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THE NEED FOR CAPACITY BUILDING AT UNIVERSITIES IN CEE COUNTRIES FOR SUCCESSFUL TECHNOLOGY TRANSFER

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Abstract: Owing to the rapid multiplication of related information, the acceleration in its dissemination and the constant reduction in the costs of access to it, technology transfer processes have undergone significant transformation in recent years. Adaptation to the changing circumstances causes difficulties for several institutions even in countries with more developed economies and considerable traditions in innovation management. The transition economies of Central- and Eastern Europe, however, have to face the challenges of combating general economic fallback and establishing institutions that can enter the competition with the operating institutional system of modern economies. These latter ones also include effective technology transfer institutions. With the help of a case study, the present paper introduces how the main sources of technologies can be utilized and what basic measures universities should take in order to build up a successful technology transfer system.

1. TECHNOLOGY TRANSFER IN KNOWLEDGE-BASED ECONOMY

Due to the changing value of technological knowledge, the way of technology transfer and the institutions involved have also been changed recently. The traditional model of technology transfer in which technology moves from a well characterized economic unit to another one has been transformed to a complex knowledge transfer process (Amesse and Cohendet 2001). As the spread of knowledge has changed the patterns of the global division of labor and comparative advantages have been rearranged or eliminated by new technologies, the relative position of actors in the new global economy is mainly determined by their capacity to absorb and modify knowledge (Buzas 2005). For the Central- and East-European countries, the emergence of a knowledge-based economy means a special double challenge: during the economic transitions, the additional require-

ments of a knowledge-based society must also be taken into account but at the same time the broadening of the economic gap has to be avoided. After several decades of planning economy, government had to recognize that its role should be to facilitate rather than control technology and the knowledge transfer process.

Considering financial and legal issues, Hungary is in the most advanced group of candidate countries together with the Czech Republic, Estonia, Poland and Slovenia. In this group serious efforts were made to restructure and reorganize science and technology facilities (Meske 2000) creating new bodies, newly established institutions with the financial ones among them changes in activity profiles and novel legislative elements, including a substantive new Act of Innovation. However, these changes did not really result in a new revolutionary innovation system as far as effectiveness is concerned. Although the importance of research and development became a watchword, the related expenditures did not increase satisfactorily, because this value is still up to 1 % in most of CEE countries. The number of researchers employed in the knowledge intensive sector is also still low and the knowledge transfer between academic and business spheres is incidental (Buzas – Szanyi 2004).

The evolvement of an effective innovation system is mainly prevented by the lack of diffusion-focused elements at the public research institution including universities.

2. INTEGRATION OF HIGHER EDUCATION INTO TECHNOLOGY TRANSFER

2.1. Pioneering

Since institutions of higher education constitute the essential elements of establishing an effective technology transfer system, precise regulation on utilizing the inventions deriving from university research is indispensable. The government needs to take the first step in this question, since achievements emerging from publicly financed research – in the lack of other legislation – would become state property. However, the state is obviously not the best owner of these inventions. Only market players can guarantee the best possible utilization of technologies born in the public sphere. But in order for technologies developed from public money to become the property of other parties and not the state, the rights of disposing over such inventions must be established.

Over the last decade, a number of concepts were proposed for modeling university-industry-government relations. One of the better known models is the Triple Helix (Leydesdorff - Etzkowitz 1996) in which the three separate spheres are defined institutionally. In this model for analyzing innovation systems, knowledge transfer is no longer considered as a linear process from origin to application, but a complex system with unique communication interfaces operating in distribute mode and mediated by special organizations such as technology transfer offices.

Prior to 1980, technology transfer was not remarkable in the university-industry nexus. The situation substantially changed when the Bayh-Dole Act came into force in the US at the end of 1980, allowing universities and other non-profit organizations to patent and commercialize the results of their discoveries made under government-funded research (Schmoch 1999, Nelsen 2004). Because the majority share of research at US universities is funded from public financial sources, this act meant a breakthrough in the history of university-industry relations. Before 1980 every achievement deriving from publicly financed research activities became the government's property. Consequently, out of the technologies considered worthy, approximately 25,000 governmental

patents were born until 1980, only 5 % of which reached industrial utilization through license agreements.

However, the Bayh-Dole Act defined new alternatives (of course, together with the related obligations) regarding such inventions. In its most important measure it made possible the private ownership of research achievements financed from public money by the inventors or their institutions. At the same time, it also obliged institutions to decide about patenting the technologies produced from public money in their sphere of action within maximum 2 years following the birth of an invention.

As a result of the Act, in 2002, 269 new products were created from inventions developed with the help of public money; users paid royalties of over 1 billion USD to publicly financed institutions at the account of the revenue deriving from the sales of such products (Spin-off book, 2004). A further, additional benefit of the Act lied in 450 new spin-off enterprises established to utilize university technologies (from 1980 the number of these has reached 4320), which was accompanied by the emergence of various new work places and therefore, the development of the economy. Last but not least, publicly financed institutes created their own technology utilization system as a result of the Act, which practically meant the establishment of so-called TLOs (technology liaison offices) or UILOs (university-industry liaison offices) and the creation of a related marketing strategy.

It is clear from the US example that various problems need to be solved in order to reach the successful utilization of publicly financed inventions. As a comparison, in the following let us examine first how and based on what European traditions Hungary, a Central Eastern European country tried to meet the challenges in terms of the above-mentioned three elements, that is, the ownership of publicly financed inventions, the foundation of utilizing (spin-off) companies and the creation of a university technology transfer system. Then we will also describe how the University of Szeged, one of the most active institutions in technology transfer, has built up its own technology management system.

2.2. Utilization of publicly financed research in Central Eastern Europe

Due to the traditional differences in innovation policies, countries could follow different models in the commercialization of domestic discoveries. The US (bottom-up) innovation policy principally focuses on creating incentives for universities so that they commercialize their inventions themselves. Federal actions foster experimentation in university policies with respect to how to best exploit the windfall of intellectual property rights brought about by the Bayh-Dole Act. On the contrary, for example the Swedish way of selling academic research ideas is far from those figured in the US (Goldfarb and Henrekson 2003) because in Sweden the government attempts to directly create a mechanism facilitating commercialization. Bureaucratic interventions enforce Swedish universities to establish an internal policy focusing on the marketing of intellectual assets. According to the authors, the latter (top-down) model is similar to the models applied by most EU countries. It can be generally say, this "European way" proved to be much less effective than the US pursuance of commercialization because of the lack of incentives for European scientists to get personally involved in the transactions.

Considering the Central- and East-European transition economies, first of all it must be stated that those countries have no traditions in business-based technology transfer. In the time of the state socialism various state-owned research institutes received assignments

from similarly state-owned large companies for technology development, so the industrial utilization of the technologies developed this way was guaranteed. The division of labor within the Council for Mutual Economic Assistance also contributed to an effective technology transfer and defined the branches that certain countries would improve, with the necessary technology almost always coming from inside the community. Consequently, the picture displayed by the R&D expenditure of that period was much more promising than that of today, although this was far from representing the real situation of the market.

However, privatization occurring due to the effects of the social economic changes of the late 90's significantly rearranged the scene in this area too. The now privately owned companies stopped submitting the former, predictable state orders of great volume and due to the economic uncertainties and the unclear nature of the related legislation, the new – often foreign – owners did not trust national institutes with research assignments until the stabilization of the basic institutions in the market economy.

In Hungary, beyond the above said, the establishment of an effective technology transfer was further hindered by the fact that the government did not have a unified concept regarding the utilization of such public money. On one hand, for a long time there was no effort to settle the issue of inventions created from public money with the help of a law similar to the Bayh-Dole Act. Although, based on the effective patent law, universities and research institutes are entitled to patent the (service) inventions created in the institute to their own benefit, but formally these still remain the possession of the Treasury. In the case of universities the new law on higher education under way would substantially change this and transfer the ownership right to the institutes, however, the date of its enforcement is rather uncertain.

2.3. Spin-off companies: diversification of the knowledge-based industry

The formation of a spin-off company occurs when a former employee of the parent organization with a certain technology or essential knowledge leaves to start his/her own firm. Due to the features of the small technology-based companies, spin-offs are among the most promising ways to commercialize technology or knowledge. While established companies adopt only new technologies closely aligned with the company's existing products, spin-offs can take advantages to absorb early stage technologies and develop them in time for market entry. Technology start-up companies can have enough flexibility to change business directions if the market requires so while established companies have standard procedures and much less ability to adapt and tailor early stage technologies as necessary. Furthermore, proximity of spin-offs to the birthplace of technologies can assure ongoing support from inventors making the technology transfer process complete.

Spin-off companies can be categorized based on the attributes of the parent organizations (Oakey 1995): the major source of the new technology-based firm can be either higher-education institutions (university spin-offs) or industrial firms (corporate spin-offs). Since universities more frequently encourage the transfer of knowledge to be used outside the university than do private companies, the formation of university spin-offs is predominant.

Irrespectively of their features, the entrepreneurial spirit is particularly important in the formation of spin-off companies. In terms of entrepreneurship, research shows that the European Union lags behind the United States (COM (2003) 27). The aversion towards taking business risks among Europeans is a main contributing factor to this attitude. In the US the brightest young people establish their own businesses, and in case of failure they keep on trying

to set up new companies until they either succeed or, after several failed attempts, apply for a job. In contrast, there is a European tendency according to which only those individuals start new businesses who do not find a decent job. This attitude resulted in a huge "entrepreneurship deficit" in Western Europe (COM (2003) 27). Due to the entrepreneurial philosophy above mentioned, in the USA spin-offs were popularized many years ago and created legendary and prestigious places, like "Silicon Valley" and "Route 128" near Boston. On the contrary, due to the lack of motivation in many European countries spin-off companies are less favored among scientists and universities often opposed the launch of such firms.

In order to study how to prevail the European tendency in a developing economy and what the main obstacles impeding the establishment of new technology-based companies are, the spin-off formation process was investigated in Hungary (Buzas 2003). In the study, both scientists with marketable scientific results and university students were considered as potential entrepreneurs. The latter group provided valuable information about the deficiencies of the education system which focuses mainly on the needs of large multinationals and neglects the small-sized enterprise-specific topics. The results showed that there are three main obstacles preventing the spin-off formation: lack of motivation, competence and reputation.

Scientists often refuse to become businessmen and in order to save their independent position as researchers they express their preferences for invention over selling (motivation gap). The barrier of lacking motivation could only be overcome by reducing the fear of an uncertain future. If a scientist is motivated enough, the academic career can serve as a good platform for launching a company, but limited experience in commercial matters (competence gap) blocks the business. Even commercially oriented researchers have limited capabilities in finance or intellectual property rights. They need an advisor with managerial abilities to transform the research results into business success. A successfully launched spin-off company itself, however, can not guarantee prosperity because trustworthiness is essential (reputation gap) for business partnering. Entrepreneurs do not have much time to become well known and to establish a strong reputation. Young spin-off companies are in constant need for guarantors confirming their outstanding technical expertise and creditability.

In order to encourage the formation of spin-off companies, in 2002 the Hungarian Government issued a call for proposals for the financial contribution to their establishment costs up to 40 000 EUR per applicant. This support can be used for the preparation of a feasibility study, adaptation of research results, acquisition of know-how, protection of intellectual property rights or preparation of prototypes. The small number (34) of proposals confirms that the above mentioned result, according to entrepreneurship has not primary financial, but motivational obstacles in Hungary.

During the last two years the changing entrepreneurial climate at universities by implementing training programs and disseminating success stories, and the provisions related to Innovation Act, as well, resulted a much higher motivation in establishing spin-off. This year the Government issued the former call with significantly increased support (maximum of 100.000 EUR, which is the upper limit of de minimis financial support in EU). Although the decision process is not yet complete, but it is known the number of applicants has multiplied.

3. CHALLENGES FOR UNIVERSITIES TO EXECUTE TECHNOLOGY TRANSFER

In order to eliminate the above-mentioned deficiencies and create an effective institutional

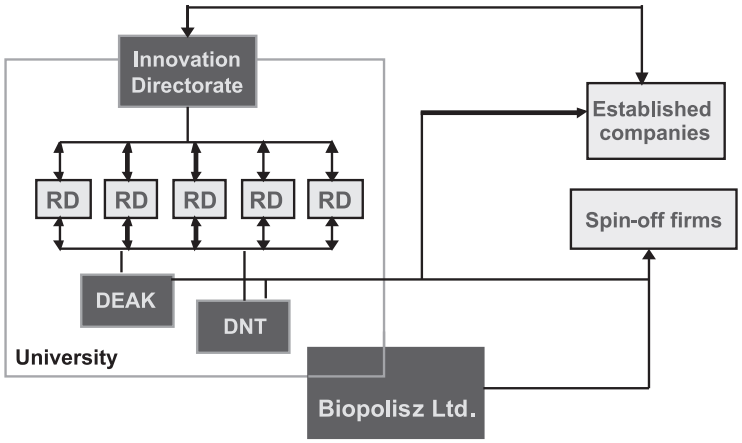

Figure 1. Schematic model of the innovation management at the University of Szeged: RD: research and development units; DEAK: Regional Cooperation Research Center of Life and Material Sciences; DNT: Regional Knowledge Center of Neurosciences

technology management system, the following general institutional target system can be defined. In the following, we will also introduce how the University of Szeged tried to integrate Szeged's higher education effectively in the international technology transfer network by realizing these objectives.

3.1. Building up the institutional model

As a first step, taking into account local characteristics, it is advised to define the already existing or future institutes that provide the frameworks of the technology transfer process. Obviously, no general formula can be used for this, since the former weight and role of the existing university institutes (innovation center, research centers, technology transfer office and so on) may define the participation of these in the technology transfer system of the institute. The expertise of employees working in the above-mentioned institutes may also be decisive, since it is not easy to find people for a system under development who are familiar with the wide range of complex technology transfer processes. However, it can generally be said that a central organization that coordinates the processes must be defined and it is also advised to find a leader who is familiar with both the scientific and business aspects of innovation processes.

For the management of its innovation processes, the University of Szeged has built up the system displayed by Figure 1. The leading institute of the system is the Innovation Directorate that, on one hand, maintains relations with economic players as a type of industrial interface, and, on the other hand, coordinates inventions created in the institute. Regional Cooperation Research Center of Life and Material Sciences (DEAK) and Regional Knowledge Center of Neurosciences (DNT), two research institutes of the university, actively participate in managing the research projects and supporting the inventions produced there. In the utilization of inventions Biopolisz Ltd. has an important role, 25 % of which is owned

by the university, since it contributes to the commercialization of inventions produced in the institute and helps the foundation of spin-off enterprises.

3.2. Creating legal regulations within the institute

In order for the interests of the institute to be represented successfully in terms of rights related to inventions, and at the same time for researchers not to feel that the institute 'deprives' them of their inventions, thoroughly elaborated institutional legal regulations successfully motivating researchers are needed.

In 2004 the University of Szeged worked up its own regulation on intellectual property. With this it unambiguously defined and since then has consequently tried to enforce the rights of the institute related to service inventions. At the same time, it distributes the sum deriving from the commercialization of inventions by assigning 50 % to the inventors and 50 % to the institute, which is much more favorable for inventors than usual. This way it tries to maintain the researchers' constant interest in the development of industrially utilizable inventions.

3.3. The development of the institute's own system of financing innovation

In order for the university to have an invention portfolio that can be handled economically, beyond the adequate institutional background and legal framework, the funds for the expenses in the initial period must also be assured. Even the most effective technology transfer activity is incapable of producing profit immediately, since, on one hand, entering the market takes time for the technologies, and on the other hand, an economically manageable amount of inventions must also be created.

To cover the expenses of patenting and management, the University of Szeged voted an annual 50 000 USD for the first 3 years of the innovation system's operation. Consequently, the registration of inventions has accelerated and in the past year the university submitted or prepared 11 new patent applications.

3.4. Linking the university to the international technology transfer circulation

The network of international relations is a highly important, although often not spectacular element of effective invention management. This means not mainly the relations through which technologies can be directly sold, but rather the international organizations and initiatives, where, through participation and membership, institutes can join in the actual information flow, follow international technology trends and the experts dealing with technology transfer have a chance to participate in training programs regularly.

To further improve its international system of professional relations, the University of Szeged has joined in its own right or through its Director of Innovation the most important innovation management organizations including the Association of University Technology Managers, the Association of Scientific and Technology Professionals, the Licensing Executives Society and the International Society of Professional Innovation Management. Furthermore, the university tries to constantly learn from institutes with decades of traditions in the field of technology management. In the framework of this it has signed a collaboration agreement with the Cedars-Sinai Medical Center of California, which includes the joint utilization of medical biological inventions, and the university, based on CSMC's experience, tries to improve its own technology transfer system.

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