BUSINESS –
SCIENCE
COOPERATION
The case of Poland

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This publication is the outcome of a research project ‘The Co-operation of Science and Business as a Factor Enhancing Innovativeness of the Lodz Region’ co-financed by the European Union under European Social Fund
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Project titled ‘The Co-operation of Science and Business as a Factor Enhancing Innovativeness of the Lodz Region’ by the Lodz University’s Foundation in cooperation with Manchester Institute of Innovation Research (The University of Manchester) in the years 2011-2013.

The main aim of the project was to work out a model allowing to create and develop networks of co-operation and information exchange related to innovations between scientists and entrepreneurs, based on solutions adopted by European countries.

Project includes:

- supporting and developing the cooperation between the science and business sectors in the area of innovation and technology transfer at regional level,
- research and analysis concerning the current situation, development trends and forecasting socio-economic changes in the region,
- information campaign and events promoting knowledge exchange.

Publication contains four articles describing main problems related to business – science cooperation in Poland on the region of Lodz example.
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1. Introduction

Creating knowledge-based economy is not possible without an ability to cooperate and transfer the knowledge between R&D sector and enterprises and between scientists and entrepreneurs. High expectations are connected with mechanisms including scientific institutions in economic sphere and creation of multifunctional business relationships. The necessity of technology transfer and commercialization has a strategic meaning for Polish and European economy. Commercialization is a process that transforms an innovative idea to a profitable commercial product. This cooperation enables enterprises to gain and maintain competitive advantage. Besides, it contributes to effectiveness growth and using local factors of production.

In Polish economy economic sector entities are not inclined enough to cooperate with higher education institutions. An important aspect of cooperation linking enterprises to universities and research institutions is joint elaboration and implementation of new curriculums and innovative ways of using knowledge or education. Another facet is facilitating knowledge flow between schools and enterprises. It is to contribute to raising skills creation of suitable attitudes and increase of competences among students. Research and educational activities are critical for ensuring consolidation and development of knowledge-intensive economy. In the process of modernization it is necessary to support the development of scientific talents and skills, entrepreneurship and ways of thinking, which enable effective functioning of scientific and educational entities in the process of educational adequacy and performance of studies. Close collaboration of education and science aims at improvement of education and science conditions by research institutions and business enterprises. Cooperation is a means for approaching the target of the knowledge economy. The development of specialized, pre-innovative services is compatible with strategy directions of the United Europe development.

The development of the science cooperation in Poland on the basis of the poll carried out in 2012 under the project with transnational component "The Co-operation of Science and Business as a Factor Enhancing Innovativeness of the Lodz Region", co-financed by the European Union under the European Social Fund. The aim of the paper is assessment of business-science cooperation in Poland carried out in 2012 under the project with transnational component "The Co-operation of Science and Business as a Factor Enhancing Innovativeness of the Lodz Region", co-financed by the European Union under the European Social Fund.


2. Significance of business-science cooperation

Innovation is a key in the process of diffusion of innovations, both in countries with highly competitive economies as well as in countries attempting to catch up with the leading example. The role of education vis-à-vis innovation is underlined by the findings of the "Europe 2020" strategy which underlines the importance of education and research investments and considers innovation as a key dynamic mechanism of economic development.

In the framework of the European Union, science cooperation is considered an essential component of the European Innovation Agenda. The "Europe 2020’ strategy targets science cooperation as a key determinant for the sustainable development of the European economy. The aim of the paper is assessment of business-science cooperation in Poland carried out in 2012 under the project with transnational component "The Co-operation of Science and Business as a Factor Enhancing Innovativeness of the Lodz Region", co-financed by the European Union under the European Social Fund.

The condition of effective cooperation between business and science is significant.

The differences between science and enterprise operation in European countries are significant. They stem from the history of their establishments, and consequently need special policies and educating mechanisms to maintain an efficient information flow and greater relationships between business and science. This has an advantage in work and more financial resources in business relationships, thus new models are formed in a more positive way. Business and science, therefore, must be linked in such a way that the cooperation is effective and efficient.

Business – science cooperation (process) in the selected EU countries

One of the most important trends in business and science cooperation is the move away from traditional ways of working. The models of cooperation and development are changing due to the change in the business and science environment. The traditional ways of cooperation are declining, while the new ones are emerging.

The CBI defines six major ways in which business and universities may work together:

1. Contract research. Often called commissioned research, this is when a business approaches universities and offers to pay for a specific piece of research. This often leads naturally into the next major form of business/university partnership:

2. Collaborative research. This is defined by mutual financial benefit and typified by both business and the university being involved in the research.

3. Sponsored research. Ordinarily this sees universities securing funding from a business or an industry for a given research project. For the purposes of this publication it also refers to business and universities working together to secure sponsorship from grant bodies such as the EC or the DTI. Universities are particularly well-versed in getting hold of research grants.

4. Sponsoring students & student placements. This is often the easiest option for small businesses who, in start-up or early on in a project, can't afford to hire graduate students with specialist skills. The university supplies the expert, and the company pays some of his/her salary, often using money from a grant.

5. Business as teacher. Sometimes relationships are struck between university and business where the business acts as a consultant to the university.

6. University as business. And sometimes universities act as consultants to businesses, with specialist skills.

The business–science collaboration might be based on a huge number of highly diversified forms – for example:

- cooperation with Polish schools
- science and technology development
- science park development
- entrepreneurship support for staff and students
- higher-level apprenticeships
- skill development of post-doctoral staff

But the challenge now is to create a system in which knowledge and industry are valued as highly as business is valued from academic theory.

One academic often stands alone in the theory of their field, but they are deemed to be valuable by the current system. But the CBI's commissioning of a review of business–university collaboration by Wilson T. is an attempt to change this.
New capabilities and skill sets will inevitably emerge from such a reorganization. Academics will learn vital communications and management skills, new techniques for organizing and maintaining working partnerships, new kinds of intellectual approaches employing different criteria. Business people will learn to value the free-thinking academic approach. The working marriage of the two approaches will generate new thinking for a modern world, without destroying the integrity of the varying disciplines.

In the near future, perhaps, we will see universities where engagement with the business world will permeate the fabric of the institutions, from the Physics departments to the English schools. Quality systems will recognize and reward excellence in such engagement and new benchmarks and standards will reflect exemplary practice. Partnerships will become an essential part of both business and university life and work.

Norway is the country where the approach to technology and knowledge transfer is specific. In Norway in the business-science cooperation process the focus is on universities and research institutions affiliated with them. Universities bear responsibility for knowledge transfer to enterprises. Approximately 30% of public funds for research and development activity come from the Research Council of Norway (RCN)\textsuperscript{119}. RCN is divided into three sections: Department of Science, Department of Innovations and Department of Strategic Solutions. The organization states that research activities have varied goals and customers have different needs and expectations, which allows for better coordination of diverse scientific disciplines combining basic studies with the applied ones.

Norwegian universities and associated institutions went through a great deal of reforms to raise the quality of higher education and research processes. Quality reform encompassed both state and private research and development institutions\textsuperscript{120}. Thanks to the above reformation each institution can adjust its fabric to own, unique character, especially assignments and challenges it has to face. Academies and associated institutions are more autonomous in reference to research programs.

Within this collaboration higher schools receive some help from other institutions when commercializing an invention and as a result, they have better conditions and greater opportunities to conduct further research and educational activities.

In Norway one puts a huge emphasis on science, technology and education. For these purposes lots of initiatives were taken, i.a. the National Centre for Contact with the Business Community on MST, in particular with SMEs. It is called RENATE (establishment date – 2003). The Center arose to make contacts and relationships between institutions, science and business environment to ensure recruitment of students in the fields such as mathematics and technology. Above all, the institution aims at paying attention to the business community’s needs like raising qualifications of employees working in SMEs\textsuperscript{121}.

In 2002 the Norwegian government introduced new regulations on the deduction of tax from R&D activity for SMEs hiring less than 100 workers. All enterprises which are subject to Norwegian tax procedures were taken into consideration. Companies that employ over 250 people can deduct 18% of total expenditures on R&D work connected with the recognized project. Small enterprises hiring less than 250 employees are allowed to deduct 20% of total expenses incurred for R&D purposes.

Sweden is the country whose approach to technology transfer issue assumes taking advantage of solutions from Western Europe, spending lots of money on R&D works if only necessary. In reference books the term “Swedish paradox” often appears because in spite of huge overall expenditures on R&D, there is a slow economic growth. It is caused by the fact that companies which conduct R&D activity in Sweden relocate their research result-based production to other countries. In Swedish R&D system public studies are carried out mainly by universities and their affiliates (university colleges). In order to underpin the cooperation between higher education institutions and businesses, the role of Swedish government is crucial as it introduced a compulsory “third task” for all universities and their partners. The third task compliments the two basic functions of academic institutions, namely the obligation of education and running R&D works and its aim is to commercialize research results. Moreover, the government just creates suitable conditions for universities to set up holding companies dealing with commercialization of research results. However, Swedish institutional structures could not fully adjust to the “third task” if Swedish universities were not independent and did not have long-term traditions in teaching and running R&D activity. Apart from biotechnology and ICT techniques Swedish science is also focused on people – human resources and sociology, education and teaching. Swedish scientific studies and technology programs aim at raising researchers’ competencies and their abilities to meet the company’s needs in the future. The goal is to engage businesses more in financing R&D works or in real cooperation with universities and research institutions. For a few years in Sweden there has been noted private capital inflow coming not only from venture capital companies but also from wealthy private investors. Interest in supporting new enterprise-based technologies results from various actions taken in most university regions. Hence, there are some instruments created in order to succor new, big technological enterprises and to assist in managing them\textsuperscript{122}.

\textsuperscript{119} Innowacyjność przedsiębiorstw na Mazowszu oraz współpraca ze szkołami wyższymi", 2012. p.13 Elaboration is a result of the survey “Diagnosis of cooperation between higher education and economic sector, incl. expert’s report on innovative enterprises in Mazovia”. The Foresight project - regional for the Warsaw and Mazovia universities „Academic Mazovia 2030”


Gestrelius S., Birck A., Cross Border Research and Innovation in Medicom Valley, Medicom Valley Academy, Lund 2004, pp. 1-4
In the discussed countries in business-science cooperation there are a lot of similarities and differences. The correspondence affects the purpose they serve, recipients, location and architecture, whereas the disparities refer to originators of parks, their legal form, the subject of investments, the range of offer (incl. access to external fabrics of financial support) and the effectiveness of cooperation between entities.

Business-science cooperation mainly focuses on improving products and technologies which already exist and are used by enterprises. The most important role is played by universities, research centers and other higher education institutions.

In Norway, Great Britain and Sweden a vast majority of academic technology transfer centers function in the form of limited liability and joint-stock companies. In most cases these are joint-stock companies, foundations and associations set up by higher education institutions making use of external funds from regional authorities, in order to increase the scope of knowledge and technology transfer, to implement diverse training courses and workshops. Entrepreneurs who undertake their activity are also given the possibility of participating in some of the programs focusing on some transfer activities. The resulting benefits of such cooperation are realized in the form of increased productivity and the acquisition of skills required for entrepreneurial activity. At the same time some universities act as companies, i.e. they have their own organizations, i.e. in the form of limited liability companies.

The most frequent cooperation form is characterized by the transfer of knowledge and technologies to companies or institutions utilizing external funds from regional authorities.

Business-science cooperation is initiated mainly to raise the competitiveness of enterprises, to develop new knowledge and technologies, to adapt technologies to the needs of enterprises, to support spin-off initiatives, and to support companies in the organization and execution of implementation processes.

In Poland, concentration on any activities tending to increase scientists and entrepreneurs' awareness in the scope of knowledge and technology transfer is observed. Training courses and workshops, as well as the realization of diverse projects are also implemented.

Entrepreneurs who undertake their activity are also given the possibility of participating in some of the programs focusing on some transfer activities. The resulting benefits of such cooperation are realized in the form of increased productivity and the acquisition of skills required for entrepreneurial activity.

In the course of the 2008 survey carried out amongst the most rapidly developing enterprises in terms of innovation (Deloitte Fast 50 ranking), the most important role was played by universities, research centers and other higher education institutions making use of external funds from regional authorities, in order to increase the scope of knowledge and technology transfer, to implement diverse training courses and workshops. Entrepreneurs who undertake their activity are also given the possibility of participating in some of the programs focusing on some transfer activities. The resulting benefits of such cooperation are realized in the form of increased productivity and the acquisition of skills required for entrepreneurial activity.

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repeatedly in other polls. In the paper “Warunki skutecznej współpracy pomiędzy nauką a przedsiębiorstwami” (Conditions of efficient business-science cooperation) the authors state that 59% of the interviewed entrepreneurs do not collaborate with scientific institutions and just one out of ten surveyed company owners declares that they remain in close partnership with scientific centers. It is also estimated that maximum over a dozen per cent of scientists employed at universities cooperate with business127.

Most frequently business relations come down to one scientific institution and science centers share their proposals with the limited number of enterprises (often the biggest ones). The polls indicate that mutual interest in collaboration is still at increase.

From entrepreneurs’ point of view the main reasons for starting cooperation between business and science are:

• counseling services in the scope of techniques used and technologies;
• seeking and finding inspiration for new technology development;
• willingness to improve existing techniques and technologies;
• need for implementation of new techniques and methods;
• willingness to elaborate on new techniques and methods;
• creating a good corporate image among employees;
• raising own personnel’s qualifications regularly and educating them in compliance with the company’s needs;
• hiring staff whose qualifications and experience correspond to the company’s needs.

From the perspective of scientific centers the main reasons for starting cooperation between business and science are:

• willingness to elaborate on new technologies and manufacturing methods;
• opportunity for R&D works to be sponsored by businesses;
• possibility of being informed (by enterprises) about the demand for new techniques and technologies;
• possibility of being informed about R&D activities run by enterprises and tech advancements which they would like to introduce129.

Business-science cooperation lies in conducting joint R&D works and elaborating on new majors and forms of education (whereby this practice is applied more often in the USA and Western European developed countries than in Poland)130. Commercial companies exert some pressure on universities in order for them to design curriculums dedicated to the particular business needs. As the practice indicates, thanks to such dependence enterprises create their competitive advantage, which is particularly seeable in the area of new technologies or technical and organizational innovations131.

Both universities and enterprises can greatly benefit from business–education partnership. In business environment science entities are perceived as practical and useful knowledge providers. Lecturers have a possibility of gaining new experiences when collaborating with specialists (economic practitioners). But enterprises receive a high quality product customized to their needs, virtually unlimited access to research and admission to the most gifted graduates.

Amongst the major benefits for enterprises there can be mentioned132:

• wide access to research;
• gaining properly prepared employees through wide access to students;
• creating a positive image among students and scientific workers;
• receiving a high quality product tailored to the company’s needs.

Among the benefits for higher education institutions there can be distinguished133:

• financial gains;
• non-financial gains e.g. new equipment, technology and educational materials;
• being regarded as a practical and useful knowledge provider; raising its attractiveness for students;
• education for market purposes, which is valued as well by employers as by students; besides, students can examine case-studies and have an opportunity to get to know a company through internship or apprenticeship.

Business-science cooperation also means personal benefits for scientists. Hence, they highlight such advantages of this collaboration as134:

• meeting one’s own need to act for society;
• fulfillment of own reflection on scientific work, passions and interests;
• gaining new experience;
• development stimulation;
• raising the quality of didactics (e.g. example-based classes);
• own experience-based scientific results such as publications;
• combining theory and practice, theory verification and improvement.

One has to mention that except for many benefits for knowledge-based economy development in Poland, there are still some barriers in cooperation between science and business. They were listed i.a. in the 2000 publication issued by PARP (Polish Agency for Entrepreneurship Development) entitled135: “System transferu technologii i komercjalizacji wiedzy w Polsce – Siły motoryczne i bariery” (System for Technology Transfer and Knowledge Commercialization in Poland – The Lifting and Hindrances). The authors of this report divided barriers into four categories – structural, systemic, cultural awareness, and competent. Some of them are concrete obstacles hampering scientists and entrepreneurs’ work, the rest belong to general matters e.g. a good atmosphere for business-science cooperation. Part of them result from imperfect law, the way of school organization, negative stereotypes and lack of skills or knowledge.


128 „Innowacyjność przedsiębiorstw na Mazowszu oraz współpraca ze szkołami wyższymi”, 2012. p.45 Elaboration is a result of the survey „Diagnosis of cooperation between higher education and economic sector, incl. experts report on innovative enterprises in Mazovia” The Foresight project - regional for the Warsaw and Mazovia universities „Academic Mazovia 2030”

129 Ibid., p.45


132 „Innowacyjność przedsiębiorstw na Mazowszu oraz współpraca ze szkołami wyższymi”, 2012. s.11 Elaboration is a result of the survey „Diagnosis of cooperation between higher education and economic sector, incl. experts report on innovative enterprises in Mazovia” The Foresight project - regional for the Warsaw and Mazovia universities „Academic Mazovia 2030”

133 Ibid., p.13

134 „Innowacyjność przedsiębiorstw na Mazowszu oraz współpraca ze szkołami wyższymi”, 2012. p.13 Elaboration is a result of the survey „Diagnosis of cooperation between higher education and economic sector, incl. experts report on innovative enterprises in Mazovia” The Foresight project - regional for the Warsaw and Mazovia universities „Academic Mazovia 2030”

One of the major barriers constraining education-business partnership is lack of sufficient experience in cooperation, which may result in low risk compensation or falling to commercialization of R&D results.

The major obstacles are communication, which may lead to misunderstanding and conflicts in understanding the research results. Communication barriers also refer to the lack of sufficient experience in cooperation, which may lead to misunderstanding and conflicts in understanding the research results.

Another category of barriers is organization, which refers to the lack of institutionalized forms of cooperation. Cultural and science differences are essential to the organization of cooperation. The effect of this state of affairs is good internalization and emphasis on basic research (knowledge development) and not too much on application (everyday cooperation with the market).

Business-science cooperation will be more efficient if the R&D results are oriented and sought to generate new opportunities for revenue. The process of R&D result commercialization is of key importance in this context. The commercialization process is key to the success of the project. The R&D results can bring financial gains for both universities and enterprises. However, the process of conducting studies and taking actions heralding market success are very expensive. Furthermore, in most cases, the funds are not sufficient enough to introduce a product into the market and generate commercialization-related profits.

The polls carried out in the recent years reveal that the activity within commercialization of the research results can bring financial gains for both universities and enterprises. However, the process of conducting studies and taking actions heralding market success are very expensive. Furthermore, in most cases, the funds are not sufficient enough to introduce a product into the market and generate commercialization-related profits. In addition, they should know a variety of procedures related to R&D results commercialization.

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5. Methodology of research

The objective of the conducted research was gaining information on i.a. research and development activity of enterprises in the Lodz region, hitherto cooperation between enterprises and research and development units and the actions which are planned in this field in the nearest future.

The conducted study was based on the survey which was prepared so as to ensure reaching the basic goals of the research.

The sample size for the survey was established at the level of 500 units. There was also the back-up sample whose proper application ensured 100% return.

The selection range constituted a list of entities registered in the Lodz voivodeship (by REGON – the National Official Register of Business Entities) as of 31 December 2011. The sample was randomly selected (no return).

The research was carried out from March to June 2012. Before the study, the randomly selected enterprises were informed about it and got familiarized with the survey. The poll was conducted by qualified interviewers who got acquainted with the subject-matter thoroughly. The interviewers always accompanied the respondents while filling in the poll, thanks to which all doubts and ambiguities could be explained immediately and it respectively ensured better return of surveys.

5.1 Profile of the questioned enterprises engaged in the survey

500 enterprises from the Lodz region took part in the survey, out of which 68.6% accounted for companies from an industry sector and 31.4% service companies. Over half of the questioned constituted the enterprises that have been running a business activity in the Lodz region for at least 10 years (chart 1).

Among the surveyed companies those which were established at the initial stage of Polish economy change, that is in the years 1990 – 1994, prevail. That is 29.4% of enterprises in total. Nearly three quarters of the questioned (73.4%) arose before 2000. The companies that came into existence after 2010 constitute the lowest ratio (4%). From the point of view of the subject-matter, this structure is very beneficial because the object of the study comprises enterprises with market stability.

Chart 2 illustrates the profile of the surveyed enterprises by capital structure. In the poll there are companies with 100% of Polish capital, with dominant part of Polish or foreign capital and companies with 100% of foreign capital.

The figures presented in the chart indicate that the companies with Polish capital (95.8%) of enterprises in total, out of which 93.0% constitute companies with exclusively Polish capital are predominant. The proportion of enterprises with exclusively foreign capital merely accounts for 3.0% of the surveyed. It is a positive phenomenon that the surveyed enterprises mostly include the national ones. In reference books it is assumed that if a mother country is better developed than a host country, foreign enterprises have much better access to new technology solutions (i.a. technologies applied as well in a mother country as in other nations or solutions applied in a parent company), technology and organizational solutions against the national companies. They are also a medium of innovations in a host country. Therefore, from the perspective of national enterprises running a business activity on local and international markets, it seems that access to the newest knowledge through cooperation with R&D sector may be meaningful.

Chart 3 depicts the profile of the surveyed enterprises by the number of employees. 161

The SME respondents constitute 95.2% of all companies taking part in the survey. Over half of them accounts for small enterprises (56.2%). Micro enterprises comprise 24.0% of the total number of businesses. The share of large entities in the sample amounts to merely 4.8% of companies in total.

161 The following enterprise classification according to the number of employees is assumed: • micro enterprises ≤ 9 employees • small enterprises 10 - 49 employees • medium-sized enterprises 50 - 249 employees • large enterprises ≥ 250 employees.
Research and development activity of the surveyed enterprises

Amongst the questioned companies there are just 11% of those that run research and development activity, nevertheless, a vast majority of them (70.8%) have introduced some innovations over the last three years. The kind of implemented innovations is presented in Table 2.

Table 2. Kind of implemented innovations in the surveyed enterprises over the last three years

<table>
<thead>
<tr>
<th>Innovations</th>
<th>% of indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>50.4%</td>
</tr>
<tr>
<td>Organizational</td>
<td>43.3%</td>
</tr>
<tr>
<td>Process</td>
<td>40.2%</td>
</tr>
<tr>
<td>Marketing</td>
<td>31.6%</td>
</tr>
</tbody>
</table>

* Total responses do not equal 100% because it was possible to indicate more than one answer.

Source: own elaboration

The most frequently implemented innovations were product ones (50.4% of indications), which means that slightly over half of respondents have introduced a new or a greatly improved product or service onto the market. Enterprises have also implemented some organizational or process innovations relatively often (adequately 41.3% and 40.2% of indications). As shown in the table, marketing innovations have been implemented most rarely (31.6%).

In the survey the respondents were asked to give the sources of gaining new ideas for implementing innovations. The responses are shown in the table below.

Table 3. Sources of gaining new ideas for new products, processes, organizational and marketing changes. Source: own elaboration

<table>
<thead>
<tr>
<th>Source</th>
<th>% of indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st answer</td>
<td>2nd answer</td>
</tr>
<tr>
<td>Based on own ideas and resources (R&amp;D works etc.)</td>
<td>76.0%</td>
</tr>
<tr>
<td>Taking over an enterprise having innovations implemented</td>
<td>2.0%</td>
</tr>
<tr>
<td>Copying other solutions</td>
<td>6.0%</td>
</tr>
<tr>
<td>Co-creation with other enterprises</td>
<td>4.3%</td>
</tr>
<tr>
<td>Hiring specialists (experts/scientists)</td>
<td>3.6%</td>
</tr>
<tr>
<td>Cooperation with enterprises having innovations implemented</td>
<td>3.1%</td>
</tr>
<tr>
<td>Purchase of license, patent or knowledge</td>
<td>1.9%</td>
</tr>
<tr>
<td>Co-creation with research and higher education institutions</td>
<td>1.0%</td>
</tr>
<tr>
<td>Other</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Source: own elaboration

The surveyed enterprises indicated own ideas and resources as the most frequent source of ideas for new products, processes or organizational and marketing changes (76.0% of indications – 1st answer). As presented in the table, companies frequently copy or imitate other solutions – 42.5% of indications in the 2nd answer and 24.4% in the 3rd one. However, as was previously mentioned, only 11% of the questioned enterprises conduct R&D works, therefore, it is alleged that the surveyed companies entrust some part of own ideas – especially in the field of most frequently implemented product innovations – to external research units for its further elaboration and putting them into practice. Despite the fact that cooperation with research and higher education institutions was one of the least essential sources of gaining ideas or concepts for implementing innovative solutions, it is worth highlighting that enterprises hire specialists (including scientists, 12.3% of indications – 2nd answer and 15.6% of indications – 3rd answer) and co-create innovative solutions together with other businesses (11.4% of indications – 2nd answer and 13.3% of indications – 3rd answer). It proves that companies are open to cooperate in the field of innovations, including the representatives of scientific disciplines.

Cooperation with science

As the hitherto conducted analysis indicates, the surveyed enterprises take some innovation activities and are open to cooperate in this area. However, merely 24.0% of the polled took joint ventures with representatives of science in the scope of gaining or implementing innovations (chart 4).

The data included in table 4 refers to the frequency of enterprise cooperation with particular research and development institutions.

The data presented in table 4 confirms the findings encompassed in reference books – business-science cooperation is occasional – regardless of the kind of R&D entity, the answer “never” definitely prevails (from 69.8% of indications in case of universities up to 95.3% in the event of technology transfer centers). If such a collaboration is conducted, enterprises take joint ventures together with higher education institutions, which is mirrored in the following indications - 72.2% for “often” and 10.9% for “sometimes”. Table 5 illustrates various forms of this cooperation.

Table 4. Frequency of enterprise cooperation with science entities. Source: own elaboration

<table>
<thead>
<tr>
<th>Science institution</th>
<th>Often</th>
<th>sometimes</th>
<th>seldom</th>
<th>never</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td>higher education institutions</td>
<td>2.2%</td>
<td>10.9%</td>
<td>93.9%</td>
<td>69.8%</td>
<td>2.8%</td>
</tr>
<tr>
<td>JBR</td>
<td>4.3%</td>
<td>7.0%</td>
<td>3.8%</td>
<td>81.7%</td>
<td>3.4%</td>
</tr>
<tr>
<td>industrial research institutes</td>
<td>4.1%</td>
<td>4.6%</td>
<td>4.1%</td>
<td>86.3%</td>
<td>2.9%</td>
</tr>
<tr>
<td>science foundations</td>
<td>0.3%</td>
<td>1.1%</td>
<td>14.1%</td>
<td>93.9%</td>
<td>3.1%</td>
</tr>
<tr>
<td>technology parks</td>
<td>0.3%</td>
<td>1.7%</td>
<td>2.5%</td>
<td>92.6%</td>
<td>2.9%</td>
</tr>
<tr>
<td>industrial parks</td>
<td>0.3%</td>
<td>0.8%</td>
<td>14.1%</td>
<td>94.2%</td>
<td>3.3%</td>
</tr>
<tr>
<td>technology transfer centers</td>
<td>0.0%</td>
<td>0.6%</td>
<td>6.8%</td>
<td>95.3%</td>
<td>3.3%</td>
</tr>
</tbody>
</table>
On the basis of the above mentioned data it is difficult to unambiguously state which form of cooperation is predominant. However, it seems that enterprises undertake joint ventures, ordering research, consulting, participating in academic procedures at university, using universities’ laboratories, cooperating in spin-offs, using university infrastructure, and using university science parks. The table shows the percentage of companies that undertake these forms of cooperation with representatives of science (Table 5).

Table 5. Forms of enterprise cooperation with representatives of science

<table>
<thead>
<tr>
<th>Source</th>
<th>1st answer</th>
<th>2nd answer</th>
<th>3rd answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint R&amp;D projects</td>
<td>5.0%</td>
<td>0.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Participation in joint ventures</td>
<td>3.5%</td>
<td>0.9%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Enterprise staff trainings</td>
<td>3.5%</td>
<td>1.1%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Ordering to conduct research by university / R&amp;D entity</td>
<td>2.7%</td>
<td>4.7%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Ordering to make a prototype, a trial run</td>
<td>2.5%</td>
<td>2.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>University / R&amp;D entity consulting for an enterprise</td>
<td>2.1%</td>
<td>2.7%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Using university laboratories by an enterprise</td>
<td>0.8%</td>
<td>1.8%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Staff participation in academic procedures at university</td>
<td>0.8%</td>
<td>1.1%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Licence agreement</td>
<td>0.4%</td>
<td>0.2%</td>
<td>0.2%</td>
</tr>
<tr>
<td>An enterprise location in university science parks</td>
<td>0.4%</td>
<td>0.2%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Using an enterprise infrastructure by university</td>
<td>0.2%</td>
<td>0.4%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Cooperation in spin-off</td>
<td>0.0%</td>
<td>0.2%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Other</td>
<td>0.4%</td>
<td>0.0%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Source: own elaboration

7. Cooperation with science

A vast majority of enterprises (69.8%) uphold that an offer of science entities is not properly adjusted to their needs. The causes of this non-compliance were reported by respondents and are presented in the table below.

As seen in the table, despite the fact that enterprises indicate lack of adaptation of science entities’ offer to the business needs, a third of the surveyed highlights unfamiliarity with an offer – 38.2% of indications for the 1st and 18.3% for the 2nd and 3rd answer. Respondents also point out that an offer of R&D entities is not adjusted to the specific character of the branch (28.3% of indications – 1st answer, 11.3% – 2nd). 13.4% (1st and 2nd answer) of the questioned admit that the suggested solutions are far too costly.

On the other hand, respondents mention the following benefits from the certain actions while cooperating with R&D entities (Table 7).

Table 6. Main reasons of offer inadequacy

<table>
<thead>
<tr>
<th>Source</th>
<th>1st answer</th>
<th>2nd answer</th>
<th>3rd answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>An enterprise is not familiar with an offer</td>
<td>38.2%</td>
<td>18.3%</td>
<td>18.3%</td>
</tr>
<tr>
<td>An offer does not comply with the trade specificity</td>
<td>28.3%</td>
<td>21.2%</td>
<td>9.8%</td>
</tr>
<tr>
<td>Suggested solutions are too expensive</td>
<td>28.3%</td>
<td>21.2%</td>
<td>9.8%</td>
</tr>
<tr>
<td>Implementation of the suggested solutions is too time-consuming</td>
<td>14.9%</td>
<td>10.8%</td>
<td>8.7%</td>
</tr>
<tr>
<td>An offer is not detailed enough</td>
<td>16.6%</td>
<td>15.4%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Suggested solutions are not innovative enough for an enterprise</td>
<td>16.6%</td>
<td>5.9%</td>
<td>10.3%</td>
</tr>
</tbody>
</table>

Source: own elaboration

Table 7. Benefits from business-science cooperation

<table>
<thead>
<tr>
<th>Source</th>
<th>1st answer</th>
<th>2nd answer</th>
<th>3rd answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possibilities of implementing new technology solutions</td>
<td>24.0%</td>
<td>12.3%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Access to the latest expert knowledge</td>
<td>21.9%</td>
<td>17.2%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Competitiveness growth</td>
<td>35.0%</td>
<td>13.6%</td>
<td>31.0%</td>
</tr>
<tr>
<td>Possibilities of cost reduction through efficiency growth</td>
<td>45.5%</td>
<td>14.8%</td>
<td>9.6%</td>
</tr>
<tr>
<td>Opportunities of own HR development</td>
<td>6.1%</td>
<td>5.6%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Enterprise prestige growth</td>
<td>4.5%</td>
<td>2.7%</td>
<td>8.5%</td>
</tr>
<tr>
<td>Acquiring new clients and/or markets</td>
<td>5.7%</td>
<td>8.2%</td>
<td>22.4%</td>
</tr>
<tr>
<td>Export-led growth</td>
<td>0.8%</td>
<td>0.9%</td>
<td>62.2%</td>
</tr>
</tbody>
</table>

Source: own elaboration

On the basis of the above mentioned data it is difficult to unambiguously state which form of cooperation is predominant. However, it seems that enterprises undertake joint ventures with representatives of science relatively most often. These are research and development projects (5.0% of indications for the 1st answer) and joint ventures (3.5% - 1st answer). It also frequently happens that companies commission the scientific environment to perform the given tasks, in particular these are:

- organizing training courses for own employees (3.5% of indications for the 1st answer)
- conducting research for a company (3.5% - 1st answer)
- making a prototype or a trial run of a given product (2.7% - 1st answer, 2.7% - 2nd)
- providing consulting services for an enterprise (2.1% - 1st answer, 2.7% - 2nd)

From the entrepreneurs’ point of view one of the reasons of taking joint ventures with representatives of science sporadically is maladjustment of science entities’ offer to their needs (chart 5)
The most frequent benefits mentioned by respondents which result from cooperation with R&D partners are:

- possibilities of implementing new technology solutions – 24,0% of indications for the 1st answer,
- access to the latest technical/expert knowledge which doubtlessly representatives of science possess – 17,9% - 1st answer, 17,7% - 2nd answer,
- competitiveness growth – 15,0% - 1st answer, 13,6% and 13,0% - respectively 2nd and 3rd answer.

What is interesting, entrepreneurs also suggest that as a result of such a cooperation business activity costs should be reduced through company efficiency improvement (6,5% of indications – 1st answer and 11,8% - 2nd answer). It can be supposed that profits achieved from this cooperation could cover expenditures incurred for cooperation enforcement which are quite high according to respondents.

Within the conducted survey there was an attempt to assess the prospects of further cooperation of enterprises and science entities (table 8 and 9).

Table 8. Does your enterprise plan to intensify cooperation with science?

<table>
<thead>
<tr>
<th>Source: own elaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>We stay at present level of cooperation</td>
</tr>
<tr>
<td>Yes, by increasing area of cooperation</td>
</tr>
<tr>
<td>No, by restricting number of partners</td>
</tr>
<tr>
<td>Yes, by increasing number of partners</td>
</tr>
<tr>
<td>No, by restricting area of cooperation</td>
</tr>
</tbody>
</table>

As shown in table 8, merely 20,8% of respondents are willing to expand the cooperation in terms of its area or number of partners. Apparently, it is a promising phenomenon. However, considering the fact that most enterprises do not plan to intensify their cooperation in this field (39,9% of the surveyed), furthermore, 18,4% of respondents are going to restrict it (in terms of area and number of partners), there is a fear that business cooperation with R&D entities will not flourish in the nearest years. Hence, it is indispensable to continuously promote and support innovation transfer networks and knowledge exchange between science and business environment in Poland.

Analyzing the intended forms of cooperation (table 9), staff trainings organized by research and development entities for an enterprise predominate (8,1% - 1st answer, 5,1% - 2nd). Enterprises’ intention of taking joint ventures with representatives of science, that is joint R&D projects (7,4% - 1st) and joint technology development (4,7% - 1st, 4,4% - 2nd) can be really advantageous.

Both reference books and the surveys indicate that business-science cooperation in Poland is in its infancy. However, entrepreneurs and representatives of science realize there is a need for implementation of joint ventures and benefiting from them.

Business-science cooperation mainly focuses on improving products or technologies which already exist and are used by enterprises commercially. Contrary to the selected EU countries, new and innovative solutions guaranteeing a company’s competitive edge are elaborated on much more seldom.

Despite the fact that a multitude of ventures aimed at reinforcing economy innovativeness and promoting business-education partnership are taken more and more eagerly, lack of efficient information flow between R&D institutions and enterprises is still a key barrier.

However, it ought to be enhanced that enterprises are open to cooperation with science entities and spot lots of benefits resulting from engagement in joint ventures. It is necessary to take actions supporting the creation and development of cooperation networks and information exchange between science and business in Poland.

<table>
<thead>
<tr>
<th>Source: own elaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise staff trainings</td>
</tr>
<tr>
<td>Joint R&amp;D project</td>
</tr>
<tr>
<td>Joint technology development</td>
</tr>
<tr>
<td>Participation in joint ventures (enterprise/ R&amp;D entities/ technology transfer entities)</td>
</tr>
<tr>
<td>University/R&amp;D entity consulting for an enterprise</td>
</tr>
<tr>
<td>Ordering to make a prototype</td>
</tr>
<tr>
<td>Ordering to conduct research by university/ R&amp;D entity for an enterprise</td>
</tr>
<tr>
<td>Using university laboratories by an enterprise</td>
</tr>
<tr>
<td>Licence agreement</td>
</tr>
<tr>
<td>University / R&amp;D entity participation in an enterprise research and development orientation</td>
</tr>
<tr>
<td>Staff participation in academic procedures at university</td>
</tr>
<tr>
<td>An enterprise location in university science parks</td>
</tr>
<tr>
<td>Cooperation in spin-offs</td>
</tr>
</tbody>
</table>
8. References

1. Annual Report on Technology Transfer, Office of Technology Policy, Technology Administration; National Institute of Standards and Technology, Technology Administration; National Oceanic and Atmospheric Administration; Institute for Telecommunication Sciences, National Telecommunications and Information Administration, January 2005


5. Benchmarking of Business Incubators Section, Sweden 2002


