/msti.htm, June 2013

Magazine), compared with around 1.1 % of GDP in 2011 and 2001 (see Fig. 2). They are less than in the United States (around 2.8 % of GDP in recent years), but for Russia they are considerable nonetheless, and the percentage is expected to reach 3 % by 2020, according to the strategy of innovative development of Russia.

But Russia patents a large amount of IP without commercial potential and commercializes only 2.2 % of inventions.[3] Most Russian R&D is carried out in public institutes that have weak commercial ties. Thus, Russia's biggest deficiencies are technology commercialization and practical application of inventions.

There are four main models of technology development in Russia: (1) government contracts and research grants; (2) business contracts; (3) university-based start-ups [Federal Law 217 (2009), "Law on Small Enterprises near Universities"]; and (4) licensing.

Russian universities are focused on models 1 and 2 of technology development and have historically not been concerned about the practical use of scientific results. But models 3 and 4 are where technology commercialization is really at, and they represent new trends for Russian universities.

Models 3 and 4 demand inventions (IP) with the potential for commercialization, support organizations (structure) and resources, and the promotion of team (especially

[3] The Federal Service for Intellectual Property of Russia (Rospatent), 2012 (http://www1.fips.ru/wps/wcm/connect/content_en/en/main).

model 3) and entrepreneurial skills. These aspects are missing at Russian universities. Universities are not ready to pursue these models of commercialization. Therefore it is precisely models 3 and 4 that need to be developed.

Technology commercialization in Russia means any form of commercial usage of IP, including a cession of the rights, licensing, and internal use of IP by universities and commercialization by specialized companies.

In Russia, the adoption of Federal Law 217 in 2009, which made possible technology commercialization at universities, has brought Russian universities closer to the model of the entrepreneurial universities one finds in the United States. Its importance cannot be overstated. The law allows universities to create small medium enterprises (SME). It was passed to support the implementation of IP in the production of innovations, which in turn was derived from the state budget.

Today, Russian universities have a quite comprehensive, although far from perfect, institutional framework for the involvement of IP in economic circulation and the realization of two main models (as in the United States) of technology commercialization.

The implementation of Federal Law 217 is considered to be a difficult process but the range of unresolved issues is constantly decreasing (in particular, in connection with Federal Law 273 adopted in 2012, "About Education in the Russian Federation"). It will take several more years to create a sustainable system.

That can be seen from the experience of colleagues in America, where a similar law was adopted but much earlier (1980).

In recent years a number of serious reforms that changed the rules of technology commercialization were carried out in Russia. However, all this was implemented in an environment created with outdated approaches.

Entrepreneurship, innovation and commercialization are a function of traditions and elements of the social structure, which are heavily influenced by the historic character of the system development and regional specialization. Regional systems of innovation emerge as a result of mutual interaction between national, sectoral, micro and region-specific determinants. In the paper (see Radosevic 2002) the conceptual model of a regional innovation system is developed and the each of its four determinants is explored.

Historically, market relations in Russia did not affect the process of technology commercialization at the country's universities; applied research was conducted generally at scientific research institutes; universities did not play major roles in innovative and regional development.

Therefore, the development of innovation and entrepreneurship, as well as finding an optimum balance between different types of activities (education, innovation, technology commercialization, entrepreneurship, etc.), is far more difficult at Russian universities than at American universities.

State legislative and structural measures in Russia are generally directed at the creation of innovative physical infrastructure and the tools of innovation (resources, incubators, science and technology parks, funds), but filling that infrastructure and finding good projects to take advantage of those tools remain a problem. Creating such structures and tools alone will not create the intended effect. Also needed are an innovative competitive environment and an entrepreneurial culture promoting the birth and advance of ideas and new technologies—two things very poorly developed in Russia. And without them the innovative ecosystem, in particular at universities, will not function. Physical infrastructure and the tools of innovation together with an entrepreneurial culture, friendly communications, networking, and mentoring—those make the environment effective for technology commercialization.

Support new functions, programs and initiatives, which if successful can lead to the creation of new organizations and physical infrastructure, rather than supporting new stand-alone organizations with undefined functions that are in search of demand (see Radosevic 2002).

So, high quality innovation—namely one that leads to smart, sustainable and inclusive growth requires patient and sustained investments in human, financial, social and intellectual capital and not just money (Carayannis and Dubina 2014).

Innovation policy in Russia is more directed at the implementation of scientific projects at universities and the stimulation of inventors and research teams to find possibilities for technology commercialization independently. However, the scientist-businessman is a rarity in Russia. Scientists are not particularly skilled at knowing market conditions, cannot determine the market value of their own inventions, and almost always cannot turn technology into a saleable product.

For its part, industry is not familiar with the technologies developed at universities. Even when an industrial company is interested in a university's technology, the university simply is not ready to work with the company. Generally this is because the university does not understand the rules of the game, does not have qualified experts who can manage the dialogue between science and business, and does not have strong project teams capable of "packaging" the innovative project for industry needs.

The Russian government conducts a top-down innovation policy: decision-making and the distribution of resources are centralized, and there is a lack of organizational flexibility. The fear of misuse of public funds blocks initiatives and the flexible adaptation of support mechanisms. Innovations should not depend on the state; they should be born independently through a bottom-up culture of innovation.

In spite of the fact that a number of important normative legal acts regulating innovative activity at universities, as well as a number of changes in legislation, have been adopted, faculty members, inventors, experts, and students do not understand basic concepts of IP protection and usage.

At the leading American universities, promoting IP management and educating key players about it began in the middle of the twentieth century, long before adoption of the Bayh–Dole Act. In Russia, they are only now beginning.

As noted, the scientific and technical potential of Russia is huge. The largest companies in the world are very interested in benefiting from and using innovative products and technologies developed in Russia. But the realization of Russian potential is not a simple matter.

One complication holding Russia back is that of training technology entrepreneurs, project teams, and innovative managers at her universities. There is no good business education in Russia. In most cases, faculty members in business schools have never been in industry and have no experience with the kinds of projects businesses usually undertake.

This gap between science and business has affected the quality of teaching and education.

Although difficult, it is possible to raise capital (invite investment) in Russia. Investors around the world would rather choose strong teams instead of good (even disruptive) technologies because without a good project team, no technology can be used to any great benefit.

The problem in Russia is a lack of strong project teams that are able to justify an investor's capital. Training of such teams and the development of business skills have to happen at the universities, which are unfortunately still a long way away from being able to

do those things. And only experts with experience in entrepreneurship can provide high-quality training.

It is necessary to train not only students in economic and business schools, but also students in technical schools, because they are future technology entrepreneurs with their ideas and projects. If there is an idea, the student or the university graduate has to know what to do with it. And such initiatives have to receive new mechanisms of support within universities, including access to capital.

Universities need a stable source of public funding for research. The Russian government actively finances and supports the development and advancement of new knowledge and technologies (through the Russian Humanitarian Science Foundation, the Russian Foundation for Basic Research, Federal Target Programs, the Foundation for Assistance to Small Innovative Enterprises, Skolkovo, Rusnano, RVC, etc.). The state acts as a so-called "business angel" during the first stages of innovative projects, helping universities to carry out R&D and to enter the market for private capital. Universities actively participate in such programs; however, when public financing comes to an end, technologies are not yet ready for the market, the project team is not ready (or has no desire) to market IP or start a business; there is no administrative and consulting support available. Participation in such programs becomes an end in itself; further development of technologies and the organization of successful new ventures happen only in isolated cases. And here is where the university can play an important role: it can encourage teams to package innovative products with the help of departments and centers of technology commercialization, or universities can arrange for outside parties (intermediaries) to market those products.

Protection of IP in Russia is a separate issue. The conceptual principles of IP protection were established in Russia with the adoption of the Civil Code of the Russian Federation (part four). The legal foundation has thus been established; however, the efficiency of the system is far from perfect. IP protection plays an important role in attracting venture and direct investments and in developing innovations.

Figure 3 shows two indexes: that for country attractiveness for investments (how attractive a country is to investors) and that for IP rights protection. Russia significantly lags behind many other countries, and that negatively affects its investment attractiveness. The United States enjoys some of the strongest IP protection and the highest index of country attractiveness for investments. Only if IP is well protected is it an asset. Strong protection of IP is a necessary condition of practical application and use of new technologies in meeting economic targets.

Patents in Russia have no such protection and they are not valid as they are in the United States. Unlike in Russia, the process of obtaining a patent in the United States remains extremely difficult, labor-intensive, and expensive. Criteria and requirements for obtaining patents are very strict. In Russia applying for a patent is quite easy; it is possible to patent practically everything and thus a patent has no value and does not make sense.

What Russia needs to do is to develop a system of intellectual rights protection, including creating an effective judicial system for IP protection and ensuring that applications for a patent are taken seriously and evaluated thought fully.

So, scientific and technical entrepreneurship is a new phenomenon for Russian universities. It demands new standards of administrative, research, and business activity, in particular:

- Entrepreneurial behavior, which should be common;
- Physical innovative infrastructures and innovation tools;
- Policies that promote innovation and that cultivate an entrepreneurial culture;

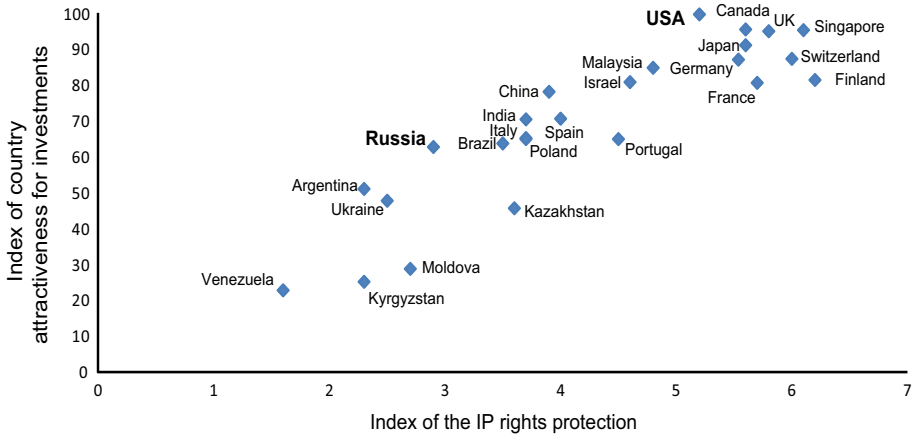

Fig. 3 Indexof IP rights protection and index of country attractiveness for investments. *Sources* The Global Competitiveness Report 2013–2014 and the Venture Capital & Private Equity Country Attractiveness Index (http://blog.iese.edu/vcpeindex/). *Note* Index of country attractiveness for investments ranges from 0 to 100; Index of the IP rights protection: 1 = very weak; 7 = very strong

- Flexible management systems;
- A system of human resources management at universities and a business network of graduates;
- Expertise and skills at marketing products and predicting what new technologies will be needed;
- Two-way communication between universities and companies.

University-industry cooperation also is a major problem, and it is actively discussed by Russian and foreign experts. As a rule, a university as a research partner can affect a business enterprise's profits in three ways: (1) increase the business enterprise's economies of technological scope, (2) reduce the business enterprise's ability to appropriate potential revenues, and (3) change the business enterprise's cost of engaging in R&D (Leyden and Link 2013).

The vital, important links between industry and universities in Russia are really weak. Universities will not be able to succeed in technology commercialization without active collaborations with industry. The basic principles of the university-industry partnership have to be defined (for instance, obligatory involvement of students and graduate students in research, lack of restrictions on the use of scientific results in further research, etc.). Universities and businesses must be free to determine specific conditions and ways in which they can cooperate.

At each Russian university the recognition of a number of barriers—legal, procedural, structural, cultural, social—which prevent a university from becoming an incubator of innovations is necessary.

The understanding of these barriers will allow universities to overcome them and to succeed as a supplier of highly qualified specialists and producers of saleable IP.

2 Conclusion

Generalizing from what we have noted above, we can propose the following recommendations for Russian universities:

- Develop an integrated ecosystem, one that brings together science, entrepreneurship education, innovation, and collaboration.
- Generate IP with commercial potential (real saleable products, not products that exist on paper only); analyze, screen, and "package" innovation projects; focus on market research and create a value proposition statement. Technology becomes a commercially viable product when it solves a specific problem in the real world; a concept is well developed and a technology is ready for industrial use when it is difficult to reproduce and has patent protection.
- Develop an entrepreneurial culture among employees and students; popularize innovations, and improve IP management and entrepreneurship. Staff and students at universities should be encouraged to generate and develop new ideas. The current culture of indifference has to be replaced by business activity and initiative, courage, and a desire to succeed in developing new products and bringing them to market.
- Create entrepreneurship education opportunities (programs, speaker series, open hours) to educate innovators with strong entrepreneurial skills; promote student innovation and entrepreneurship; create and train project teams and IP managers.
- Involve those with business skills in innovations in IP management and entrepreneurship education.
- Connect with companies to collaboratively use resources and pursue opportunities; facilitate university-industry collaboration; aspire to win–win scenarios (the university and industry benefit); work directly with local businesses and communities; focus on the real requirements of business.
- Weaken centralization, to give freedom to divisions and the ideas of the young generation.
- Establish American-Russian long-term business relationships of interest, benefiting both countries (e.g., EURECA).

We began this paper by proposing that Russia can benefit a great deal from the United States when it comes to technology commercialization. Needless to say, the way in which US universities have promoted technology commercialization cannot be copied detail for detail, because the situation in Russia is not exactly like the situation in the United States. We can observe the best practices of US universities, but they cannot be exactly replicated. It is necessary therefore to create a Russian model of technology commercialization that, while drawing on the spirit and general features of technology commercialization in the United States, is adapted for the specific conditions in Russia.

In Russia, research activity is conducted largely without a specific goal for commercial use. However, the following has to become the rule of any scientist and inventor: secure strong legal protection and license an idea (to begin a business) so that others do not begin to use it and do not start earning money from it. Unfortunately, in Russia, there are a lot of cases in which intellectual property is appropriated and put to commercial use. It is necessary to understand that the most valuable asset in technology commercialization is well-protected IP. Technology commercialization is generally not about science; it is about the market, clients, partners, marketing, finance, etc. It is extremely important to keep in mind the needs of end users of innovative products. And all stakeholders in the technology commercialization process have to realize that commercialization is not a game of "what do we have" but one of "what does someone need."

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Appendix: A case of the University of Maryland

The key institutions contributing to technology commercialization include the Office of Technology Commercialization (OTC) and the Maryland Technology Enterprise Institute (MTech).

The main objectives of the OTC are to ensure the transition of IP from the university to industry and business as well as management and development of an IP portfolio. The OTC has three main areas in which it provides its services: Information Science (22 % of inventions and 20 % of licenses in 2014), Life Science (30 % of inventions and 40 % of licenses in 2014), and Physical Science (48 % of inventions and 40 % of licenses in 2014).[4] The main results of the OTC activities for 2008-2014 are presented in Table 1. The revenue periodically changes, but in general it is at the level of $K 1000. In 2014 the revenue has grown in comparison with previous years—$K 1032. The OTC (as well as similar offices at other universities) generates revenue by licensing intellectual property. The royalty income and patent reimbursement are the main income. A large corporation as well as a start-up company can act as a licensee (See Table 1).

Until 2014, about 87 % of licenses at the University of Maryland were concluded with a small business, and in 2014 that figure was 86 % (according to the Bayh–Dole Act, universities are encouraged to license inventions to small businesses). In recent years about 50 % (in 2014, 45 %) of inventions were funded with public money (a percentage that approximately corresponds to the general tendency around the country).[5]

One of the key issues in licensing theory, policy and practice is royalty distribution. The OTC has the following royalty distribution policy: 10 % of the income received goes to the inventor(s); 30 % is paid in university administrative fees. After expenses are covered, 50 % of net revenue goes to the inventor(s) and 50 % to the university (of which 85 % goes to the inventor's department and 15 % goes toward promoting patents).[6]

Mtech's mission is as follows[7]:

- Educate the next generation of technology entrepreneurs;
- Create successful technology ventures;
- Connect Maryland companies with university resources to help them succeed.

Mtech's total economic impact since 1985 has been about $32.3 billion; about 8,000 direct jobs have been created through Mtech programs; and twenty-nine entrepreneurship and innovation courses, as well as a number of successful venture creation programs that help entrepreneurs create successful new ventures, have been offered by Mtech.[8]

[4] OTC, University of Maryland, College Park (http://www.otc.umd.edu/about/statistics).

[5] OTC, University of Maryland, College Park (http://www.otc.umd.edu/about/statistics).

[6] OTC, University of Maryland, College Park (http://otc.umd.edu/sites/default/files/documents/royalty-distribution.pdf).

[7] Mtech, University of Maryland, College Park (http://www.mtech.umd.edu/).

[8] Mtech, University of Maryland, College Park (http://www.mtech.umd.edu/docs/mtech_spread_2014.pdf).

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