Sub-theme 6.1. Technology transfer and entrepreneurship: 'traditional' and new science-industry interface organizations, mechanisms, organizational design, networks, etc.

Challenges of higher education in Russia: ivory tower or entrepreneurial university – case study of Tomsk State University of Control Systems and Radio Electronics (TUSUR)

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Globalization leaves no option for universities' development toward a combination of higher education with entrepreneurship and growth in order to produce a competitive educational product, or specialists, for the world market. A university either chooses the "ivory tower" model or strives to become an entrepreneurial university since nowadays the latter particularly provides regional and global competitive advantages.

The paper analyzes the current situation in Russia's higher education sector with emphasis on the specifics of Russian science residing in Russia's Soviet past. It addresses the Russian national innovation system from the standpoint of the triple helix institutional spheres interaction using entrepreneurial university criteria. The paper underlines the specifics of the Russian tertiary education sector with an analysis of TUSUR's case and assessment of the university's successes and challenges. Finally, the paper reviews the internal and external threats for TUSUR's future in terms of education, innovation activity and development of entrepreneurial culture. The further research will focus on developing recommendations on dealing with threats imposed.

There are several explanations as to why an "ivory tower" mentality managed to survive several decades after World War II when science supplied practical results for the military and university researchers worked with engineers from manufacturing companies. Today "ivory

tower" approach is still relevant to the educational mainstream of many universities worldwide. The first and only respectable reason, of course, is a nature of science based on curiosity which cannot be reduced to such things as production of a new bomb or necessarily lead to a greater company's profits. According to A.Einstein "the supreme task of the physicist is … the search for those most general, elementary laws from which the world picture is to be obtained through pure deduction"[1]. Another reason is the fear that external interests would intervene in the university and harm the conduct of science.[2] This logic not only prevents philanthropists from donating to scientific research but creates absolute academic autonomy of science which is inconsistent with the challenges of the 21st century. Nearly 150 years have passed since American physicist Henry A.Rowland addressed American Association for the Advancement of Science ("A Plea for pure science"), but these issues still remain controversial.

Things thus do not seem self-evident to the academia of the Western World after rapid development in a market environment for more than a century. Scientists of the USSR who worked behind the "iron curtain" greatly contributed to the status of the Soviet Union as one the world's greatest powers. Now they have to face another reality where the psychological and economic situation is even more complicated. Each country and its people who abundantly contributed to the pool of mankind's achievements deserve thorough analysis. The reason is obvious: a lot of these people are still alive and are actively working in education as well as the science and technology sphere. The transition from the USSR to modern Russia has seriously transformed the underlying country's conditions and credo of Soviet academia. However, the legacy of the old days inevitably lingers on. If often combines world-class scientific research competences with archaic and idealistic views. That is why it is imperative to find optimal mechanisms to engage this knowledge and competences in the very challenging project of building a knowledge-based economy in Russia.

Some historians believe that communism in the USSR collapsed because as a purely statist society the Soviet Union did not offer incentives for individual initiatives and innovation. The legacy of the Soviet era is quite contradictory since the government was the only customer – the highest authority – creating demand for all the sectors of Soviet economy through administrative channels, though achievements of Soviet scientists in fundamental and applied research were acknowledged by the world scientific community.

However, the lack of incentives for individual initiatives is true only for innovation in manufacturing of consumer goods since military industry for decades has been the first priority. The Soviet government paid those working in defense-related areas reasonably well, giving them incentives to generate great ideas but the USSR's accomplishments were limited by this system. For instance, Russian consumers have always admired home electronics produced in abroad. These goods were reliable and often small in size. Neither military nor civilian engineers managed to achieve miniaturization of technology: the military did not need it then and consumers did not have any choice due to the monopoly of state manufacturers. If consumer needs could have been ignored by the USSR leadership, the problem of quality and reliability

[1]Don A.Howard, "Einstein's Philosophy of Science", *The Stanford Encyclopedia of Philosophy (Summer 2010 Edition), Edward N.Zalta (ed.),* http://plato.stanford.edu/archives/sum2010/entries/einstein-philscience/.

[2] Henry Etzkowitz, *The Triple Helix: University-Industry-Government. Innovation in Action (*New York: Routledge, 2008), 142.

would have been solved within the same framework which had nothing to do with the principles of market economy. The key to success of military R&D management was the top priority; the resulting technology was superior because of higher standards achieved through a massive inspection system at enormous cost.[1] The analysis carried out by the author is based on views of Soviet expatriate scientists and engineers. The following conclusion explains the abyss between the qualities in military and consumer products: "No civilian consumer could afford the real cost of the products produced by and for the military"[2]. This is a sketchy description of environment Russian scientists and engineers worked before 1990's – the years that brought both chaos and freedom to individuals and economy of Russia. The legacy of the Soviet era thus was very contradictory. In the 1980s the government was increasing funds allocated to science and technology every year. Substantial efforts were made to incorporate science courses into the school curriculum at all levels. The world's scientific community admits the achievements of Russians in mathematics, theoretical physics, geophysics, atmospheric science and geology made during communist time. Historian of science A. Kozhevnikov found the paradox of Soviet science as an interesting problem which "is not why this science works badly—it is quite natural —but just the opposite: why despite all the unfavorable conditions it still works and works sometimes better than one would expect" pointing out also that five Soviet physicists had been awarded Nobel Prizes for their work at a time when Stalinist repressions were in full swing.[3] Higher education inevitably accumulated the strengths and weaknesses of the science and technology sector in Russia. Its expertise and traditions have been partially brought to the new millennium. As it was pointed out above Russia has to modernize its economy with the help of those who share both knowledge and traditions of the past. This dichotomy bears in itself both advantages and challenges for building a knowledge-based economy is Russia.

The Triple Helix model implies the leading role of universities in a knowledge-based economy. Universities are no longer "ivory towers" because they actively partake in R&D generating innovation in partnership with government and industry. Tomsk State University of Control Systems and Radio Electronics (TUSUR) and all its research units have been working for decades for the USSR's military demand. This fact partly explains why the "ivory tower" syndrome does not apply to the current activity of the university. When the contracts with the Soviet military and national security agencies had become the thing of the past, it took the tremendous effort of TUSUR's leadership to turn it into an entrepreneurial university. The irony is that when the cold war was over the leadership literally followed the ideas expressed in Roosevelt's letter to Vannevar Bush in 1944: "There is, however, no reason why the lessons to be found in this experiment cannot be profitably employed in times of peace. The information, the techniques, and the research experience developed by the Office of Scientific Research and Development and by the thousands of scientists in the universities and in private industry, should be used in the days of peace ahead for the improvement of the national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living".[4] The Soviet Union had highly integrated science and technology with its own developed

[1] Harley D.Balzer, *Soviet Science on the Edge of Reform (*Boulder: Western Press, 1989), 135.

[2] Harley D.Balzer, *Soviet Science on the Edge of Reform*), 135.

[3] As cited in Loren R. Graham, *Science in Russia and the Soviet Union (*Cambridge: Cambridge University Press, 1993), 212.

[4] Vannevar Bush, *Science: The Endless Frontier* (Washington, DC: US Government Printing Office).

infrastructure, but it lacked a developed domestic market. Thus, TUSUR had to learn how to use its R&D facilities and to adapt to new conditions. Besides, the transformation of the world into "digital space" imposes new challenges on any educational institution which gives powerful impetus to its curricula development.

Tomsk city is a unique place where every 6th person is a student. Besides TUSUR there are other universities accounting quite a long and remarkable history: Tomsk State University (TSU), Tomsk Polytechnic University (TPU), Siberian State Medical University (SSMU), Tomsk State University of Architecture and Building (TSUAB). What makes TUSUR "more entrepreneurial university" than the leaders of Tomsk educational system as TSU and TPU? The answer to this question is the key for understanding the very phenomenon of entrepreneurship within the university walls in the post-communist countries.

TSU is also called "classical university". It is one of the oldest universities in Russia (opened in 1888). In his speech at the opening ceremony Professor V.Florinsky has pointed out that "only a combination of the academic process with scientific research will enable our university to fulfill its high mission and, independently of its direct utilitarian objectives, to bear fruit in higher education"[1]. These are the principles that still constitute TSU's policy and mission. The "direct utilitarian objectives" have always been beyond the sphere of interests of "ivory tower" institutions even though it is impossible to deny their role and achievements in generation of knowledge and education. In this paper we will not discuss SSSM and TSUAB within the framework of comparison of "ivory tower" and "business" mentality because both of these universities heavily depend on traditionalist knowledge where innovations play an important role only when they represent a real breakthrough. Innovation of that scale is relatively rare even though they are of great importance for our lives.

Tomsk Polytechnic University (TPU) is one of the thriving engineering schools in Russia where education is tightly connected with the country's industry. It is not a secret though that the list of Russia's "thriving" industries is short. In TPU's board of trustees[2] one can find the list of influential figures from oil, gas and nuclear industry – not exactly the spheres to grow up young entrepreneurs for. However, TPU claims that part of the university mission is to promote "independence of thinking and creative approach to address challenges"[3]. There is an evident contradiction: independent thinking may lead young specialists to the conflict in a big company where discipline and conformity are the key values. In other words, the chemical plant, nuclear reactor and pipeline do not represent the proper environment for engineers to become entrepreneurs. Of course, they all provide the food for thought and exploration, sometimes intended to develop new ideas and approaches that finally would lead to new technologies but it is not what real entrepreneurship is about. The same is valid for the universities that have nothing to do with the "ivory towers" but have a little chance to play a role as entrepreneurial incubators.

IT and electronics are the best for this purpose because these fields provide the ideal ground for the triumph of the spirit of individualism and intellect based on business idea. When

[1] As cited in "The First in Siberia", Website of Tomsk State University, http://www.tsu.ru/webdesign/tsu/coreen.nsf/structurlprn/history_doc1.

[2] Board of Trustees, Website of Tomsk polytechnic University, http://www.tpu.ru/eng/trustees.htm/.

[3] TPU's Mission, Website of Tomsk polytechnic University, http://www.tpu.ru/eng/mission.htm.

the team work is required for the project it is usually the group of free-thinking people united by the common goal even if they are bosses and employees. Of course, there are exceptions to this logic but all cases that contradict it go back to the traditional fields and the Soviet past. For instance, the work in a pipeline automation company does not require free spirit except for top management level. Entrepreneurship is also completely irrelevant in companies working in the military industry. We must admit that TPU is also renowned for its achievements in IT, electronics and other areas but this is not the main factor that attracts young people after they graduate from high school and think about further education. Those whose main and only priority is seen as guaranteed employment upon graduation can not even dream about the idea of being self-employed. We cannot say that the same mechanism does not work in TUSUR but the very atmosphere in TUSUR offers an alternative to the legacy of the Soviet era mentality. The very word "business" in Russian language (like "dissident" and "intelligentsia") can be pronounced with the negative connotation. G.Orwell wrote: "When the general atmosphere is bad, language must suffer. I should expect to find… that the German, Russian and Italian languages have all deteriorated in the last ten or fifteen years, as a result of dictatorship. But if thought corrupts language, language can also corrupt thought".[1]

The very phenomenon of entrepreneurial university does miracles with the mindset and corrects language: the word "business" is no longer considered hostile to the academia. Moreover, the problem of business education for the engineers becomes priority number one if countries like Russia finally plan to build an economy based on knowledge. These plans could only be viable if the values of the liberal democracy finally prevailed. These values promote freedom and good governance giving people better opportunities through market capitalism. We come to the conclusion that entrepreneurial universities help to transform societies. And vice versa: such universities cannot survive in the purely statist economies (USSR-like) for there should be systems consuming innovation which goes beyond military needs and service of raw materials export. For example, Israel is a small country but Israelis deserve the title of a "start-up nation"[2] when brilliant minds create and sell high-tech companies so that the following production takes place somewhere else. Russia cannot follow this suite for one simple reason: it is a huge country with population which is more than 10 times bigger than population of Israel. The country needs jobs created by high-tech companies and subsequent production.

The active role of universities in the innovation process is very natural for Western society. Though for Russians, there is a certain ambiguity in the perception of tertiary education sector in Russia in terms of its goals and principles. The typical traditional mindset is highly influenced by specifics in science and research development in Russia, science financing mismatches, traditions of non-disclosure of R&D results. The R&D sector in the USSR was represented by there major science clusters: the Academy of Sciences with its infrastructure and own finance resources, applied science with its partnership with hi-tech industries, and universities with students as their main resources. Nowadays, Russian universities need new organizational models since it is obvious that R&D university units are not capable of relying on federal government donations only.

[1]George Orwell, *Politics and the English Language* (1946), http://www.mtholyoke.edu/acad/intrel/orwell46.htm.

[2] Saul Singer and Dan Senor. *Start-Up Nation: The Story of Israel's Economic Miracle (*Council of Foreign Relations Book, McClelland & Stewart, 2009).

It is necessary to mention the specifics of Russian reality when we talk about the triple helix model. Unlike many countries of the world where university is the place both for science and education, Russian universities account only 7% of expenses allocated to R&D. At the same time basic research is still conducted by institutes of Russian Academy of Sciences as it was during Soviet era. Only 45.4% of Russian universities are engaged into research activities and only 18.7% of university lecturers and professors work on research projects. Thus, Russian science still resembles very much to the Soviet science: 73% of the scientific and research organizations are still owned by the government and this ratio has hardly been changing during last 10 years.[1]

The more unique and interesting turns to be the case of TUSUR. Created in 1962, TUSUR from its very beginning had a project-conscious approach as its basis. It generated its first hybrid and quasi-commercial structures in 1989 when entrepreneurship was legally allowed. As a crucial cornerstone of TUSUR's entrepreneurship logic was the idea that scientific advisors and researchers responsible for particular R&D contracts were capable of managing all finances allocated to particular orders. Scientists and researchers bearing responsibility for fulfillment of R&D contracts gained at the same time authority and influence within the university. Soviet military demands resulted in the development of TUSUR's organizational culture which was not institutionalized but was widely accepted. Some steps towards the understanding and realization of entrepreneurship principles have been taken both according to world practices, and based purely on the intuition and experience of TUSUR's leaders.

To what extent is TUSUR entrepreneurial? Today TUSUR is in the center of a regional economic cluster working in the radio electronics industry and businesses related with it. This cluster is one of the drivers of the regional economy and it also operates in the world market. TUSUR's entrepreneurial culture and entrepreneurial status is shaped by its innovation infrastructure and its educational approach. Both these criteria need further development and strengthening.

TUSUR's innovation infrastructure is represented by its Commercialization Office, student business incubator, technology business incubator. Also, there are opportunities for a new company to be relocated to a special economic research and development zone of Tomsk region. A close market environment or economic cluster also called "innovation belt" includes 125 companies operating in TUSUR's technology specialization area. Most of these companies were generated by TUSUR, started by TUSUR's employees and employ TUSUR's students and graduates. These companies manufacture 80% of high-tech products in Tomsk Region and they make part of the Educational, scientific and innovation complex of TUSUR (UNIC) with the university in its core.

While talking about the entrepreneurial university, we imply a number of criteria or "four pillars":

- "academic leadership able to formulate and implement a strategic vision;

[1] I.G. Dezhina, "The Nature of Russian "Triple Helix" Interrelations among Government, Science and Business", *Innovation*, no. 4 (2011): 50.

- legal control over academic resources, including physical property such as university buildings and intellectual property emanating from research;
- organizational capacity to transfer technology through patenting, licensing, and incubation;
- an entrepreneurial ethos among administrators, faculty, students."[1]

Though all these pillars are partially present at TUSUR, Russian reality seriously interferes with the autonomy of the university as a state institution in terms of control over its resources and formulation and implementation of a strategic vision. Besides, there are legislative gaps in the intellectual property domain. Though recently there have been some positive changes in legislative environment.

During Soviet times entrepreneurship was prohibited; perestroika brought the opportunity for universities to create hybrid units and departments though a little bit later this process was restricted. In 2010 the Russian government enacted a revolutionary Federal law 217 widely known in Russia as FL-217. This law authorizes the creation of hybrid structures (new companies) within university in collaboration with industry. Some specialists are rushing forward to call this law a Russian equivalent to the US Bayh-Dole Act. Nevertheless, implementation of this law during its first year requires thorough examination and assessment since it raises too many controversial issues.

UNIC's companies create R&D units within the university. It might be a research institute or scientific laboratory, a new start-up company (according FL-217) or educational department (chair) teaching students for the needs of the business. UNIC's companies can provide a primary market for TUSUR's new R&D results, but the network interaction of TUSUR and UNIC cluster business is relatively weak and requires further institutionalization.

The new educational organizational approach is represented by a project approach to R&D and is known as GPO model (group project educational process). Being conceived as small creative R&D groups (3-8 students) with individual approach of scientific advisors to every student, GPO studies embrace the university's third and fourth year students. Today TUSUR has around 250 GPO groups which later can become residents of the student business incubator and move further on within TUSUR's innovative infrastructure. This project approach teaches students to work as small businesses, but at the same time it is not efficient enough since it does not lead to the creation of a sufficient number of start-ups. During the USSR era the country lacked a market economy and educational establishments did not promote entrepreneurship as an important societal function.[2] Today Russian technological school standards demonstrate failure in providing entrepreneurship courses to raise entrepreneurship literacy standards for students engaged in math, physics, applied science and engineering. Today, the Institute for Innovation, a part of TUSUR, is exploring implementation of the Novum Trivium[3] concept into TUSUR's teaching practice for pilot student groups.

[1] Henry Etzkowitz, *The Triple Helix: University-Industry-Government,* 27.

[2]Research paper by The New York Academy of Sciences, *Yaroslavl Roadmap 10-15-20* (August 20, 2010), for Global Policy Forum held in Yaroslavl, Russia, September 9-10, 2010, www.nyas.org/yaroslavlroadmap.

[3] Henry Etzkowitz, "Triple Helix Model", *Innovation*, no. 4 (2011): 9.

The group project approach more than any other educational techniques stimulates creative thinking since the real project simulates company's R&D activity. At the same time there is a gap in the development of management and marketing skills. This emphasizes Russia's general problem of disconnection between Russian strength in science and the ability to turn that science into products and new companies providing the potential for rapid growth through implementation of commercialization processes.[1] Since Russia's academia inadvertently sees the "ivory tower" model as the most appropriate for today's stage of economic development, it is necessary to legitimize the model of entrepreneurial university. This model does not contradict the idea of a research university – the image of a university that Russian science has been accustomed to for many decades. A serious problem for higher education arises from the weak internal market demand for innovation and poor knowledge of hi-tech international markets. There is a need for a shift in the traditional mindset making it clear that the Russian federal budget cannot provide enough financing for universities' competitive development. Today it is clear enough that there are legislative changes, and implementation of FL-217 provides a new legal environment for a dialogue of university and industry with government.

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[1] The New York Academy of Sciences, *Yaroslavl Roadmap 10-15-20.*

The New York Academy of Sciences. *Yaroslavl Roadmap 10-15-20*. August 20, 2010. www.nyas.org/yaroslavlroadmap.

Website of Tomsk Polytechnic University. http://www.tpu.ru/eng/.

The fundamentals of entrepreneurship. Millions new enterprises start each year despite more than a 50% failure rate. Consumers, business people, and government officials take an interest in this activity.Â Using new ideas he developed new technology into products to achieve economic results. Carnegie, who descended from a poor Scottish family, made the American steel industry one of the wonders of the industrial world, primarily thanks to his ability to win competition, rather than his inventiveness or creativity.Â of supply of materials or a new outlet for products; by reorganizing an old industry and creating a new one In this definition the concept of innovation and newness is an integral part of entrepreneurship. But how can established organizations build successful new businesses on an ongoing basis? Certainly, the road is littered with failures. The iPod should have been a Sony Corp. product. The Japanese corporation had the heritage, brand, technology, channels â€" everything. But it was Apple Inc.â€™s Steve Jobs who recognized that the potential of portable digital music could be unlocked only through the creation of a new business, not just a better MP3 player. To investigate how organizations succeed at corporate entrepreneurship, we conducted a study at nearly 30 global companies (see â€œAbout the Re University technology transfer offices (UTTOs) function as â€œtechnology intermediariesâ€ in fulfilling this role. Yet, entrepreneurship theory and research on the role of the UTTO in business incubation and new venture formation is sparse. To move the research along, we use grounded theory to build a framework to address two questions: (a) Which UTTOs' structures and licensing strategies are most conducive to new venture formation; and (b) how are the various UTTOs' structures and licensing strategies correlated with each other. Our findings reveal a complex set of relationships betwee