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COOPERATION OF SCIENTIFIC CENTRES AND COMPANIES ON IMPLEMENTATION OF RESEARCH RESULTS

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Introduction

Products introduced to the market by companies in the 21st century can be called the „R&D generation". Research, development of technology and products are an element of competitive edge and building the competences of companies. Stronger interest in R&D products supports strategies focused on relation marketing. However, introducing R&D technologies and products by a company requires high spending on research and scientific infrastructure and building specialist competences in a particular area of science and research. One of the options for companies may be to start cooperation with research and scientific organizations in order to jointly conduct research works or use ready results of research in practice. At the same time scientific and research organizations are not isolated entities and the results of research works should find application in the industry or the didactic process of scientific centres. In other case, it is hard to find justification for financing the above-mentioned projects.

The article titled „Cooperation of scientific centres and companies on implementation of research results" covers three theoretical issues and a case study showing a scheme of cooperation of a university and a company from the SME sector. In the first part a theoretical outline of cooperation of research and scientific centres with companies is presented. Cooperation of science and industry is explained by the analysis of three foundations: technology, economy and management. The second part points to determinants shaping the science-industry relations based on triple helix and Austin Technopolis models. Another issue presented in the article are push and pull strategies in science – industry relations. Theoretical deliberations end with a case study concerning the cooperation of scientists with entrepreneurs – on the basis of the operation of UL Incubator.

Cooperation of scientific and research centres with companies – theoretical outline

Financing research and scientific activities, research and development works or implementation in companies undoubtedly contributes to cooperation of various organizations. The cooperation of scientists and entrepreneurs has also become an important element in regional innovation strategies in Member States of the European Union. The significance of cooperation of associations of entrepreneurs, clusters, academic institutions and research institutions can be noticed in the innovation strategies of Nord Pas de Calais, Castilla y LeonVästa, Götraland and the region of Madrid[1]. The necessity to establish an innopolis is shown in the strategy of the Daedeok Innopolis region in Daejon in South Korea. Daedeok Innopolis was established for new companies and research and scientific centres which wanted and want to support investments in research and development[2]. Nevertheless, Baker et all[3] points out, on the basis of analysis of the British market, that investments of the business sphere in research and development are comparably low, in comparison to the utilization of R&D products in international competition. Entities cooperate with each other in order to directly gain financing or invest in promising, innovative projects[4]. Scientific and R&D cooperation of companies and scientific and R&D organizations may be established by gaining intellectual property rights and boosting technological capacity and as a result a company's competitiveness on the market[5]. Market research has revealed a trend that more and more often it's not companies themselves that are the sources of innovations, but rather non-business entities, for example academic circles. However, these entities, in order to disseminate innovation have to establish cooperation with the business environment, including companies[6]. The cooperation of companies and research and development organizations should generate such steps like purchasing licenses (granting), patents, research results and financing a part of the costs generated by those who develop technological projects[7]. The compensatory role of partnership is very important with regard to the borne costs. Markowski[8] makes an analysis of supporting and hampering factors at the meeting point of science and business in Poland.

1 E. Książek, J. M. Pruvot, Budowa sieci współpracy i partnerstwa dla komercjalizacji wiedzy i technologii, PARP, Poznań/Lille 2011, p. 41-49.
2 D. S. Oh, B. J. Kang, Creative model of science park development: case study on Daedeok Innopolis, Korea, [in:] Global perspectives on technology transfer and commercialization. Building innovative ecosystems, Edward Elgar, 2011, p.162-188.
3 K. Barker, L. Gheorghiu, H. Cameron, United Kingdom public and collaboration in R&D, [in:] European collaboration in research and development. Business strategy and public policy, ed. Y. Caloghirou, N. S. Vonortas, S. Ioannides, Edward Eldar, 2002, p. 186-209.
4 L. W., Busenitz, Innovation and performance implications of venture capital involvement in the ventures they fund, [in:] Handbook of research on venture capital, ed. H. Landström, Edward Eldar, 2007, p. 194-218.
5 Z. Balbinot, L. P. Bignetti, Technological capabilities of high technology firm in cross border alliances, [in:] Management of technology new directions in technology management, ed. M. H. Sherif, T. M. Khail, Elsevier, 2007, p. 249-261.
6 M. Nowak, M. Mażewska, S. Mazurkiewicz, Współpraca ośrodków innowacji z administracją publiczną, PARP, Łodź - Gdańsk - Kielce 2011, p. 14.
7 W. J. Mitchell, Challenges and opportunities for remote collaborative design, [in:] Collaborative design and learning competences building for innovation, ed. J. Bento, J. P. Duarte, M. V. Heitor, W J. Mitchell, Praeger, 2004, p. 4-12.
8 T. Markowski, Bariery współpracy na styku nauka-praktyka a rozwój regionalny, [in:] Partnerstwo dla Innowacji, ed. B. Piasecki, K. Kubiak, Wydawnictwo SWSPiZ, Łódź 2009, p. 97-104.

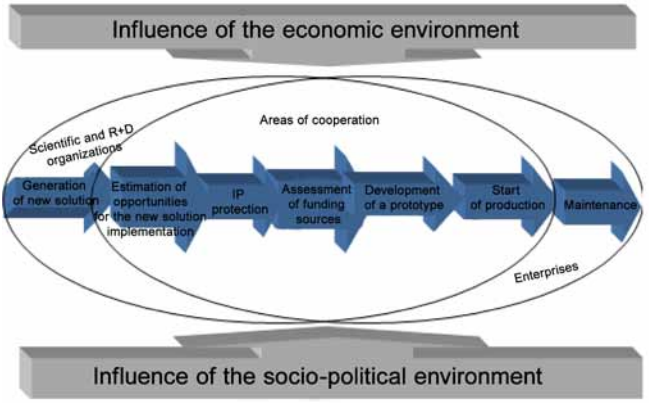
Results of the analysis show that poor equipment of research laboratories, unwillingness to register patents and use patents, low level of social capital, lack of or low level of the quality of services of organizations supporting business hamper the cooperation of companies and R&D and scientific organizations on the implementation of research results in economic practice.

Building cooperation between scientists working in scientific and R&D centres and entrepreneurs should take into consideration the fact that these groups often base their market activities on completely different motivation, styles of interaction, levels of risk acceptance and understanding of value added to cooperation. The culture of organization, structure, goals and strategies of action of scientific and R&D organizations most often vary. For this reason cooperation on commercialization and technology transfer requires support from institutions of innovative business (such as scientific and science-technology parks, technology incubators, technology transfer centres), which may serve the role of an integrator between scientists and entrepreneurs. Analysing thirty five of the most revolutionary technologies of innovators younger than 35, according to Technology Review, it is possible to conclude that the opinions of businessmen had a significant influence on the development of these projects and their subsequent commercialization. Scientists developing eg. a new test for blood analysis not requiring the preparation of blood sample (University of Washington), nano-crystals for more effective solar collectors (University of Illinois) or windows that could block heat from escaping outside on demand (University of Buffalo)[9] cooperated closely with the market or a company that could implement the solutions they were developing. Key technical attributes of an invention can be ascribed to purchasing qualities that could stimulate sales.

A challenge for every scientist is to convince entrepreneurs that they should invest in production and sale of research results. At the same time, close cooperation of scientists and entrepreneurs leads to sharing knowledge and information about the market potential of a new solution or about the opportunities for the utilization of the new solution. The needs of potential buyers of research results have to be in the centre of attention of the authors of research and have to constitute one of the main driving forces behind research works[10]. In the process of commercialization the areas of cooperation between scientific organizations and R&D are broad, as shown on picture 1.

9 Technology Rewiev, 2012, October, p. 40-1, 46, 60-61.
10 D. Trzmielak, M. Grzegorczyk, Rola relacji w procesach komercjalizacji technologii na rynkach międzynarodowych, [in:] Transfer technologii, przedsiębiorczość innowacyjna w rozwoju firm, ed. D. Trzmielak, Centrum Transferu Technologii UŁ, Łódź 2011, p. 151-172.

Picture 1. An example of areas of cooperation for the implementation of research results on the market.



Source: Prepared on the basis of: D. Trzmielak, W. B. Zehner, Methods and organization of consulting in the area of transfer and commercialization of technology, PARP, Łódź-Austin 2011, p. 31; W. G. Howard, B. R. Guile (ed.), Profiting from Innovation, The Free Press, New York 1992, p. 62, V. K. Jolly, Commercializing New Technologies, Harvard Business School Press, Boston 1997, p. 17.

The cooperation of science and industry in the area of conducting, developing and implementing scientific research results is the foundation of industrial applications. Implementation is also the result of accumulation of knowledge through learning about each other's needs (scientist, entrepreneur). Using knowledge in the industry has to be based on economic foundations, but its development has to achieve certain foundations of knowledge[11]. Research results, technologies and new products can be introduced by businessmen to the market, as soon as they meet the requirements of buyers and bring income. Cooperation between companies and scientists (scientific and R&D organizations) should be based on three foundations:

- technology,
- economy,
- management.

The first foundation to a great extent determines whether scientists achieve a high level of innovativeness in their scientific research. Scientists conduct research, because they want to acquire new intellectual property (including knowledge), develop more effective processes, more efficient methods or new devices. The economic factor is crucial for the effective commercialization of technology and knowledge. Entrepreneurs provide support for research works or use the results of research in order to develop new technology or a product. The provided support should be profitable for companies. Added value in form of higher revenues or company's increased competitiveness encourages entrepreneurs to

11 M. Heitor, Introduction… in the way of a manifesto: Competence building for innovation, [in:] Collaborative design and learning competence building for innovation, ed. J. Bento, J. P. Duarte , M. V. Heitor, W. J. Mitchell, Praeger, London 2004.

invest in scientific and research cooperation. The cooperation of science and industry based on economic relations allows making commercialization effective. The third foundation makes it possible to identify and plan the stages of the process of commercialization. On this basis entrepreneurs can efficiently pass through particular stages of the process.

According to trends observed around the world, new technologies are most often the effect of scientific research aimed at acquiring new knowledge. Application doesn't have to be the basic goal, but it can be just a secondary goal. The nature of academic technologies covers solutions at the very early stage of the life cycle of a technology or a product. They are often completely detached from the market and they pay little or no attention to the competitive edge that a company has to achieve thanks to implementation of research results[12]. The results of research achieved in R&D centres are adapted to the needs of entrepreneurs to a much greater extent. However, this doesn't fully satisfy the requirements of the target market. It is often hard to identify the possible industrial application of the results of research and development works. This is because the results of research and development works are often at the early stage of the learning curve of a particular organization. The assessment of the economic value of a technology and the market brings preliminary information about the added value that can be perceived by the buyers of research results. Information from the market makes it possible to prepare further activities which reveal the strategy of technology transfer and instruments for research result management.

The next stage involves testing a prototype, which confirms the efficiency of a technology outside the laboratory. Implementing and applying research results in the market requires searching for sources of competences for scientists and entrepreneurs[13]. On this basis only the cooperation of businessmen and research and scientific centres can help achieve scientific, R&D and business goals.

Shaping the relations between science and industry

In the United States a change in dynamics of cooperation of scientific and research centres with the industry took place following the adoption of Bayh-Dole Act in 1980. It assumes that universities and other scientific and research centres taking advantage of public funds become the owners of intellectual property created in course of research and scientific works, as well as research and development activities. Miller and Boef proposed a relational model of cooperation between science and industry based on 9 foundations[14]:

- building relations by raising the significance of scientific research and limiting single operations associated with sales of research results;
- developing didactic mission through the development of technology and research in the company sector;
- working out mechanisms encouraging scientists and students to develop entrepreneurship;

12 F. Betz, Academic government industry strategic research relationships, "Journal of Technology Transfer 1997", Vol. 22, nr 2, p. 9-16.
13 R. Mazzoleni, R. R. Nelson, The benefits and cost of strong patent protection: A contribution to the current debate, "Research Policy" 1998, nr 27, p. 273-284.
14 R. C. Miller, B. J. Le Boeuf, Developing, pathways to innovation from the West Coast, John Wiley, 2009, p. 1.

- transfer of research results from a scientific centre to the industry with participation of both students and scientists;
- communication of scientific centres with entrepreneurs, explaining the non-commercial goals of a university or R&D institution;
- management of the transfer of technology and research results by professional commercialization managers;
- development of a clear system of assessment of success of a transaction of purchase of knowledge, granting a license or other form of transfer of intellectual property rights from a scientific centre to companies;
- support from other public institutions for all activities between industry and scientific centres aimed at commercialization of knowledge and technology;
- including scientific, as well as research and development organizations to clusters of companies.

Managing technology and building cooperation between science and industry should be based on the relational model of cooperation. Etzkowitz points out that scientific centres, local or central authorities, as well as entrepreneurs shouldn't just coexist, but should combine their activities on the market. Triple helix[15] and K2 Austin technopolis models assume close relations between science and the industry with active participation of public administration (picture 2). Such partnership may bring the so-called multiplier effect. It results from the cooperation of three spheres essential for the implementation of research results. The effects are facilitating the development and functioning of new companies, eg. academic companies, research and educational projects, which could be created with the participation of entrepreneurs. Public administration can support emerging initiatives with attractive seed capital necessary for the implementation of research results in new ventures in the sector of advanced technologies.

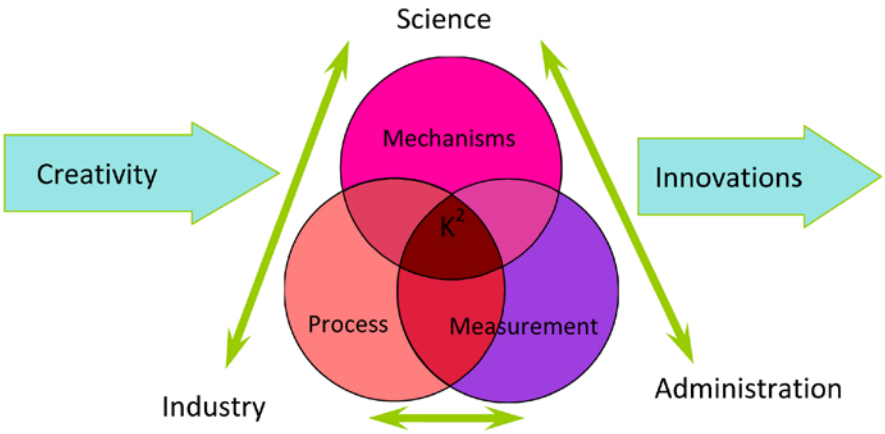
The industry, recognizing a chance for development, may join research projects. Additionally, support groups may emerge. Their purpose would be to create conditions for the economic development of various entities, the transfer of knowledge and technology from research and scientific centres to the industry. Among these groups there are, above all: science and technology parks, technological incubators, technology transfer centres, industrial chambers, business groups, associations of entrepreneurs, associations of inventors and foundations for education and entrepreneurship[16].

Relations between science and industry cannot be limited solely to financial and material investments[17]. Guliński[18] points out that it is necessary to take a broader look at entrepreneurship involving

15 H. Etzkowitz, The triple helix. University-Industry- government innovation in action, Routledge, London 2009, p. 15-22.
16 K. Zasiadły, D. Trzmielak, Doświadczenia amerykańskie, [in:] Innowacyjna przedsiębiorczość akademicka – światowe doświadczenia, ed. J. Guliński, K. Zasiadły, PARP, Warszawa 2005, p. 119-139.
17 PP. Conceição, M. V. Heitor P. Oliveira F. Santos, Conceição P., Heitor M. V., Oliveira P., Santos F., On the socioeconomic context and organizational development of the research university, [in:] Science technology and innovation policy. Opportunities and challenges for the knowledge economy, ed. P. Conceição, D. V. Gibson. M. V. Heitor, S. Sharią, Quorum Books, 2000, p. 99-118.
18 J. Guliński, Praktyczne aspekty zarządzania przedsiębiorczością akademicką w szkole wyższej, [in:] Kreowanie działań innowacyjnych i przedsiębiorczych - wybrane aspekty, ed. W. Potwora, Wydawnictwo Instytut Śląski, Opole 2009, p. 79-103.

scientific centres. Academic entrepreneurship means innovative, creative attitudes, which have to be formed by managing scientific centres in a professional way. The success of scientific teams in the commercialization of the results of scientific research depends also on managers responsible for relations with companies. Sources of skills of the scientific team should be based on the foundations of strategic thinking about the process of commercialization, analysis of its particular stages and getting involved in various ventures forming the ability to learn from the relations with the industry[19].

Picture. 2 Triple helix and the innovative model K2 Austin technopolis.



Source: D. V. Gibson, D. Mahdjoubi, E. Mercer, Creative regions, innovation clusters, and science parks in developed, developing, and emerging regions worldwide, [in:] Transfer technologii, przedsiębiorczość innowacyjna w rozwoju firm, ed. D. M. Trzmielak, Centrum Transferu Technologii Uniwersytetu Łódzkiego, Łódź 2011, p. 35-50; H. Etzkowitz, The triple helix. University-industry-government innovation in action, Routledge, London 2009, p. 15-22; K. Zasiadły, D. Trzmielak, Doświadczenia amerykańskie, [in:] Innowacyjna przedsiębiorczość akademicka – światowe doświadczenia, ed. J. Guliński, K. Zasiadły, PARP, Warszawa 2005, p. 119-139.

An important element in the relation between science and industry is the culture of entrepreneurship in the commercialization of technology it is associated with factors which determine the behaviour of authors, recipients of technologies and people who could support innovations. The culture of entrepreneurship should be discussed in two dimensions: passive and active. The passive dimension involves initiative in generating ideas for scientific research, creating knowledge, innovative technical parameters and inventions. At the same time active dimension illustrates commercial perspective of the authors of research results and creators of new technologies. Active culture of entrepreneurship motivates to look for applications on the market, alternative technologies, new segments of the market, positioning

19 E. Gwarda-Gruszczyńska, T. Czapla, Kluczowe kompetencje menedżera ds. komercjalizacji, PARP, Łódź 2011, p. 24.

of research results, to take the risk of implementation on the market and investing own financial assets into the development of a technology or a product in a newly formed company.

Many authors of research projects show interesting research results, but only some of them can be used in companies. This is the effect of lack of market potential for research projects, lack of the ability to transform technical parameters into benefits on the target market and aversion to taking risk. The above-mentioned elements determine active culture of conducting research aimed at implementations. Additionally, the unwillingness to take risk may hamper or make it impossible to take actions and go ahead of the predicted changes on the market[20]. Every good scientific project has to be turned into signals of value of technology or product comprehensible for the final user. Very often, creators of technology don't present their new technology in a way comprehensible for entrepreneurs interested in scientific and research cooperation. As a result, the effects of research remain in scientific centres and "don't leave the laboratory".[21]

Push and pull strategies in relations between science and industry

Research and development centres can limit their commercialization activities associated with looking for a business partner to waiting for an entrepreneur and providing him with information about their intellectual and laboratory assets. However, they can also actively look for recipients of research results and potential partners for implementation of inventions. What facilitates answering the following, essential questions, is active approach to looking for a partner from the industry:

- Does a scientific and research organization have the skills to transfer knowledge into a future product or service?
- Can the achieved results of research constitute added value for a company, following implementation?
- Can the cooperation between an entrepreneur and scientists be based on the existing infrastructure?
- Can a scientific-research organization support strategic activities of entrepreneurs?
- Does the personnel of a scientific and research centre have the competences necessary to provide a company with technology and knowledge?
- Are the expectations of entrepreneurs convergent with the expectations of a research and scientific organization?
- Has a scientific and research organization identified main factors of competitiveness of a company?

Yuval, pointing to key factors in managing applied research, emphasizes the significance of integration of ideas of scientific research with future target markets of potential recipients of the results of research and scientific works[22]. In case of implementation of research results and as a consequence, in relations

20 K. Rupik, Orientacja a wiedza przedsiębiorstwa – wybrane relacje i ich uwarunkowania, [in:] Marketing-handel-konsument w globalnym społeczeństwie informacyjnym, ed. B. Gregor, Acta Universitatis Lodziensis, Wyd. UŁ, Łódź, p. 88.
21 D. Trzmielak, W. B. Zehner, Metodyka i organizacja doradztwa w zakresie transferu i komercjalizacji technologii, PARP, Łódź-Austin 2011, p. 32-36.
22 E. Yuval, Integration of academic research into innovation projects: The case of collaboration with a University Research Institute, [in:] Applied technology and innovation management. Insights and experiences from an Industry-leading innovation center, ed. H. Arnold, M. Erner, P. Möckel, Ch. Schläffer, Springer, Berlin 2012, p. 26-28.

between scientific organizations, R&D and companies, time, pace of action and decision-making, flexibility of cooperation, availability in business issues, are of the essence. Integration with the market already at the stage of working out a plan for a research project shortens the time needed later to reach the market with the results of research. Knowledge, which is one of the basic resources of scientific and research organizations determining the development of new technologies, emerges in the minds of scientists, but it is implemented on the market by entrepreneurs. Due to the fact that the life cycle of products is getting shorter and shorter, the ability to integrate new solutions with the goals of an entrepreneur, especially under conditions of rapid changes on the competitive market, is extremely important.

Scientific and research organizations can base their actions associated with looking for a partner, preparing and developing a research project, as well as implementing the results of research on the following basic strategies of action:

- pushing a technology and a product;
- pushing a technology and pulling of a product by the market;
- pulling of a technology and a product by the market;
- pulling a technology and pushing a product.

The strategy of pushing a technology and a product comes from the domination of scientific and R&D activities in the areas of innovativeness of an organization. The commercialization of technology and the implementation of a technology and a product is the result of specialization of experiences derived from the market of research. Large et al[23] strongly emphasize that the push strategy is applied above all by centres financed with public funds. It can also come from the fact that certain results of research (not planned) appear during experiments, searching for or testing a prototype. Processing the results of research may and very often actually builds new know-how, which can be sold or used to prepare a new technology. The strategy of pushing technology and pulling of a product by the market already introduces the element of forming a product according to the needs of the market. The strategy of commercialization of pulling of a technology and a product by the market[24] is to the greatest extent the reflection of the needs of the market with regard to research and scientific works. The market, final buyers force or determine the direction of scientific research from the stage of generation of ideas. At this point it is possible to strongly integrate a research and scientific organization with an entrepreneur already at the stage of a concept for research. For example, buyers report unsaturated demand for a new product and the lack of a necessary technology determines the direction of the development of a research project. The strategy of pulling a technology and pushing a product is illustrated by a situation, where buyers force works on a particular technology, but there are no signals that there is demand for products, which may mean the failure of the technology on the market.

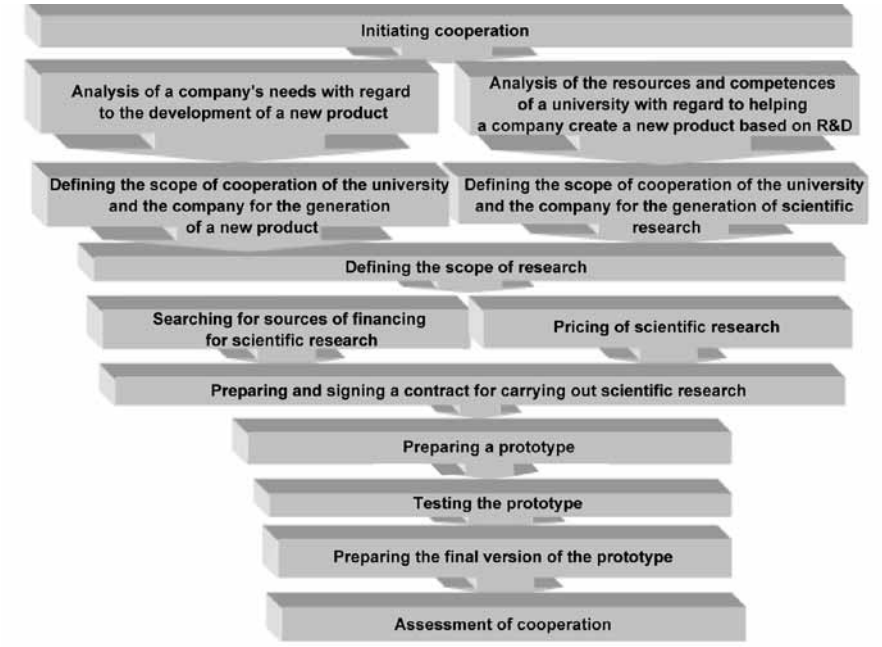
23 D. Lange, K. Belinko, K. Kalligatsi, Building successful technology commercialization teams: Pilot empirical support for the theory of cascading commitment, Journal of Technology Transfer 2000, Vol. 25, p. 169-180.
24 B. Yoon, R. Phaal, D. Probert, Morphology analysis for technology roadmapping: application of text mining, "R&D Management" 2008, Vol. 38, no. 1, p. 51-68.

The transfer of technology and commercialization of knowledge are the results of creative cooperation of the science and business spheres. Partnership can help not only to develop new technologies, which may be commercialized and which could create added value for entrepreneurs, but it also raises the efficiency of activities of a scientific and research organization.

Companies building their competitive position based on innovations look for technologies and partners for cooperation who have ready technological solutions, research resources, such as an equipped laboratory, personnel with knowledge and ability to conduct scientific research in order to create new, competitive technological solutions. Scientific and research personnel allowing the extraction of knowledge from a research and scientific centre is also an important stimulus for cooperation. Entrepreneurs, through cooperation with scientific partners want to reduce the risks of activities and raise the competitiveness of products.

The stages of initiating cooperation between a university and a company for the strategy of pulling a technology or a product are shown on picture 3.

Picture 3. The stages of initiating cooperation between a university and a company for the strategy of pulling a technology and/or a product.



Source: Own materials.

The implementation of every strategy and in particular "pulling" requires clear procedures for the flow of information and protection of intellectual property rights, which allow effective operation. The need

for fast actions adapted to the entrepreneurs' needs guaranteeing timely operations comes from the characteristics of the process of decision-making on a competitive market. Building formal relations based on the standards of functioning of research and scientific organizations and companies facilitates the transfer of research results from the sphere of science to business, but what is not less important, but certainly much harder, is establishing relations based on organizational factors, such as trust, the feeling that the flow of information is safe, competences, creativity and reputation. Factors other than organizational ones influencing the relations between a scientific and research organization and an entrepreneurs boost the quality of cooperation. Christensen and Eyring describe organizational factors determining the cooperation of a university with the business environment using the phrase "quality outside the lecture hall"[25].

The cooperation of scientists and entrepreneurs on the basis of activities of the UL Incubator – a case study

Analysis of the needs of a company and obstacles hampering the development of a new product

A company called Hipovet was looking for a new, unique technology, which would allow it to create new products for its target market. New technology should provide the opportunity to develop new products in various segments of the market. New products based on the new technology, introduced systematically into following segments of the market would raise the share of new products in the market of cosmetics for horses. This way a portfolio of products based on R&D activity would be created. This portfolio of products would also allow creating a product line and a new brand distinguished by its new components. Meetings and discussions of representatives of the company and managers of the UL Incubator finally resulted in a recommendation for the commencement of research at the University of Łódź aimed at working out an antiallergic and antibacterial material for cosmetic products Hipovet. The main obstacles identified in course of analytical work were: financial barriers, Hipovet's lack of experience of cooperation with a university, weak adaptation of research works of units of the University of Łódź to the needs of companies and the lack of strong channels for the distribution of the company's new products.

Analysis of research resources and competences of faculties of the University of Łódź

It turned out that the analysis of resources and competences of the faculties of the University of Łódź was a very hard task due to the fact that the database of knowledge and competences of the University of Łódź contained only the results of research. The results of scientific research in most cases didn't cover the subject of new technologies in the area of cosmetics for horses. They had to be transformed into traits (signals of value) of new products for Hipovet. The analysis of the resources of knowledge and competences led to the selection of two departments from the Faculty of Biology, Protection of Environment and Chemistry (Department of Bacteria Immunology and the Department of Chemical and Material Technologies) for further consultations concerning the acceptance of the order for research

25 C. M. Christensen, H. J. Eyring, The innovative university. Changing the DNA of higher education from the inside out, Jossey-Bass, 2011, p. 271.

on a new technology. Further consultations specified the detailed scope of research and identified existing competences and results of research useful for further cooperation with the company. The need of the company associated with the necessity of introducing a new product based on antiallergic and antibacterial properties could be satisfied with the nanotechnology of producing nanosilver and nanosilver as a material for new products of Hipovet.

Searching for sources of financing

Financing research at the University of Łódź by Hipovet was unrealistic. It was a young company – a so-called start-up – and its development required substantial financing. The financing of the development of distribution channels in order to reach the target markets was of utmost importance. The only realistic source of financing for the new cooperative venture could be public funds. Representatives of the UL Incubator started looking through contests and programs of support for scientific research for the development of small and medium companies. "Bon na innowacje" was selected from a large number of contests organized by government agencies. The beneficiary of the program could receive a subsidy of no more than PLN15,000, which was supposed to be used for the purchase of research and expert services. The financing provided by "Bon na innowacje" didn't cover the whole cost of research. For this reason Hipovet agreed to co-finance the research at the Department of Bacteria Immunology with its own funds. Centre for Technology Transfer UL took care of managing the company's order for research work, in line with university procedures.

Research works

Scientific works concerning the creation of a colloid of nanosilver, according to specifications required by Hipovet, were divided into four stages: creating a colloid of silver for anti-bacterial purposes, specifying the characteristics in water solution, the measurement of optical density for antibacterial tests and conducting antibacterial tests. Nanoparticles of silver display strong antibacterial and fungicidal effect. The efficiency depends on many internal factors (eg. the size of nanoparticles) and external factors (eg. chemical composition of the final product). The goal of scientific research was to create, characterize and research the efficiency of nanoparticles of silver in hampering the growth of bacteria and fungi. Final conclusions suggested the concentration of the new solution of nanosilver for hampering the growth of fungi and bacteria selected by Hipovet.

Production of test material

Positive results of research encouraged Hipovet to make the decision to order additional test material. In the following stage CTT negotiated the conditions of a contract between the University of Łódź and Hipovet for the preparation of material for testing the efficiency of nanosilver in two products. The Department of Chemical Technology prepared nanosilver test material to be used in Hipovet's products: „Maść na grudę" and „Balsam na otarcia". Tests were successful, both „Balsam na otarcia"

and „Maść na grudę" displayed antibacterial properties with regard to all investigated strains of bacteria.

Defining the mode of protection of intellectual property rights

Protection of intellectual property rights is essential for introducing new R&D products. It was possible to apply for patent protection of the produced nanosilver material. The new material satisfied all three requirements for patent registration: the concept for creating nanosilver was new, the inventive level was high and the invention was designed for industrial application.

Applying for patent protection should also be based on three additional factors: having financial assets necessary to protect and exercise rights derived from the achieved protection and acceptable costs of activities protecting intellectual property. The analysis of the second factor brought worries whether it would be possible to exercise the patent and in particular, whether the competition would be able to bypass the patent. It was very likely that the competition could resort to a strategy mimicking Hipovet's new products. The competition could order research works in order to recognize the composition of Hipovet's products and nanomaterial and later modify its new products so that they don't infringe Hipovet's patent. For this reason Hipovet rejected the concept of patent registration. The company chose the strategy of introducing a new line of products under a new brand "Silver". The protection of intellectual property rights was reduced to the protection of trademark. New trademark means new chances for access to markets and building up the reputation of a company. A registered trademark combined with the strategies of creating the quality of a product, building a positive image of the company, brand and product was assessed as much more beneficial than a patent for a new chemical compound. Rapid introduction to the market and building up the loyalty of the client could be more effective in fight against the competition on Hipovet's target markets.

Transfer of know-how and the technology of production of nanosilver

Positive results of laboratory tests opened positive prospects for the development of new products on the market of horse cosmetics. In a longer perspective there was a chance to enter new markets with the new products. The market of cosmetics for dogs was substantially bigger, but the prices of products on the market are lower. The problem which appeared was the method of transfer of technology. The question was how to transfer intellectual property created as a result of the cooperation of the University of Łódź and Hipovet to the company. The transfer of intellectual property rights to the company depended above all on the willingness of the company to take the risk of producing the component of a new product based on nanotechnology. Granting a license on the basis of a contract with the owner of rights to the technology (University of Łódź), which would define, among others, the conditions for using industrial property, would be the fastest form of transfer of science and technology. The license would define the price that the entrepreneur would have to pay for using the technology, as well as the scope of the licensee for the intellectual property. However, Hipovet wasn't interested in the production of nano material for new cosmetic products in the horse segment.

The second solution that could be introduced in order to finalize the transfer of results of research conducted at the University was granting a license to an already existing company or a start-up. The act on higher education"[26] provides for only two forms of transfer of technology and commercialization of knowledge: by means of centres for transfer of technology functioning in form of academic units, foundations, or companies and in form of a special purpose vehicle. University of Lodz didn't have a special purpose vehicle, thus the only form of transfer of the nanotechnology could be that the University's Centre for Technology Transfer would grant a license to a company which could produce nanosilver for Hipovet.

Granting licenses to academic companies

Granting a license to a so-called spin-off company[27] called also an academic company, in case of introducing intellectual property created at a university to a company in order to launch the production of a material was one the most desirable solutions. To a large extent this resulted from the fact that the license could be based on academic know-how. The creators and those who carried out the research had the biggest knowledge about the technology of production of nanosilver. Even though it is possible to clearly describe the technological process, in know-how there is always an intangible element, which is the effect of skills acquired over years of work on a particular technology. For this reason establishing an academic company was very attractive in terms of development of the technology. However, it was also necessary to consider business factors focusing on the management of the company. In the process of license granting it was already possible to highlight important and decisive factors determining the future development of the company. The first one of them was the value of the license. The higher the value of the license, the higher the cost and the lower the income from a commercial venture using the right to the license and the smaller the profitability of the used technology. This is what determined the proposal that license fees for the new spin-off company should go in the direction of setting two types of fees: fixed fee on the possibly lowest level covering the administrative costs of preparing a license and a degressive license fee based on the revenues of the company. License fees on company's revenues contain two important benefits: it is comparably easy to define them on the basis of the company's financial documentation and they move the costs of a company into the future. An important element in the negotiations on a license contract between the Centre for Technology Transfer and the planned spin-off company was how the company would purchase the license. The founders of the company wanted to base the development of their business concept by introducing external capital to the company. Despite the fact that a capital company (in case of the planned spin-off company it was supposed to be a limited liability company) has a more complicated structure and higher operating costs than partnerships, only such entity is suitable for acquiring shares in exchange for contribution or the so-called venture capital. The issue of purchasing

26 Ustawa z dnia 18 marca 2011 r. o zmianie ustawy – Prawo o szkolnictwie wyższym, ustawy o stopniach naukowych i tytule naukowym oraz o stopniach i tytule w zakresie sztuki oraz o zmianie niektórych innych ustaw, artykuł 4, ust. 4 i artykuł 86. Dodatkowe informacje dostępne są na stronie: http://www.nauka.gov.pl/fileadmin/user_upload/ministerstwo/Aktualnosci/20101210_KomercjalizacjaBR_web2.pdf

27 Innowacje i transfer technologii. Słownik pojęć, ed. K. B. Matusiak, PARP, Seria Innowacje, Warszawa 2011, p. 78-80.

a license was very important for the planned entry of a venture investor. Having a license, compared to having property rights to know-how means higher investment risk. It was concluded that if the buy -out was supposed to take place sooner than in three years from the moment the license is granted, the value of the buyout would be negotiated again. In case of the entry of a capital investor in a period of 4 to 10 years from the moment a license agreement is signed, the value of the license buyout would be calculated as an accumulated value of proportional payments of the additional, unrealized remuneration of the University calculated based on the income of the company for 3 years preceding the year in which a declaration on buyout was made. After ten years the licensee can buy the right to use know-how for 10% of revenues of the last year when the license was valid.

The first three years of the functioning of a new technology company are essential. It was possible to presume that in this period the research and development idea would attract investors from the group of angels of business. On the other hand it is hard to predict the income of the company in its first years of operation due to the necessity to probe markets, test new products and build up the company's portfolio. For this reason, the value of know-how (buyout) could be very low and grow dramatically in the following years. Especially following the buyout of shares and the entry of a capital investor. In the first years the business concept requires preparing a strategy of action aimed at raising the potential of the market. The chances of the company to find an investor from the group of angels of business increase as soon as the idea for the company's operation on the market is validated by the market. The above considerations led to the conclusion that it made no sense to attempt to evaluate the method of license buyout before three years have passed. It was concluded that the right solution (not burdened with high risk of underestimation – from the point of view of the University) was to buy out the license after the third year of the contract based on the accumulated value of proportional payments of unrealized remuneration.

Analysis of cooperation

The process of transfer of technology from the University of Łódź to Hipovet took place in eight stages. In the first stage the analysis of the needs of the company and the obstacles for transfer, was carried out. In the second stage analytical works were continued, but also with regard to the University's offer of technology and competences. The next stage involved formulating the strategy of cooperation and searching for sources of financing. The fourth and fifth stages were about formulating the R&D attributes for the future product and creating an outline of the order for scientific works at an academic unit. Positive results of research and the created prototype gave the foundations for the assessment of the future strategy of protection of intellectual property rights (stage six). The seventh stage covered creating variations of the new product and laboratory tests. Identification of the possibilities of sale of new products in various segments of cosmetics for horses provided the foundations for predicting future sales and the discussion concerning the method of technology transfer in form of selling a license to various entities taking part in the commercialization of the technology. Transfer of technology serves, among others, the purpose of creating new companies, generating cooperation between science and business and boosting the

competitive position of a company. For this reason the implementation of research results completes the stage of pre-market development of a new product and starts the life cycle of a product on the market and the life cycle of new commercial entities. That's why it is necessary here to point to the relationship between the transfer of technology and the marketing activities of a company. Moreover, licensing as a form of transfer may take various shapes. License can be granted directly to a company introducing new products, to a producer of components already existing on the market, or to a new company built on the basis of implementation of a new technology (intellectual property). The eighth stage of the process of technology transfer to Hipovet is granting a license for the production of nanosilver component based on the know-how generated by the University. The transfer of technology and know-how serves, among others, the purpose of introducing new academic or the so-called R&D products to the market. For this reason, the last phase also involves introducing further products in the portfolio of Hipovet's products with the R&D component to the market.

Conclusion

Analysing the issue of building cooperation between the entrepreneur and scientists in order to implement research results it is necessary to pay attention to various aspects of functioning of these entities. The division into entrepreneurs and scientists itself creates barriers in thinking. This often results in unjustified fears of cooperation. One of the key factors necessary to enter science-business relations is the ability of scientific and research organizations and entrepreneurs to absorb information about their partners. The goals of scientists and entrepreneurs are often completely different and getting them closer may be as difficult as bringing the West and the East together. Nevertheless, the innovative potential of entrepreneurs requires new ideas. At the same time the efficiency of scientific and research works depends to a large extent on applying research results in economic practice. This is why it is necessary to look for areas of cooperation already at early stages of research projects. The sooner a scientist establishes relations with an entrepreneur, the greater the justification for further works on a research and scientific project.

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