

14. Role of Technology Transfer Offices in University-Industry Interactions

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University and industry relations have been developed since the past few decades in several ways. In knowledge based economy these two parties need to work together in order to implement the successful commercialization of research results. For industry, in long term, it is a cost-efficient opportunity to get the newest knowledge and the best solutions for their technological problems. Universities need to find their positions on the global intellectual property and research and development service market. Therefore in developed countries universities have established organizations in order to commercialize the knowledge generated at university level, to keep the existing or to get new contacts and to join networks. The evolution of this kind of inter- or outer organizations can differ in the sense of scientific profiles or geographical positions of universities, so it is necessary to examine the major patterns and the differences of their mechanisms and strategies of commercialization.

This paper¹ aims to investigate the key forms of business-academia interactions and to position and highlight the role of university technology transfer offices in the different types of relationships with the industry, using the main literature findings and national and international examples. The paper also aims to present how these offices can contribute to commercialization process of knowledge generated by universities, what are the motives of industrial involvement, and what services can be provided for inquiries coming from the parent university or outside.

Keywords: universities, technology transfer offices, business-academia interactions

1. Introduction

Universities and industrial partners are playing important role in technology intensive industries. The successful research and development and innovation processes cannot be implemented without these organizations. To understand the position of technology transfer offices in the university industry collaborations we need to discuss these three actors of this field.

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In the first part of the paper we present the general characteristics of industrial partners and the universities collected by empirical sources. Section 2 considers a few theoretical backgrounds of university industry collaborations. In third part we describe the models of technology transfer offices focusing on their position in universities and the financing sources. Then we introduce the case of University of Szeged presenting briefly the current results of technology transfer.

2. Characteristics of industrial partners and universities

According to their operation the one of the greatest challenges of industrial partners are the time and the permanent need for quick market responses. Drug development or other industries can be different, because of the long term development ineludible flows, but a good example for this can be the mobile phone market or any other IT related technologies.

With a late introduction of a new technology achievement, a market leader can be also failed and it can lose their first position. A wrong estimation of market opportunities for a possible new product line and a late recognition of new market potential can also harm the position in ranking at global market as well. It means that the proper timing of innovative product introduction is also crucial task for a usually innovative company, and it assumes a proper timing of the research and development. In some cases companies cannot afford a long term research and development (R&D) process if their competitors attack their standings. This can enhance the need for collaboration with universities or public research organizations (PROs). Using university knowledge for a concrete technical problem solving, can save time for industry too. This can be implemented by licensing-outs or joint research programs as well. During the cooperation industry and universities can concentrate on their core activities at the same time. Companies can prepare to produce, to market and to sell their new products, universities can use their knowledge and get money for it or for actual and future other costs.

Mostly at small and medium enterprises (SMEs) a general character is the insufficient research and development resources too. Not even all big companies have the all special, usually very expensive, equipment for e.g. a specific measurement or analysis. There are several examples for the other direction too. Sometimes universities cannot afford to invest in a big device, so they have to find some industrial partner to cooperate with in order to carry the specific scientific project out.

Without connection to the other part, the lack of R&D equipment can be a major market disadvantage for a company or for a university. The insufficient human resources for

innovation are also great challenge mostly in industry however it is not so relevant in big companies, because of the better wages and career offers. For SMEs, to maintain and to finance a research group is not the most cost effective solution and mainly they cannot employ the best experts due to the big companies better opportunities offered to them. To tackle with this problem the good terms with university can be an answer. Companies can hire universities to deliver the results what they need, without paying attention to purchasing or operating the physical or the human resources presence.

In contrast with industry, universities execute scientific oriented works and tasks. They are relatively far from the markets, so their interests are in general not business like. Their information of market relations is incomplete and the technical or the consumer changes of markets are not so relevant for them. The organization structure is also different from companies. The decision making process is usually slow and the size of the entire organization is bigger than the most companies, even the big companies as well.

The main focus of universities is basic research oriented, experimental development or applied research are mainly relevant only in specific industry related programs. The fundamental tasks of universities are knowledge generation – the research - and knowledge transfer – the education. The third role, the knowledge utilization is the next step in the evolution of universities that could extend the collaboration opportunities with the industry. This activity is based on the concept of entrepreneurial university.

Marketable knowledge produced by universities as output showed up first time in Etzkowitz (2008) many works, according to them the “entrepreneurial university” is handled one new approach of the relationship between universities and companies. The concept of “entrepreneurial university” is based on industrial co-operation so that knowledge acquired by universities - during interaction - is used to work out and apply their own business activities in business environment in order to contribute - first of all - to the regional economic and social development. This process became well-known as the third mission of universities after research and education.

According to Bajmócy (2011) the components of the third, academic mission are human resources, intellectual property, spin-off organizations and contracts with companies and individuals but in a wider sense participation in policy making, in cultural life or even in the ordinary knowledge transmission too.

Third mission of universities have started to expand at first in USA in the last few decades, later in the other more developed countries too (Bajmócy 2005). The market demand itself was not enough even in the USA since legislation background was not applied. Patent

and Trademark Amendments Act, called Bayh-Dole Act in the literature too, tried to cover this lack in 1980. It means that universities and research centers had big freedom in the possession of the intellectual properties created from the governmental financing. This decision was very important at that time which gave new momentum for the American economy.

3. Theoretical background of university industry relationships

According to Blum and Müller (2004) categories the differentiation for cooperation can be done by the directions. The first group is connected to the horizontal cooperation. In this case the task distribution and the task implementation is done jointly by the availability of resources for R&D&I. In this case the ownership of intellectual property rights are collective. The second option is the vertical cooperation, when the relation is divided into two separate parts, to customer and to service provider part. The customer, mostly the industrial partner pays the charges of research and development to the service provider, university partner. The vertical cooperation allows customers to be entitled to be the owner of the intellectual property rights created.

Fontana and his co-authors (2006) highlighted that the university industry collaborations are analyzed by the impacts of scientific results to the economy, derived from turnovers, research and development activities and patenting activities of companies. They also (Fontana et al 2003) investigated the interactions by the universities' and other public financed organizations' point of view by the particular roles in the implementation of innovation and idea transformation activities. Other selection criteria are the forms of the channels used for cooperation, because universities and the industrial partners can work with each other by formal or informal channels as well.

Varga (2004) created four options for knowledge transfer mechanisms to companies, started from universities. Knowledge transfer, as a form of university industry collaboration, can be distributed by the knowledge flows, the knowledge transfer by networks, the formalized knowledge diffusion and the knowledge transfer using physical facilities of universities by industry.

Inzelt (2004) grouped the interactions by the actors. The three main levels are the cooperation by individuals, cooperation by individuals and institutions and cooperation by institutions (Figure 1).

Table 1 Types of interaction

Between individuals	Between individuals and institutions	Between institutions
1. Ad hoc consultations of firm employees at universities	5. Buying university research results (patents) ad hoc basis	12. Access to special equipment of firm/university with or without assistance of owner's organizations
2. Lectures of firm employees held at universities	6. Employing faculty members as regular consultants	13. Invest into university's facilitates
3. Lectures of faculty members held at firms	7. Coaching of firm employees by university researchers	14. Regular acquiring university research
4. Regular (informal) discussions between faculty members and firm employees on the meetings of professional associations, at conferences, and seminars	8. Training of firm employees by university professors	15. Formal R&D co-operations such as contract research
	9. Joint publications by university professors and firm employees	16. Formal R&D co-operations such as joint research projects
	10. Joint supervision of Ph.D. and master theses by university and firm members	17. Knowledge flows through permanent or temporary mobility from universities to firms
	11. Joint IPRs by university professors and firm employees Arm's length	18. Knowledge flows through spin-off formations of new enterprises

Source: Inzelt (2004)

The university industry collaborations can be advantageous for industry because in short term they can get the latest knowledge and the solution for their specific technical or technological problem, in mid-term they can be allowed to use and exploit the human and technical infrastructure of universities, including the selection of new employees from graduates. In long term they can position themselves as knowledge oriented company at level of researchers, students and even competitors. Companies can also establish a long term cooperation and stable professional, scientific background for future innovation and product or technology development smaller or bigger plans, like research centers or company departments at universities.

For universities there are two main benefits of cooperation. The first and most important benefit is the involvement new, state-independent and in some cases significant financial resources. The second is the competitive advantage in the competition for new industrial partners and for students.

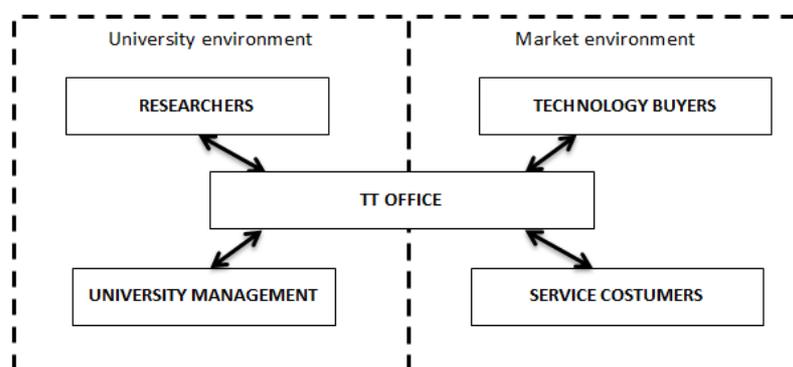
4. University technology transfer office models

The academic knowledge utilization activities are based on the co-operation particularly with the industrial partners which can be grouped in many ways (Etzkowitz 2008). The levels of the university-industry co-operations have different evolution phases. One of them is Technology Transfer Office (TTO). The creation of Technology Transfer (TT) is not necessarily the first step to utilize the created knowledge. This level places between many other stages like the establishment of industrial liaison office or incubators.

According to the Organisation for Economic Co-operation and Development definition the TT office in the university or research center or an institute which has tasks as identification and management of academic intellectual property (IP), IP protection, IP commercialization and license contracts (OECD 2011). Besides them main task is the creation and management of spin-off organizations and contact keeping with the partners.

TT offices can be identified as an extended hand of to the industrial actors in order to solve the important technical and scientific problems raised by the industry side. Furthermore it is a bridge between the academic management and academic researchers as well (Figure 1).

Figure 1 The direct environment of university technology transfer offices



Source: author's own construction

Literature highlights three different basic forms or types of TTOs according to the role and position of them in their organization (OECD 2002, 2011):

1. The first and the most usual case when the TT office works in the organization as a department. This "Department-type" model gives financial and management advantages for the universities, especially in case of a new TT office. When the own technology portfolio is small can finance themselves and in many cases the office can handle

additional tasks too. In this model technology managers and researchers can be closer to each other in time and in localization too.

2. The second opportunity, if the office works as internal department of the university. This is useful if the university cannot guarantee the financial and human resources. This model is cost effective for universities since it does not maintain organizational infrastructure which means fix costs. But the TT office is a bit further from the researchers so the in-house contacting is harder in this “Wholly owned subsidiary” model.
3. In the third opportunity, the university can hire an independent organization. In the case of this “independent” model the university can have resort to the professional technology transfer service which costs can be higher in many cases, especially after a successful business transaction. Their advantages are the know-how and high effectiveness, mainly if the university’s product portfolio includes just few marketable components.

According to Young (2007) overview there are some international examples for technology transfer models and the forms of financing. In Australia the PROs organized TTOs by the „Wholly owned subsidiary” model and they can finance their operations without involvement of other financial resources. In India the organization of TTOs is not in formal frameworks. Most universities have established some offices, but they had to use their own financing resources for implementation of tasks.

From a 1998 legislation, the TT offices can be operated in Japan. This act provides an opportunity for Universities to finance the two-third of the costs of the offices in the first five years. The Chinese universities run TTOs in the wholly owned model with external services providing. Besides the main technology transfer activities the private companies are active costumers of them, so the financing is secured in general. The most common services are business planning, spin-off management consultancy, incubation and business planning.

In United Kingdom state supporting schemes were introduced in last century in order to enhance collaboration between the university and industry. The most attractive example of the British TTOs is the ISIS Innovation Ltd. that is an outsourced company of Oxford University. The company is one of the most emerged University technology transfer organizations. Through its three basic pillars, the Isis Technology Transfer, Oxford University Consulting and Isis Enterprise, they offer a wide range of services for non-profit and profit oriented organizations. Young also highlights that the most University in United Kingdom run a

department-type organizations as well. Their tasks are mainly in connection with administration, contacting and connecting with new partnerships.

As mentioned earlier the Bayh-Dole Act was the key element to start the official way of university technology transfer in the United States. According to this law, the income structure of the TT activities has to cover the administration costs of the offices, the financial revenues of the inventors also.

In Hungary the introduction of the acts on Higher Education, the Research and Development and Technological Innovation and the Research and Technological Innovation Fund in 2002-2005 enabled the legal framework for official technology transfer initiatives as well, including the financial resources, the opportunity of the company establishment of universities or the EU harmonized definition of research and development activities (Inzelt 2008).

5. Case of University of Szeged

University of Szeged was pinned on the global map of science, when Albert Szent-Györgyi, the head of the Faculty of Biological Chemistry, won the Nobel Prize for discovery of vitamin C in 1937 (SZTE 2012). Now University of Szeged is one of the largest universities of Hungary. The average number of students is 25,000 with 700 additional students on PhD doctoral schools. The University has 12 faculties, including medical and pharmaceutical sciences, ICT, natural sciences (chemistry, biology, physics, environment) and economics. University of Szeged is the biggest employer of the region with 7,000 employees. The University offers 88 BA and BSc, 117 MA and MSc majors, 4 undivided degree courses, 59 postgraduate and complementary training courses.

According to the 2011 statistical data University of Szeged 291 researchers and the 2,239 instructors; 21 of them are full members of the Hungarian Academy of Sciences (HAS) and 114 are corresponding members, and 643 are Doctors of Philosophy (SZTE 2012). In recent time 20 joint cooperation research teams operate at 4 faculties of the University, 12 of which are financed by the Hungarian Academy of Science. The average annual number of publications is more than 10,000 (SZTE 2012).

At this time the research and development and innovation activities placed under the vice-rector (SZTE 2012). The Vice-rector manages The Directorate of R&D and Innovation, which works as an interface between the academic community at Szeged and external collaborators in both the public and private sectors. The Directorate has four parts, the

R&D&I secretary, the Industrial Liaison Office, the R&D project management office and the Technology Transfer Office. The basic task of the TTO is the managing and extending the university intellectual property portfolio. This part of the directorate handles the university knowledge map, prepares the intellectual property applications, analyses the market potentials of the inventions, creates business concepts and executes the possible partner search. The TTO coordinates the innovation services for external partners and the international technology transfer cooperation as well. Using the own professional knowledge of its faculties, the Directorate also employs a legal expert and marketing experts in order to help the commercialization and partnership building processes in the field of technology transfer.

The University of Szeged started its new technology transfer program in 2009 by a joint implementation with College of Kecskemét. The nearly 2 million EUR project was partly financed by European structural and Hungarian governmental funds.

As the result of this project and the earlier efforts the patent portfolio of the University consists of more than 40 patents, many of which have already been commercialized through license agreements and spin-off enterprises established especially in the field of medical, pharmaceutical, environmental sciences and ICT. In 2012, University of Szeged has seven spin-off companies (SZTE 2012).

Table 2 Income structure of utilization of research results at University of Szeged 2006-2011

	2006	2007	2008	2009	2010	2011
Income generated by utilization of R&D results (in EUR, EUR/HUF=290)	10,362,459	12,119,962	14,492,997	15,899,614	11,254,348	8,334,486
in % of types of activities						
joint research	78.3	86.91	81.91	65.41	68.68	75.9
licensing out	0.05	0.03	0.01	0.25	0.47	0.09
contract research	21.65	13.06	18.08	34.34	30.85	24.01

Source: SZTE (2012)

6. Conclusion

Several factors are available for the cooperation by universities and the industrial partners. The first but not the most important factor can be the high level of interdependency. Industry has the financial sources for R&D, but the knowledge for it at the university side. In some cases the cooperation is started by a top-down initiative, which is important if it is paired with financial support. Direct or indirect governmental supporting schemes can provide joint projects implemented by both parties, or a voucher system can be also a good tool for the

enhancement of collaboration. Other reasons for collaboration is the risk sharing, cost and time saving at both sides. University and industry R&D and innovation (R&D&I) processes are overlap each other so there are few steps that far from the core activity of the actors. This option induces the optimization of resources as an additional motivation and job keeping and job creating opportunities mostly on the university side.

As universities and the industry are on competition in their market, so image improvement is also a key element for collaboration. Industries can boost the sales figures if a new product is branded as a result of a joint research with a famous or acknowledged research organization. In case of getting new students universities can gain market advantage if they have a number of industry related connections. They can be more attractive for applicant students than others who offer less marketable curriculum and degrees mostly in natural, technical, medical and agricultural sciences.

In reality, the combinations of TTO models exist since the universities use mixed models because they take into account the advantages, contact system, prepared human resources, utilization purposes, etc. The evolution of the models can come from two directions:

1. The universities which have bigger technology portfolios which include a lot of marketable technological and intellectual products should start with the first model and then go to the direction of the second model.
2. The universities which have smaller portfolio should start with the independent organization as first step and then go to the first model and the second model can follow it.

For the universities the second model can be the most effective. But the main criteria of the selection can be the availability of the human resources, contact system, number of technologies in portfolio and their possible business potential. The involvement of technology transfer offices at the development of university industry cooperation can be different in each university, it is an issue of the decision of university management. It is a matter of commitments and missions made by university in case of utilization of research results generated at its sites.

University of Szeged has made the first steps in order to become a successful technology transfer actor. At this time the TT activities are implemented in the framework of the department-type TTO model. The first financial inputs have established a stable fundament. In the next few years a future research can investigate and measures its

effectiveness and make comparisons with other Hungarian and international Universities, who have mostly the same geographical, economical or scientific background and environment.

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