Chapter 1.2

Raising innovators as a major task of leading universities

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Introduction

The formation of a global knowledge economy puts universities under significant new pressures, as businesses and governments raise their expectations regarding the role of universities in social and economic development in a world where the generation of knowledge is becoming a key to growth and prosperity. At the same time, the academic community develops new opportunities for the application of its intellectual potential. In addition to acting under the conditions of publicly funded academic freedom, academics start to focus on requests from business in order to compete in the global market of education, research and innovation.

In the modern world innovation is seen as a crucial response to global economic challenges, and higher education institutions (HEIs) are assumed to be the major actors in finding effective solutions to socio-economic problems. In the European Union Innovation Agenda, knowledge is increasingly seen as the new strategic production factor (Van Vaught, 2009). The creation, transfer and application of knowledge are assumed to be of prime importance for economic re-orientation and further social and economic development. In the United States, meanwhile, research universities are also considered to be nation's leaders out of the economic crisis, and are expected by those who support them and the public at large to lead the way in terms of innovation (Thorp, Goldstein, 2010).

As a consequence of this, universities around the world are seeking adequate new development models for the changing external conditions. The concept of market-oriented innovative universities based on the 'Knowledge Triangle' (Education-Research-Innovation) starts to dominate in all developed parts of the globe.

Universities in the global market of innovation: is there a chance to beat corporations?

Universities have not yet fully recognised all of the opportunities for implementing their 'market-oriented' function, and most tend to concentrate efforts on the generation of income from the commercialisation of inventions made by their researchers. At the turn of

the 21st century universities all over the world introduced the system of technology-transfer offices. The primary tasks of these was the evaluation of the commercialisation potential of inventions made by university researchers, their patenting, and further support. While the role of universities' innovation infrastructure is considered to be the commercialisation of inventions, the launch of new innovative products or services and the creation of university spin-off companies, the situations where universities acquire a large income from licensing a prospective technology or receive a return on equities from a rapidly developing spin-off company are very rare. Moreover, generally, such luck is fragile, because the university can receive income from licensing a new prospective technology on average for only around two years, after which the technology goes out of date. As a result, the Technology Transfer Development Programme of one of the USA's and the world's leading universities, the University of California, states that 'for the last 90 years the bulk of university revenue from technologies is earned on a small number of so-called "blockbuster" inventions and, unfortunately, it is almost impossible to predict which inventions have blockbuster potential' (UC TLP, 2012).

The second market function of universities is the commercialisation of university inventions through industry connections (i.e. through contract research and developments). In recent years, the global industry has become more active in terms of implementation of applied research at universities. In a sense, it is a more reliable and stable option for the university, as the industry knows exactly which applied scientific research it requires, and formulates objectives for university researchers. Thus, the university enters the market whether or not its researchers have any breakthrough inventions.

This form of commercialisation of inventions has a number of disadvantages for the university though. First, in contract research the university is usually not the full owner of the results of research activities. Second, businesses, acting as sponsors of research, follow their own business interests. Contract research, in most cases, is of an applied nature and aimed at the production of new knowledge to solve specific problems for the sponsor. In addition, each industrial enterprise employs its own professional research staff and, in the case of large enterprises, entire research laboratories and centres to conduct professional research in their respective areas. Participating in contract research puts the university in the position of an assistant catching up to corporations. In this way, similar to a social and economic phenomenon of 'catching up modernisation', we can talk about universities 'catching up innovatisation' with industry. If a university wants to catch up with corporate research in a certain area, then it will likely have to concentrate the maximum internal resources on a particular area of research, which is an impossible task for a comprehensive university involved in a wide range of subject areas.

This leads us to a conclusion about the inconsistency of the situation regarding the innovative activity of universities. On the one hand, modern leading universities do their best to emphasise their innovative mission and the world's leading countries assign their

universities the role of key players in knowledge production and their market application (Hagen, 2008). On the other hand, meanwhile, there are concerns that the role of universities is reduced to the 'catching up innovatisation' in respect of the high-tech sector of the economy – figuratively speaking, 'playing in the second league'.

The experience of leading countries shows that the real drivers of global innovative development are the large industrial corporations. Private-sector companies are the main source of innovation in Organisation for Economic Co-operation and Development (OECD) countries and in rapidly developing economies, driven by the need to ensure market competitiveness (OECD, 2011). The economic impact of university innovation is actively fuelled by the examples of successful innovation clusters such as the Silicon Valley, Boston and North Carolina areas in the United States or Cambridge in Great Britain. An important role in this process is played by the well-known cases of high-yielding licences for university technologies, such as the Gatorade energy drink (University of Florida), human growth hormone (University of California, San Francisco), the vaccine against hepatitis B (of the same university), the chemotherapeutic drug Taxol (University of Florida) and a number of successful world-class companies that came out of universities such as Cisco, Google, Yahoo (all three originated from Stanford University, while two of them purchased licenses from the university) and Facebook, founded by students at Harvard (though, in this case, against the university's will).

Less well known is the fact that the creation of new businesses based on university research and technology constitutes only a small fraction (about three per cent) of the total number of new companies (Lester, 2005). The same applies to university patent activity: the results of 2011 show that even in the US – a world leader in university research and innovation activities – out of approximately 224,500 patents granted, only about 4,000 were issued to the universities (AUTM, 2012; USPTO, 2012). The probability of universities deriving significant financial benefit from the activities of technology transfer is also low. The total revenue of US universities from licence sales in 2011 was only four per cent of the volume of Research and Development funding ($2.5 billion and $61 billion, respectively). Interestingly, this percentage has not changed significantly over the past decade: in 2002 it amounted to the same four per cent, but with the absolute volume of maximum funding twice as small (Lester, 2005).

A university is unable to perform the functions of major industrial corporations, while even the traditional name for small innovative enterprises created at universities – spin-outs and spin-offs – indicates that there is some 'centrifugal force' shaping the direction of the development of such companies. There is no such university in the world where the innovative component of its budget plays a decisive role, a fact that demonstrates the importance of university innovation is manifested in areas other than finance.

We should recognise that universities will not be able to beat corporations in the innovation market. This new understanding of contemporary reality has come around only recently and

now it is trying to fight its way through the enthusiasm and dreams of possible economic return on university innovation development.

The realistic assessment of universities' potential in technology transfer does not mean that this function is rendered useless, or that the effort spent on its development should be curbed. The new functional model of a university – an innovative university based on the 'knowledge triangle' – became ingrained in everyday life and now it is the fundamental paradigm of university development. If we view the university technology transfer as its main contribution to the creation of an innovation economy we put leading universities into a dead-end position of 'catching up modernisation', and they will try to become something that they fundamentally can never be – commercial industrial enterprises.

Major task of leading universities in the innovation economy: the tetrahedron of knowledge

So, what can universities offer for the innovation economy? What unique competitive advantage do HEIs have that will prevent other players from driving them out of the global market? In our opinion, this advantage is the historic function of the university – production of human capital, but human capital of a fundamentally new quality. Universities should give the innovation economy its main resource for development – highly qualified professional creators, skilled in innovative entrepreneurial activities, or, in other words, innovators.

While the results of academic research and innovation activities such as scientific publications and patents are not a unique product to universities, human capital is 'produced' only by universities and acts as a main factor in the successful development of an innovative economy. International experience shows that large multinational companies consider collaboration with the world's leading universities primarily as a means of selecting talented students and nurturing future employees, who should be highly educated effective professional innovators.

This idea was confirmed by the international case study based on implementation of the Russian–American Programme 'Enhancing University Research and Entrepreneurial Capacity' (EURECA). The programme was launched in 2010 to develop the Russian national research universities' ability to successfully transfer the results of university research to the economy through the experience and capabilities of US research universities. This programme is an initiative of the US-Russia Foundation for Economic Development and the Rule of Law (USRF), and is supported by the Ministry of Education and Science of Russia.

Lobachevsky State University of Nizhni Novgorod National Research University (UNN) has participated in the EURECA programme since its launch, and has implemented joint projects with the two US research universities: Purdue University and the University of Maryland.

The projects are addressing the issues of international technology transfer and student innovation entrepreneurship development at UNN on the basis of the foremost experience of the leading US universities in that sphere.

This exclusive experience of international co-operation helps us to propose a new approach to the interpretation of the functional model of the university on the basis of the 'knowledge triangle'. As before, we consider fundamental and applied research and education to be the basis for the development of innovation activities at the university, but suggest changing the alignment of priorities in understanding the problems of universities' innovation activities.

Without denying the importance of the actual production of innovations at universities, we are also convinced that the most important part of their innovation infrastructure is as a 'laboratory base' for the training of entrepreneurs capable of effectively developing innovative activities in their areas of expertise. Just as the participation of students in the scientific work of the department or the laboratory is an integral part of the training of highly qualified professionals or researchers, university students' participation in the activities of technology transfer offices or small innovative enterprises is essential in effectively forming the competences of innovation entrepreneurs. Innovative university infrastructure, therefore, plays the same role in the development of a new type of professional innovator as university research laboratory does in the preparation of traditional 'Humboldtian' specialists and scientists.

Thus, we believe that the innovator, being the main 'product' of innovative universities, should be placed on top of the 'knowledge tetrahedron' – the geometric interpretation of the proposed functional model of the leading universities in the innovation economy (see Fig. 1). At the base there is the 'knowledge triangle', the corners of which stand for the three key components of the university: Education, Science and Innovation.

This 'knowledge tetrahedron' gives a clue as to what the main competitive advantage of the university is in relation to the other players in the knowledge economy. The concept of the 'knowledge triangle' involves close and effective interaction between education, research and innovation activities in a university. Each of the three edges of the triangle can be associated with certain types of the modern university's activities that reflect the interaction of education, science and innovation. In particular, on the edge that connects education and innovation there are types of university activity such as the organisation of contract training commissioned by companies, the involvement of practical trainers from business, the development of university-wide entrepreneurship training, and the preparation of theses and student business projects. The edge that connects science and education corresponds to the traditional 'Humboldtian' university lectures and practical classes, the organisation of research and practical training, and laboratory experiments. Finally, on the edge that connects science and innovation, there are activities such as contract research commissioned by industry, the patenting and licensing of scientific inventions, the creation

of small innovative enterprises, competitions of academic researchers and innovators, and applications for innovation grants. Full implementation of all three key functions is equally important for the effective development of innovative modern universities and for the training of highly qualified innovators.

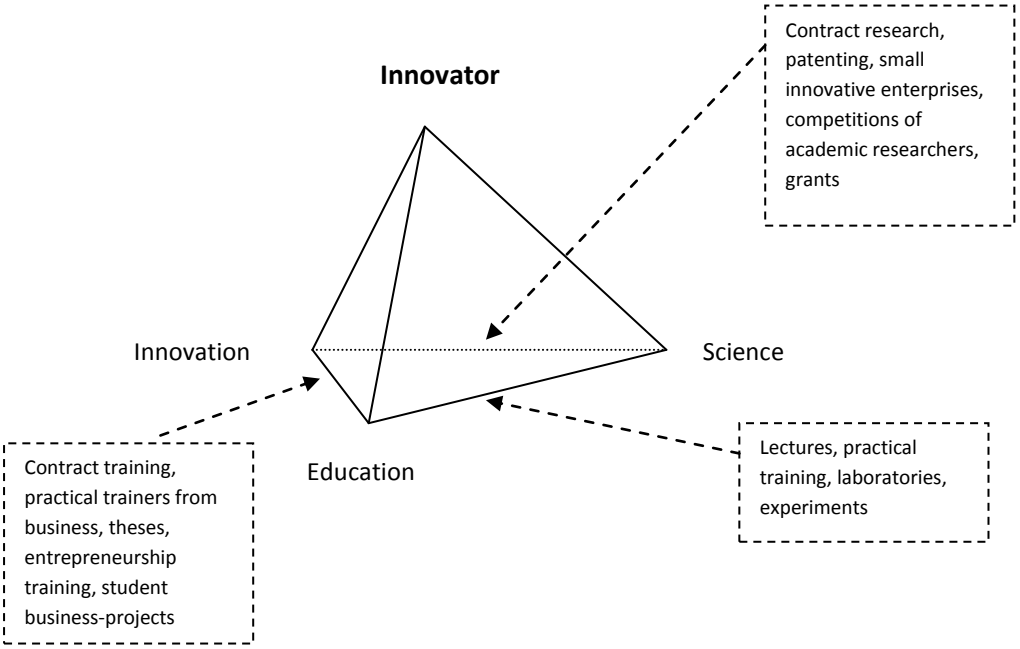

Figure 1: knowledge tetrahedron: a functional model of leading universities

Conclusion

The university 'knowledge tetrahedron' is a clear interpretation of the concept of the entrepreneurial university. The main characteristic of the entrepreneurial university is a comprehensive entrepreneurial culture of employees and the development of such a culture among students (Clark, 1998). A new mentality of researchers, teachers, students and postgraduates , and a new organisational culture of the university as a whole – that's what the term 'entrepreneurial university' means.

It has been generally recognised that the creation of innovative products requires an entrepreneurial mindset that views great problems as great opportunities. An entrepreneurial approach is a necessary component of the innovation process, a special mechanism for problem solving and an effective addition to the basic methods of fundamental knowledge in the liberal arts and natural sciences (Thorp, 2010). The 'knowledge tetrahedron' clearly shows that all aspects of the activities of a modern competitive university must be imbued with the spirit and culture of entrepreneurship.

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