BUSINESS – SCIENCE COOPERATION

The case of Poland

Scientific Editor: Jerzy Różanski

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 – economics 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.

1. Antoszkiewicz J. Metody skutecznego zarządzania [Effective magagement methods], ORGMASZ, Warsaw 1996, Jonasz W. (ed.) *Innowacje w strategii rozwoju organizacji w Unii Europejskiej [Innovation in organisation development in European Union],* Difin, Warsaw 2009.
2. *Działalność innowacyjna przedsiębiorstwa w latach 2006-2009 [Innovation activities in companies in 2006 – 2009],* GUS, Warsaw 2010
3. *Działalność innowacyjna przedsiębiorstwa w latach 2008-2010 [Innovation activities in companies 2008 – 2010],* GUS [Main Office of Statistics], Warsaw 2012
4. Innowacyjność 2010r. [Innovativeness in 2010], PARP Warsaw 2010
5. Jasiński A.H. *Innowacje i transfer techniki w procesie transformacji [Innovation and technology transfer in transformation],* Wyd. Difin, Warsaw 2006
6. Jonasz. K., *Kapitał w finansowaniu działalności innowacyjnej przedsiębiorstw w Polsce. Źródła i modele.* [Capital in financing innovation activities of companies in Poland. Sources and models] Difin, Warszawa 2010
7. Jonasz W., *Innowacyjność i przedsiębiorczość w kulturze organizacyjnej przedsiębiorstwa jako systemu społecznego [Innovativeness and enterprise in organisational corporate culture as a social system]* [in:] Jonasz W. (ed.) *Innowacje w strategii rozwoju organizacji w Unii Europejskiej [Innovation in organisation development in European Union],* Difin, Warsaw 2009
8. Lancaster G., Massinghan L., Marketing Management, McGraw-Hill, London 1993
9. Lisowska R., Starzyńska D., *Działalność innowacyjna polskich przedsiębiorstw przemysłowych – analiza komparatywna [Innovation activities of Polish industrial companies – comparative analysis],* in *Przyszłość Integracji Europejskiej – konkurencyjność i rynek [The future of European integration – competitiveness and the market],* edited by Bieńkowski W, Bukowski S., Olszewska G., Wyd. CEDEWU, Warsaw 2012
10. Matusiak K. B., *Innowacje i transfer technologii: słownik pojęć* [Innovation and technology transfer: glossary], PARP, Warsaw 2008
11. Nauka i technika w and Technology in 2006], GUS, 2006r, Warsaw 2007
12. Niedzielski P., *Innowacyjność w działalności przedsiębiorstw: Kompendium wiedzy [Innovation in companies' operations. Knowledge base.]* , Wydawnictwo Naukowe Uniwersytetu Szczecińskiego, Szczecin 2007
13. Oslo Manual. Guidelines for collecting and interpreting innovation data, European Commission,2005 *http://www.nauka.gov.pl/fileadmin/user_upload/43/46/43464/20081117_OSLO.pdf*

BUSINESS-SCIENCE COOPERATION IN POLAND ILLUSTRATED WITH AN EXAMPLE OF THE LODZ REGION

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Creating knowledge-based economy is not possible without an ability to cooperate and transfer the knowledge between enterprises and science entities. In particular, hopes are reposed in science development, especially the ability to turn knowledge into new products or services. Knowledge, creativity, innovations, entrepreneurship and technology transfer play a more and more important role. High expectations are connected with mechanisms including scientific institutions in economic sphere and creation of multifunctional business relationships. The necessity of deepening the integration of so-called knowledge triangle, that is science, education and innovation, is enhanced. Moreover, science and research sector is considered a flywheel of knowledge-based economy[110].

The issue 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[111]. This cooperation enables enterprises to gain and maintain competitive advantage. Besides, it contributes to effectiveness growth and using local factors of production. As a result of socio-economic changes and R&D sector reforms, Polish research and development units have new possibilities of transferring their achievements to enterprises. In the area of commercialization of innovations, it entails the necessity of indicating solutions that could be applied in Polish economic conditions. Hence, it is really essential that the process of research results transfer should be properly monitored and supervised. Solutions applied in other countries, with particular focus on good practices in this field, should be observed as well.

The aim of the paper is assessment of business-science cooperation in Poland on the basis of the poll carried out in 2012 under the project with transnational component[112] "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.

[110] Matusiak K. (red.), Ośrodki Innowacji i Przedsiębiorczości w Polsce. Raport 2010, PARP, Warszawa 2010, p.11

[111] De Liso N., Leoncini R., Internationalization, Technological Change and the Theory of the Firm, Routledge, New York 2010, p.103

[112] The partner of project is a team of scientists at the University of Manchester

In innovation-led countries with highly competitive economies, a key role in the process of diffusion of innovations lies in cooperation between R&D sector and enterprises together with practical application of research and development work results in economy. Among various forms of cooperation, partnership between economic sector and higher education institutions plays a significant role. On the one hand, it is connected with the functions of universities in the process of educating staff, on the other hand – with their huge research potential. Higher schools are an intermediary in transferring knowledge and new technology methods to all economic branches. Cooperation between these entities allows for spreading the risk among organizations that are involved. The aftermath of the partnership can be reinforcement of partners' competitive position, access to the latest knowledge and scientific information, or development of partners' resources etc. During the cooperation partners should also think about the benefits and needs for its partners, specifically: how partnerships may change over time, importance of nondisclosure agreements, resolving challenges, longevity of the arrangement, and so on[113].

In Polish economy economic sector entities are not inclined enough to cooperate with higher education institutions. The reasons might be cultural, organizational, marketing or communication conditioning. However, recently a lot of actions supporting different forms of cooperation between R&D sector and colleges/ universities were initiated[114]. 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 in partners' competitiveness through solution-focused problem solving collaboration. It also aims at promoting the development of entrepreneurs' talents and skills, entrepreneurial attitudes and ways of thinking which enable scientific workers to rapidly react to changes occurring in Polish economy. Close collaboration of business and science aims at improvement of education adequacy and pertinence of studies conducted by research institutions for business purposes. The issue of technology transfer and commercialization has a strategic meaning for Polish and European economy. The development of specialized, pro-innovative services is compatible with strategic directions of the United Europe development[115].

In the announcement published in March 2010 "*The 2020 Europe* – strategy for intelligent and balanced development fostering social inclusion" which determines a new, long-term program for EU socio-economic development and which replaced the Lisbon Strategy, knowledge and innovation-based evolution is one of the three key priorities. The objective of regular improvement of research and development activity conditions tending to increase in research and development up to 3% of GDP is closely related to the mentioned Strategy. The instruments of the *2020 Europe Strategy* implementation constitute leading initiatives prepared by the European Commission and National Reform Programs created by the EU member states[116].

[113] Harrison A., *Business Environment in a Global Context,* OUP Oxford, New York 2010

[114] A. Bąkowski, M. Mażewska (red.), *Ośrodki innowacji i przedsiębiorczości w Polsce, Raport 2012,* PARP, Warszawa 2012, p. 12

[115] Matusiak K. (red.), Ośrodki Innowacji i Przedsiębiorczości w Polsce. Raport 2010, PARP, Warszawa 2010, p.24

[116] Mojsiewicz M (red.).,Science and technology in Poland in 2009. Główny Urząd Statystyczny w Szczecinie, Warszawa 2011,p.3

The condition of effective cooperation between business and science is efficient information flow and greater interest in partnership of companies and universities. The changes should be directed for collaboration in two areas – didactics (not having to stick to centrally imposed majors, elaboration and establishment of new curriculums in cooperation with enterprises) or in the research and development field. As a matter of fact, entrepreneurs notice business benefits from such a partnership more and more often. In the time of economic uncertainty most companies focus on ongoing activity, reducing some investments to minimum. Presently traditional ways of building competitive edge are no longer the key to a long-term success for an enterprise.

One of the most essential challenges is adaptation of science and R&D sector to the changes which occurred in Polish economy in the last few years. Higher institutions are just learning how to take up commercial tasks in terms of organization. When it comes to enterprises, one of the hindrances is the fact that some part of companies buy new technologies more frequently than elaborate on their own solutions. Such enterprises usually perceive import of ready-to-implement western solutions as something better than cooperation with Polish schools.

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

- „applied research in advanced technologies in company upskilling of employees,
- bespoke collaborative degree program mes,
- science park developments,
- enterprises education,
- entreprenurial suport for staff and students,
- higher – level apprenticeships,
- skills development of post doctor al staff."[117]

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 a university department 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 business. Indeed they even set up businesses based on technology generated by their own research. These are called spin-offs, and they often start life in so-called "incubators".[118]

[117] Wilson T., *A review of Business – Universty Collaboration,* 2012, str. 1, *https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32383/12-610-wilson-review-business-university-collaboration.pdf*

[118] Todeva E., Management of International Business Networks, Routledge, Oxford 2010, s. 87

The differences between science and enterprise operation in European countries are significant. They stem from the history of their establishment, different needs in particular countries and consequently varied goals. Including Sweden, Great Britain and Norway in the above analysis was provoked by a high position of these countries in world's competitive and innovative economies ratings. The selected nations are characterized by a high level of competitiveness, innovativeness and GDP, including GDP per capita. However, each of the countries has its own original solutions in the area of innovation transfer to economic applications.

The CBI, with 3M and the Design Council, recently conducted a survey of innovation in UK companies. The research shows that Millennium Product award-winning firms are among the UK's most innovative. They use a high level of collaboration with UK universities as a source of their innovation advantage. They deem this collaboration an essential part of the innovation process. But the picture is markedly different from these companies. For a variety of reasons, a quarter of companies surveyed said they had no collaboration with universities or other businesses at all. Of those, 48% simply had not considered it, 36% did not want to share ideas, 32% said they did not need to do it, and 10% said they would, but could not find a partner.

In the age of communication revolution, it is almost inevitable that innovative companies work more closely with universities, but the evidence is mounting that if Britain is successful in wedding more companies to universities, then the British economy, British businesses and higher education in the UK could all benefit.

National and international business is quickly evolving to satisfy the needs and opportunities of the communication revolution and the knowledge economy. Universities are doing the same. But many are hamstrung by old systems and old values that will have to adapt to the rapidly changing times in which we live. Universities have to secure more and more finance by exploiting business relationships and conducting themselves more along business lines. This has its advantages and drawbacks. But if this new system is going to work, then the very way in which universities function must be reviewed - as many funding decisions are based on the criteria of an earlier age.

Universities have traditionally been seen as contributing to society through the creation of a rich intellectual culture, underpinned by free-ranging academic curiosity of ten uninhibited by concerns about making a profit or creating something practical. For grant, research and status purposes, universities and academics are often still judged along these lines. If an academic or a department is regularly publishing papers on the theory of their field, then they are deemed to be doing a good job.

But the challenge now is to create a system in which knowledge derived from practical application and investigation in the world of business and industry is valued as highly as knowledge derived from academic theory. Currently some institutions and academics feel penalized for the work they do in business, because its fruits are not sufficiently recognized by the current system.

The real challenge is to make such an engagement a core value for both universities and business, where academes truly value the insights and perceptions that the practitioner world brings, and where business truly value the insights and discoveries of the academic world. In this new system, universities will be recognized and rewarded for their business relationships and for providing students with practical experience in their field. Research funding will recognize the legitimacy of such relationships. Practice will become an input for academic analysis, as well as an output.

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)[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[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.

[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"

[120] K. Santarek (red.), Transfer technologii z uczelni do biznesu. Tworzenie mechanizmów transferu technologii, PARP, Warszawa 2008 [za:]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, Annual Report on Technology Transfer, pp. 22-52 January 2005 *www.technology.gov/reports/TechTrans/FY2004.pdf*

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[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[122].

[121] K. Santarek (red.), *Transfer technologii z uczelni do biznesu. Tworzenie mechanizmów transferu technologii,* PARP, Warszawa 2008, [za:]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, Annual Report on Technology Transfer, pp. 22-52 January 2005; *www.technology.gov/reports/TechTrans/FY2004.pdf*

[122] Gestrelius S., Birck A., Cross Border Research and Innovation in Medicon Valle, Medicon 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 and R&D sector.

The collaboration was initiated mainly to raise innovativeness and competitiveness of the national economy through galvanizing knowledge and technology transfer from R&D sector to enterprises. The parks in Great Britain or Sweden come to being on the initiative of the three key entities: research units (in particular universities, and negligible research institutes), local authorities and entrepreneurs. In the analyzed countries technology parks differ in terms of legal frame of activity. 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 and private entrepreneurs. Parks which arise in Great Britain are purely private ventures in the form of independent companies or joint venture organizations in which universities, enterprises and local authorities have their own shares. In the selected nations the parks belong to the basic business-science cooperation centers. These centers aim at active policy of experiences and knowledge exchange between business and R&D sector, through both formal and informal channels – assistance in organization and execution of implementation processes is offered and *spin-off* initiatives are supported (e.g. through outer capital inflow, market analysis, assessing attractiveness of elaborate solutions and seeking their recipients)[123]. 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.

[123] Wnuk U. ‚Struktury wsparcia procesu transferu technologii w Polsce na tle doświadczeń europejskich, e- mentor 1 (48)/2013

Poland concentrates on any activities tending to increase scientists and entrepreneurs' awareness in the scope of knowledge transfer, i.a. through diverse training courses and workshops. Entrepreneurs who commence their business activity are also succored e.g. through help to gain some startup funding (venture capital funds). In research entities there are some teams consisting of a few people handling technology and knowledge transfer within a university or institutions strictly related to academe but acting in the form foundation or a company. This form is chosen most frequently as it gives more flexibility in supporting entrepreneurship or adapting to the companies' needs. The best incentive for technology transfer is an epitome. A very positive role in this process is played by enterprises started by scientists and being constantly related to university they derive from. Through the participation of university the companies have an opportunity to develop new technologies. Unfortunately, higher education institutions lack in-school policy in the scope of technology transfer and sources of funds that can support this process. Obviously, it does not foster the effectiveness of any actions that are taken.

Business-science cooperation in Poland is in its infancy, however, it is quite intensive and beneficial for both parties. Depending on the goals, it may take various forms. The most frequently mentioned is face-to-face communication within the scientist-entrepreneur relationship. In the course of time it might change into an institutionalized form. The second thing is common ventures which usually aim at solving a practical problem. From the perspective of a company, the result of such cooperation is a product or service adjusted to its needs and a university's profit is research material which is used in didactics afterwards. Another form of collaboration between these two spheres is hiring the representatives of academe in enterprises. While working for companies scientists use their expert knowledge to resolve commercial problems and on the other hand, they gain valuable, practical experience which can be used for didactic purposes[124].

Business-science cooperation mainly focuses on improving products or technologies which already exist and are used by enterprises commercially. It indicates some immaturity of this collaboration because one can assume that cooperation with scientists should aim at elaborating on new and innovative solutions which will ensure a competitive advantage[125].

The 2008 surveys carried out amongst the most rapidly developing enterprises in terms of innovations (Deloitte Fast 50 ranking), the biggest ones considering income and company's property (Lista 500 "Rzeczpospolita") and the most reputable universities ("Wprost" rating) revealed that 57% of the surveyed scientific centers and 41% of the polled enterprises entered into business-science cooperation. Regarding the fact that in a sample size there were also the top colleges (lots of technical, economic and medical schools whose scientific activity can be easily commercialized) and enterprises, this ratio is not really satisfactory (in international surveys the percentage for companies and scientific centers amounts to 75-80%)[126]. These results appear

[124] „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. expert's report on innovative enterprises in Mazovia". The Foresight project - regional for the Warsaw and Mazovia universities „Academic Mazovia 2030"

[125] Gabryś A.(red.), Najlepsze praktyki w zakresie współpracy ośrodków naukowych i biznesu przy wykorzystaniu środków z UE, Fundacja Aurea Mediocritas, Warszawa, p.24

[126] 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. expert's report on innovative enterprises in Mazovia". The Foresight project - regional for the Warsaw and Mazovia universities „Academic Mazovia 2030"

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 business[127].

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[128]:
- counseling services in the scope of techniques used and technologies;
- seeking and finding inspiration for new technology development;
- willingness to improve existent techniques and technologies;
- need for implementation of new technologies and methods;
- willingness to elaborate on new technologies 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 introduce[129].

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 innovations[131].

[127] Bąk M., Kulawczuk P (red.)„Warunki skutecznej współpracy pomiędzy nauką a przedsiębiorstwami. Warszawa, 2009, p.23

[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. expert's report on innovative enterprises in Mazovia". The Foresight project - regional for the Warsaw and Mazovia universities „Academic Mazovia 2030"

[129] Ibid., p.45

[130] Domański R., Sieciowe koncepcje gospodarek miast i regionów, Wydawnictwo Naukowe PWN, Warszawa 2003, p. 12

[131] Breen H., Hing N., Improving competitiveness trough cooperation: Assessing The benefits of cooperative education partnership in gaming management, „Gaming Research & Review Journal" 2000, no 1, pp. 57-72

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 mentioned[132]:
- 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 distinguished[133]:
- 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 as[134]:
- 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) entitled[135]„System transferu technologii i komercjalizacji wiedzy w Polsce – Siły motoryczne i bariery" (System for Technology Transfer and Knowledge Commercialization in Poland – The Lifeblood 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.

[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. expert's 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. expert's report on innovative enterprises in Mazovia". The Foresight project - regional for the Warsaw and Mazovia universities „Academic Mazovia 2030"

[135] Matusiak K., Guliński J., System transferu technologii i komercjalizacji wiedzy w Polsce – Siły motoryczne i bariery, PARP, Warszawa, Poznań, Łódź, Wrocław, 2010, p.6

One of the major barriers constraining education-business partnership is communication. Entrepreneurs often pay attention to not getting acquainted with science entities' R&D offer. The hindrance is also insufficient awareness of businessmen on benefits that can be achieved through such collaboration. Communication barriers do not fade away even when the cooperation has already started. It may lead to malfunctioning lying in the fact that badly informed enterprises are not able to efficiently take advantage of the opportunities offered by scientific centers which respectively do not deliver such research results that would correspond to the business needs. Another obstacle is different expectations and mutual prejudice which are even reinforced when cooperating. First and foremost, entrepreneurs complain that scientific workers do not know business reality, they complete tasks late, are impractical and their offer is neither concrete nor substantial. The next allegation is their insusceptibility to changes, conservatism and passive approach to companies maintaining that science environment expects much more benefits for themselves than they give in return. According to businessmen, science environment treats them instrumentally. The offers which are directed for companies most frequently assume that they will be just a funding source or one of the cooperation constituents regarding bureaucracy requirements. Any financial matters connected with high expenditures on R&D works and limited own resources of both universities and enterprises also hamper such collaboration. Misunderstandings on the financial background result from difficulties in gaining outer funds and high risk in new technology-based investments as well. Company owners also paid attention to scientific workers' lack of sufficient experience in cooperation with economy, which may result in severe financial penalties connected with late task completion or failing to commercialize research results[136].

Another category of barriers is organization which, in case of higher education institutions, refers to lack of established standards of sharing profits from intellectual property sales and lack of institutionalized forms of cooperation. Cultural differences are essential as well. Business and science environments are characterized by a completely different organizational culture – for companies profit plays a dominant part, and for universities – science development. The effect of this state of being is goal internalization and emphasis on basic research (knowledge development), environment encapsulation (everything or nearly everything is accomplished by oneself; collaboration with other centers incl. economy to a slight extent), dissemination of research results mainly through publications, free access to knowledge for the interested (slight interest in intellectual property protection), lack of interest in implementation of research results[137].

The polls carried out in the recent years reveal lots of factors contributing to cooperation development. These are i.a. openness and engagement of both parties, honesty and fulfillment of the tasks entrusted, conquering mutual reluctance and distrust and defining expectations at the beginning of collaboration. The authorities of university should introduce some incentives or stimulants motivating scientists to start joint ventures with business environment and promote the school achievements.

[136] Innowacyjność przedsiębiorstw na Mazowszu oraz współpraca ze szkołami wyższymi"|, 2012. p.15 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"

[137] K. Santarek (red.), Transfer technologii z uczelni do biznesu. Tworzenie mechanizmów transferu technologii, PARP, Warszawa 2008, p.

Besides, one has to pay attention to raising effectiveness of research results commercialization. It can be achieved through i.a. implementation of commercialization strategies and new patterns, amendments to legal regulations and starting up spin-off & spin-out companies. Observation, analysis and implementation of world's R&D trends and promoting projects aiming at research results commercialization are very vital as well.

Business-science cooperation will be more effective and efficacious if academic workers tackle developmental issues with huge innovativeness potential, know business environment, reality and the specificity of entrepreneurs' work. The representatives of science should be research results-oriented and ought to generate commercialization opportunities. In addition, they should know a variety of procedures related to R&D results commercialization.

The activity within commercialization of 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, there are always funding shortages to start this course. The above mentioned deficiency in financial resources constitutes the biggest barrier in transferring research results into economic practice. At the initial stage of development innovative ventures are financed by enterprises or scientists themselves. However, in most cases the funds are not sufficient enough to introduce a product into the market and generate commercialization-related profits[138].

Scientific workers should be more open to new experience and gaining new skills or qualifications. They should also be more entrepreneurial and more inclined to take a risk. The cooperation success depends on the actions taken by entrepreneurs as well. In order to greatly contribute to the success of education-business partnership they should recognize and examine the potential of a given science environment and clearly define the benefits resulting from business-science cooperation and commercialization of R&D results[139].

[138] Gabryś A.(red.), Najlepsze praktyki w zakresie współpracy ośrodków naukowych i biznesu przy wykorzystaniu środków z UE, Fundacja Aurea Mediocritas, Warszawa, p.24

[139] Innowacyjność przedsiębiorstw na Mazowszu oraz współpraca ze szkołami wyższymi"|, 2012. p.15 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"

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).

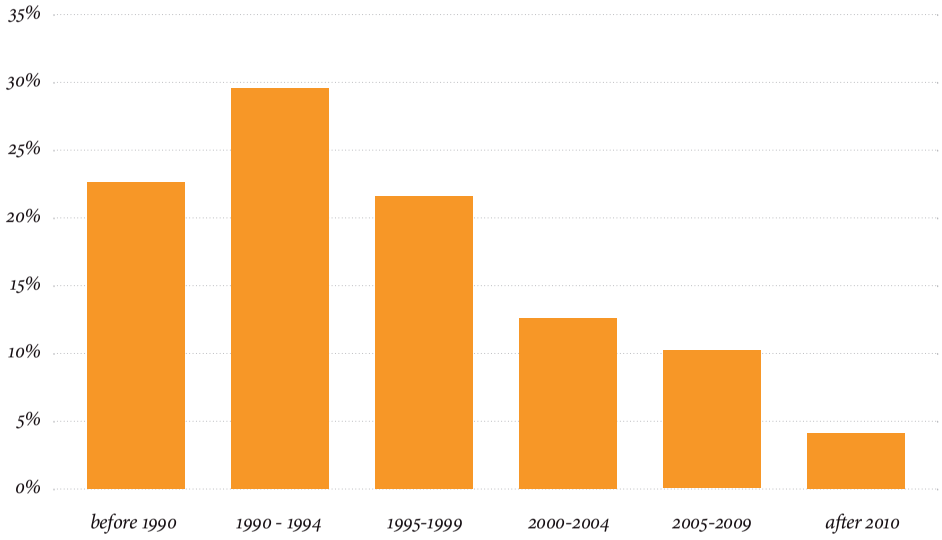
The research was carried out from March to June 2012. Before the study, the randomly selected enterprises were informed about it and got familiarized with the survey. The poll was conducted by qualified interviewers who got acquainted with the subject-matter thoroughly. The interviewers always accompanied 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).

Chart 1. Structure of the surveyed enterprises by establishment date

Source: own elaboration



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.

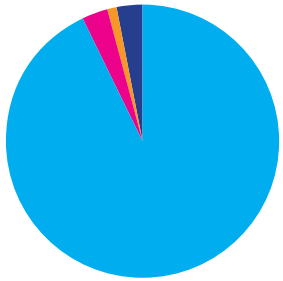
Chart 2 illustrates the profile of the surveyed enterprises by capital structure. In the poll there are companies with 100% of Polish capital, with dominant part of Polish or foreign capital and companies with 100% of foreign capital.

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.[140]

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.

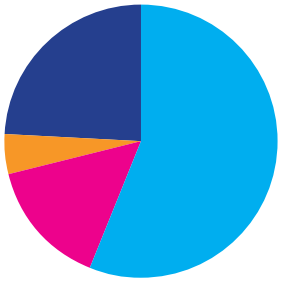
Chart 2. Profile of the surveyed enterprises by capital structure



100% polish capital	93.0%
100% foreign capital	3.0%
dominant part of foreign capital	1.2%
dominant part of polish capital	2.8%

Source: own elaboration

Chart 3. Profile of the surveyed enterprises by the number of employees



small enterprises	56.2%
medium sized enterprises	15.0%
large enterprises	4.8%
micro enterprises	24.0%

Source: own elaboration

[140] 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.

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

Innovations	% of indications*
Product	50,4%
Organizational	41,3%
Process	40,2%
Marketing	31,6%

** 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%).

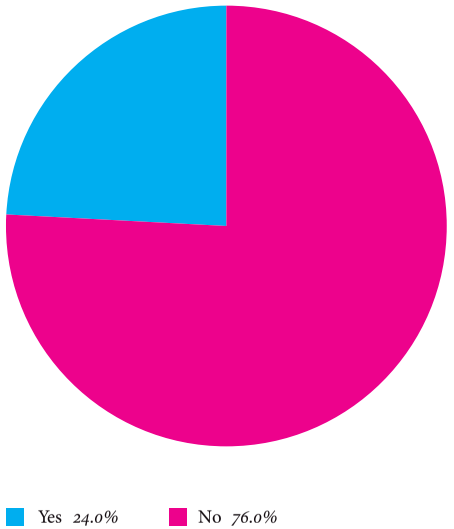
In the survey the respondents were asked to give the sources of gaining new ideas for implementing innovations. The responses are shown in the table below.

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 – in 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.

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

Source	% of indications		
	1st answer	2nd answer	3rd answer
Based on own ideas and resources (R&D works etc.)	76,0%	10,4%	9,4%
Taking over an enterprise having innovations implemented	7,0%	1,0%	0,0%
Copying other solutions	6,0%	42,5%	24,4%
Co-creation with other enterprises	4,3%	11,4%	13,3%
Hiring specialists (experts/ scientists)	3,6%	12,3%	15,6%
Cooperation with enterprises having innovations implemented	3,1%	5,8%	11,1%
Purchase of license, patent or know-how	1,9%	8,1%	10,0%
Co-creation with research and higher education institutions	1,0%	2,9%	7,2%
Other	1,0%	1,3%	1,1%

Chart 4. Share of enterprises which cooperated with representatives of science in the scope of gaining or implementing innovations



Source: own elaboration

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 - 7,2% 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

Science institution	Often	sometimes	seldom	never	no
higher education institutions	7,2%	10,9%	9,3%	69,8%	2,8%
JBR	4,3%	7,0%	3,8%	81,7%	3,2%
industrial research institutes	4,1%	4,6%	4,1%	84,3%	2,9%
science foundations	0,3%	1,1%	1,4%	93,9%	3,3%
technology parks	0,3%	1,7%	2,5%	92,6%	2,9%
industrial parks	0,3%	0,8%	1,4%	94,2%	3,3%
technology transfer centers	0,0%	0,6%	0,8%	95,3%	3,3%

Table 5. Forms of enterprise cooperation with representatives of science **Source:** own elaboration

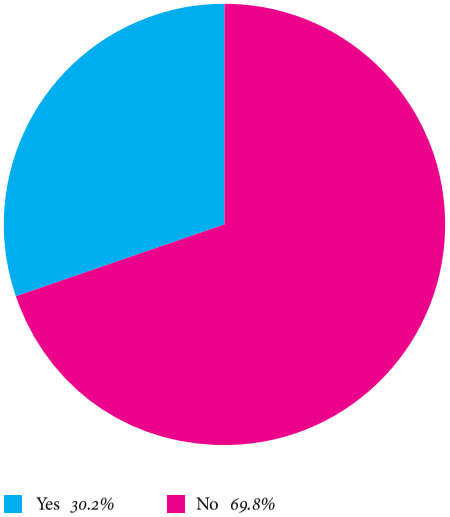
Source	form of cooperation		
	1st answer	2nd answer	3rd answer
Joint R&D projects	5,0%	0,7%	0,7%
Participation in joint ventures (enterprises/ R&D entities/ technology transfer entities)	3,5%	0,9%	0,9%
Enterprise staff trainings	3,5%	1,1%	0,5%
Ordering to conduct research by university/ R&D entity for an enterprise	2,7%	4,7%	1,2%
Ordering to make a prototype, a trial run	2,5%	2,7%	0,7%
University/R & D entity consulting for an enterprise	2,1%	2,7%	2,1%
Using university laboratories by an enterprise	0,8%	1,8%	2,4%
Staff participation in academic procedures at university	0,8%	1,1%	0,7%
Licence agreement	0,4%	0,2%	0,2%
An enterprise location in university science parks	0,4%	0,2%	0,2%
Using an enterprise infrastructure by university	0,2%	0,4%	1,9%
Cooperation in spin-off	0,0%	0,2%	0,5%
Other	0,4%	0,0%	0,2%

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 (2,5% - 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).

Chart 5. Adaptation of science entities' offer to the company's needs



Source: own elaboration

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 **Source:** own elaboration

	1st answer	2nd answer	3rd answer
An enterprises is not familiar with an offer	38,2%	18,3%	18,3%
An offer does not comply with the trade specificity	28,3%	11,3%	9,5%
Suggested solutions are too expensive	13,4%	13,4%	7,1%
Implementation of the suggested solutions is too time-consuming	1,9%	10,8%	8,7%
An offer is not detailed enough	1,6%	13,4%	5,6%
Suggested solutions are not innovative enough for an enterprise	1,6%	5,9%	10,3%

Table 7. Benefits from business-science cooperation **Source:** own elaboration

	1st answer	2nd answer	3rd answer
Possibilities of implementing new technology solutions	24,0%	12,3%	9,6%
Access to the latest expert knowledge	17,9%	17,7%	4,5%
Competitiveness growth	15,0%	13,6%	13,0%
Possibilities of cost reduction through efficiency growth	6,5%	11,8%	9,6%
Opportunities of own HR development	6,1%	5,5%	8,5%
Enterprise prestige growth	4,5%	7,3%	8,5%
Acquiring new clients and/ or markets	3,7%	8,2%	12,4%
Export-led growth	0,8%	0,9%	6,2%

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 ,
- 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). 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?

We stay at present level of cooperation	*39,9%*
Yes, by increasing area of cooperation	*13,4%*
No, by restricting number of partners	*11,4%*
Yes, by increasing number of partners	*7,4%*
No, by restricting area of cooperation	*7,0%*

Source: own elaboration

Table 9. Intended form of cooperation

Source: own elaboration

	1st answer	2nd answer	3rd answer
Enterprise staff trainings	*8,1%*	*5,1%*	*3,6%*
Joint R&D projects	*7,4%*	*1,9%*	*0,8%*
Joint technology development	*4,7%*	*4,4%*	*1,5%*
Participation in joint ventures (enterprises/ R&D entities/ technology transfer entities)	*4,3%*	*1,6%*	*1,5%*
University/R&D entity consulting for an enterprise	*2,9%*	*5,1%*	*1,3%*
Ordering to make a prototype	*2,0%*	*3,0%*	*2,3%*
Ordering to conduct research by university/ R&D entity for an enterprise	*1,6%*	*4,9%*	*4,6%*
Using university laboratories by an enterprise	*1,3%*	*1,9%*	*2,6%*
Licence agreement	*0,7%*	*0,9%*	*0,8%*
University /R&D entity participation in an enterprise research and development orientation	*0,7%*	*2,3%*	*2,3%*
Staff participation in academic procedures at university	*0,7%*	*0,5%*	*0,3%*
An enterprise location in university science parks	*0,7%*	*0,2%*	*0,5%*
Cooperation in spin-off	*0,0%*	*0,0%*	*0,3%*

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.

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HUMAN CAPITAL
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