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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.
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Economy innovativeness is one of the conditions to achieve a competitive advantage in today’s market economy. Therefore, one of the top priorities of many country’s authorities is running innovation policy skillfully and effectively. Strong competition of the world’s biggest economies forces searching for new technology solutions, introducing a greater number of elements supporting SME innovative enterprise development, funding SMEs or deepening relationships between universities and a private sector. Competition, whose goal is affiliation to the most innovative countries in the world like the US, Japan or Finland, starts to be prevailed by the countries with an above-average growth potential, huge internal markets and a high share in the world market for exports, that is, China, Russia, Brazil or India.

The CEE countries (Central & Eastern Europe) being EU member states are also making an effort to implement a well-operating innovation policy system in order to be able to compete with the most developed countries of the Old Country. One has to remember that the process of creating new market economies is still lasting in this region of Europe. Over 20 years after the collapse of communism is too short in order for all mechanisms to function as well as in Western Europe. It is obvious that a dozen years will pass before new EU member states’ economies become mature. However, there is no doubt that most socio-economic changes taking place in these countries should be assessed positively.

Referring to innovation policy, the main incentive for its development was unquestionably meeting all requirements set by EU membership. Since then all strategies connected with the countries’ internal policies must have been elaborated in compliance with the EU guidelines and objectives. As a consequence, there was a need to implement the Lisbon Strategy’s priorities or The Europe 2020 strategy.

Poland as an EU member since 2004 approaches the implementation of European guidelines conscientiously and thoroughly. For a nearly decade one of the priorities declared by authorities has been the willingness to increase the level of Polish economy innovativeness. Polish authorities realize that competitive edge, which economic development is mainly based upon (that is low labor costs), will be finally depleted. That is why, in order not to come to economic standstill, the skillful running of innovation policy is so essential nowadays.

An immersive observation of solutions in the scope of innovation policy resulted in the introduction of a multitude of legal regulations and various instruments aiming to reach this intention. Unfortunately, in any innovation ratings, as well global as European ones, Poland is ranked on a distant position, what is worse, it has not changed over the years.

The objective of this paper is to present the model of Polish innovation policy, to find causes of a low position of Polish economy against other EU member nations and to indicate some directions of innovation policy development for the nearest years.

The article is divided into 4 parts. In the first chapter there are theoretical considerations related to the notion of innovation itself and the review of reference books in terms of conducting this policy. The second part characterizes Polish innovation policy system and presents the comparison of its effectiveness with other EU member states. The third chapter describes innovation policy in Great Britain. It is worth highlighting that these mechanisms can serve as an epitome and the application of instruments functioning in the UK could help to improve Polish economy innovativeness level. In the last part there are conclusions and recommendations for innovation support policy in Poland.

1. Introduction

2. The essence of innovation in contemporary economics

The foundation of innovation theory belongs to J. Schumpeter who precisely defined what can be called an innovation. According to J. Schumpeter innovation is an discontinuous, new combination of materials and efforts which lead to (Schumpeter, 1960, pp. 103-104):

1) introducing a new product which is unknown to consumers, or a new type of a given good,
2) introducing a new production method,
3) opening a new market,
4) gaining a new source of raw materials and semi-finished products,
5) the commencement of a new industry.

Hence, innovation should not be abstract, it just lies in elaborating on a concept of a new product, technology or other supply sources but above all, it ought to be put into practice. In order to achieve this, one needs to elaborate on the innovation implementation rules so as to make this process successful.

So far lots of scientists have tried to define innovations and determine what can be acknowledged as a novelty.

J. Fagerberg stated that innovation is a process related to the enterprise development because e.g. J. Schumpeter connects the appearance of qualitative changes with the company development. The qualitative changes take the form of production, technological, organizational, marketing or supply innovations. Thus, there can be distinguished the notion of development and growth which does not trigger any qualitative changes in a company. The notion of growth threshold refers to such a moment in a company’s life cycle when there is a growth barrier, which entails some qualitative changes, that is innovations.

J. Kline and N. Rosenberg suggest that innovation improvement immediately after its implementation on the market may be more meaningful for enterprises in terms of economy than its original form (Kline, Rosenberg, 1986, p. 283).

One has to highlight that in contemporary worldwide economics innovations constitute one of the most important factors leading to competitive advantage.

Furthermore, innovation is not an objective itself – it is aimed at achieving some clearly defined results related to better use of the given resources, miniaturization of the particular parts, using more reliable materials, shortening the production time, which results in the enterprise effectiveness improvement.

The implementation process is connected with (Podręcznik Oslo..., 2008, p. 48):

1) introducing a new or improved product on the market,
2) real use of a new process, organizational or marketing method in a given company.

Innovation can be not only a novelty (product, manufacturing method) created by an enterprise, but also an innovation which was absorbed by the company through the transfer of knowledge.

One has to point out that innovation is closely related to the enterprise development because e.g. J. Schumpeter connects the appearance of qualitative changes with the company development. The qualitative changes take the form of production, technological, organizational, marketing or supply innovations. Thus, there can be distinguished the notion of development and growth which does not trigger any qualitative changes in a company. The notion of growth threshold refers to such a moment in a company’s life cycle when there is a growth barrier, which entails some qualitative changes, that is innovations.
Each kind of innovation has its own specific properties. Product innovation is a new manufacture or vastly improved product in terms of functions and applications (Podręcznik Oslo..., 2008, p. 50). Obviously, it is always controversial what change should be introduced to consider a given product as a greatly improved one.

Technological changes are connected with the use of other materials, components, or a different construction of product technological lines. In this case the notion of process innovations appears. Such innovations differ from technological ones and entail the introduction of a new or greatly improved production method or delivery, which ought to bring the company the benefits such as (Podręcznik Oslo..., 2008, p. 50):

1) reduction of production or delivery unit costs,
2) rising the product quality,
3) production of greatly improved products.

Organizational innovations lie in implementing a new organizational method in an enterprise or creating a new vacancy but also they affect the relationship of enterprise with its surroundings. These changes result in achieving better effects by a company (e.g. administrative or transactional costs reduction, better work effectiveness, delivery costs reduction etc.). The modifications can be also connected with the outsourcing of some functions and processes (Podręcznik Oslo..., 2008, pp. 53–54).

Among marketing innovations there can be mentioned implementation of a new marketing method bringing forth huge alterations in a product design/construction or packaging, distribution, promotion or price policy. This new marketing method leads to satisfying customers’ needs faster and more effectively, opening new markets or to the new positioning of company’s products for sales growth (Podręcznik Oslo..., 2008, p. 52).

Innovations can be divided into incremental ones and radical investments. Incremental innovations aim to improve the state of being and contribute to the company competence growth.

Radical investments contribute to significant effectiveness growth, they are connected with a complete change of the way of solving problems in an enterprise. The required competencies change and they are replaced by a new kind of know-how (Jaeggi, 2010, p. 32).

Another classification of innovations is their division into continuous and breakthrough ones. Enterprises which possess enormous knowledge resources and abilities to run innovative processes can maintain and even expand their competitive advantage. These companies may take some former actions, they are able to maintain the pace of the product technology-oriented development exceeding the needs of the most demanding market recipients.

Breakthrough innovations put emphasis on market expansion through reaching new and less demanding consumers. In this case the main virtues of products are low price, handiness and simplicity Anthony et al., 2010, p. 36).

Apparently, the range of innovations can be varied. In this respect innovations can be global or national, they can affect full-scale production or just the enterprise scale.

A completely different thing is the occurrence of imitations which pose a threat to a great deal of innovators because some novelties may appear to be cheaper and better than the original ones.

One of the basic problems connected with the implementation of innovations is using any effects and results that can be brought by them. Innovation should contribute to enterprise development, capturing new markets, providing the right operational and technological level in enterprises. Consequently, innovation leads to the growth of enterprise values, that is unquestionably to achieving the main goal of each company which functions in the market economy.

3. General profile of Polish innovation policy

3.1. Strategic documents of Polish innovation policy

The demise of communism in Poland in 1989 initiated huge changes in an economic and political system. By profound reforms the centrally planned economy had to be quickly transformed into the market one and it was necessary to take some immediate actions concerning i.a. transformations of ownership structure or liberalization of goods and services. There was also a need to develop a private sector, open the country to external markets and create free market institutions. The national authorities realized that in order to gain competitive advantage towards other nations, the best solution is to put emphasis on innovation policy development (Ciok, 2010, p. 127). Since 1993 numerous legal references, governmental programs and also strategic long-term and medium-term documents have been introduced. They made up a support for Polish innovation policy and became a foundation to achieve strategic goals in this scope.

The main incentive which intensifies the authorities’ operations in the field of innovation policy was the necessity of fulfilling pre-accession commitments towards EU in the period which directly preceded entering the European Community (EC). The main focus was on eliminating long-term systemic malpractice resulting from the changes in economic system and on intensifying actions which aim at lessening the distance between Polish and other EU nations’ economy.

The willingness to enter EU meant that all strategies concerning Polish internal affairs should be compatible with the guidelines and objectives of the European Community. On a summit in Lisbon in March 2000, the EU development plan was accepted. It assumed that within 10 years Europe would become the most dynamic and competitive economic region in the world. It was the response to rapidly rising competition of American and Chinese economy. One of the three items of Strategy was the increase of allocations for R&D up to 3% of GDP. It was complimented with so-called “Barcelona target” accepted on the European Council meeting in Barcelona in January 2002 which assumed that the above-mentioned increase of allocations for R&D will be achieved thanks to the funds from a private sector in a proportion of two-thirds.

A primary strategic document affecting the development of Poland and taking the Lisbon Strategy postulates into consideration was "National Development Strategy 2007-2015". "National Reform Program 2005-2008" was supposed to be helpful in order to achieve this Strategy.²

As innovation policy fits into “National Development Strategy”, in September 2006 the Council of Ministers approved of the document “Directions for promoting innovative economy in the years 2007-2013”. The document presents the assessment of the state of Polish economy and contains some recommendations for various actions until 2013 aiming at improvement of the position of competitive Poland.

1 National Development Strategy approved by the Council of Ministers on 27 June 2006 defines the objectives and priorities of socio-economic growth of Poland

2 National Reform Program 2005-2008 approved by the Council of Ministers on 28 December 2005 presents the actions that are going to be taken by Polish government in the years 2005-2008 to implement the objectives and postulates of the new Lisbon Strategy. Its continuation was National Reform Program 2008-2011
3. General profile of Polish innovation policy

One of the instrument of implementing innovation policy are financial assets derived from European Funds: Innovative Economy Operational Program (OP IE) and Human Resources Operational Program (OP HR) above all. As far as OP IE is concerned, all its priorities aim to support innovations and create actions which succor innovativeness and supervise its implementation, especially in the SMEs. The biggest challenge for the Polish economy is its modernization and improving its competitiveness on the international market through converting it into more innovative. Hence, the main priority of OP IE will be to support particularly these innovations with possibly short term of application, as well as with the biggest diffusion potential.

The specific objectives of OP IE encompasses i.a. research and development of new technologies, improvement of innovativeness of Polish enterprises, intensification of business and science cooperation, dissemination of Polish innovative products worldwide, and further IT implementation nationwide.

Over 90% of all assets derived from OP IE were allocated both to innovative enterprises introducing new, advanced technology products and entities conducting research and development activities in cooperation with private sector (Grycuk, Russel, 2011, p. 58). In order to implement the Program, between 2007-2013 all claimants benefited from nearly €10bn, out of which 8% came from Regional Development European Fund and only 15% from domestic funds (Ministry of Regional Development, Innovative Economy..., 2007, p. 7).

The actions taken within OP IE are supported and complemented with various programs on the regional level such as: Operational Program Development of Eastern Poland or 16 Regional Operational Programs for particular voivodships.

Human Resources Operational Program is complimentary with OP IE especially in the field of human resources development, raising qualifications of workers in R&D sector and

4 EU allocation of 3% of GDP for R&D

5 It was elaborated on the basis of the following documents: 1) "Directions for promoting innovative economy in the years 2007-2013", 2) "Strategy of innovative and effective economy dynamic Poland 2020", 3) "National Reform Program in favor of the Europe 2020 strategy implementation".

In order to achieve competitive advantage it was assumed that Polish economy should be knowledge-based (knowledge-based economy – KBE). Polish authorities were aware that in the nearest future the sources which initially decided about the country’s economic growth (i.a. cheap labor force, access to cheap raw materials, propitious location in the centre of Europe or entering the EU) would deplete.

Global financial crisis and debt crisis affecting some of the EU member countries triggered a quick response of the EU authorities. Structural weaknesses of European economy and negative long-term factors (i.a. ageing society, globalization, limitation of resources) caused that further priorities of the European Community had to be changed.

Lisbon Strategy goal achievement has born a failure, therefore on 17 June 2010 the European Council ratified a new document: “The Europe 2020 Strategy”. One of its top priorities – “smart growth” is crucial from the innovation policy point of view. It highlights the necessity of further development of knowledge-based economy, increasing allocations for R&D and putting theoretical knowledge into economic practice (European Commission, 2010, p. 5). Besides, the European initiative called “Innovation Union” became predominant within “The Europe 2020 Strategy”.

Poland was obliged to implement the objectives included in the foregoing documents. Moreover, new socio-economic conditionings also entailed the necessity of elaborating on new strategic documents including updated priorities of development of the state. Hence, between 2009-2012 two documents were accepted: the former contains a long-term vision of development of the country – “Poland 2030” and the latter “National Development Strategy 2020” is a medium-term document. “Strategy of innovative and effective economy ‘dynamic Poland 2020’” as a document concerning the national innovation policy is closely related to the previously mentioned elaborations. The suitable notations connected with further development of Polish innovation policy can be also found in the document from April 2012 “National Reform Program in favor of the Europe 2020 strategy implementation”.

The top priorities of Polish innovation policy for the nearest years:

1) over two-fold increase in allocation for R&D (from 0.8% of GDP in 2012 to 1.7% of GDP in 2010);

2) adjustment of regulatory environment to the innovation needs (i.a. matching the economic system of regulations to the innovative economy needs, deregulation that facilitates running business activity);

3) adjustment of financial environment to the innovation needs (i.a. greater accessibility to the funds for innovative ventures in all development stages of companies [so-called venture capital]; introduction of tax reliefs encouraging to take some innovative ventures);

4) the reform of tertiary education (i.a. adjustment of the system and educational quality to the modern economy requirements, reinforcement of links between science field and economy);

5) intensification of studies devoted to economy (i.a. financing scientific studies and development works conducted by enterprises, restructuring program for research units public sector, development of lab facilities and purchasing modern experimental equipment);

6) preparation of staff for modern economy (i.a. exchanging staff between R&D sector and enterprises);

7) intellectual property for innovations (i.a. support for intellectual property management; support for entities having a patent applied abroad);

8) institutions for innovations (development of governmental institutions and non-governmental organizations providing services in favor of innovative companies);

9) development and modernization of telecommunication and ICT infrastructure (greater access to the Internet, especially in rural areas; digitalization; implementation of ICT management systems and providing services);

10) effectiveness growth of natural resources and raw materials exploitation (i.a. limiting economic energy and material consumption);

11) The growth of the internalization of the Polish economy (i.a. the support for the Polish export and overseas investments; succoring the inflow of innovative investments to Poland).
greater awareness of the value of the science in modern economy (Actions 2.1, 2.3, 4.2). For implementation of the Program over €11bn were allocated and nearly €10bn came directly from EU funds (Ministry of Regional Development, Human Capital..., 2007, p. 9).

3.3. Innovation and entrepreneurship centers in Poland

Innovation policy functions in the network created by enterprises, research centers and non-government organizations, public administration, and citizen initiatives. The mutual flow of ideas as well as the exchange of knowledge, information and technology between foregoing subjects create the foundation of strong innovative economy which can successfully compete with the others on the international market.

On the national level innovation policy is supported by following state institutions: Ministry of Economy, Ministry of Science and Higher Education, Polish Agency for Enterprise Development, Industry Development Agency, National Capital Fund, and the National Economy Bank.

Since the beginning of 90s, the number of innovation and entrepreneurship centers in Poland is increasing year by year. They encompass: technology parks and incubators, business incubators, pre-incubators, centers for technology transfer, counseling and training centers, credit and guarantee funds, business angels network (Bąkowski, Mażewska, 2012, p. 10). In 2012 there were 821 such institutions, concentrated mainly in urban areas. Most of them have their headquarters in the following voivodeships: Silesia (main city – Katowice), Mazovia (Warsaw), Great Poland (Poznan), Little Poland (Cracow) (Figure 1).

Figure 1. The number of innovation and entrepreneurship centers in Poland in the years 1990-2012 Source: Eurostat

3.4. Innovation policy fiscal instruments in Poland

In order to implement innovation policy in Poland there are several instruments which has been gradually bringing in by the government. It seemed to be indispensable to introduce suitable legal regulations improving the conditions of running innovative activities.

The most developed type of centers are technology parks, which main aim is to support small enterprises conducting innovative-oriented activities, the transfer of technology, and implementing results of research into economic practice. The activity of technology parks also lies in consultant service as well as in, popularizing office technical infrastructure and assistance in raising external funds (Bąkowski, Mażewska, 2012, pp. 25-30). The first technology park was established in Poznan in 1995 (The Poznan Science and Technology Park) and in mid-2012 there have been 54 such centers overall.

Very interesting entities supporting innovativeness are business incubators and academic business incubators. Their key task is to succor enterprise development at the early stages of their functioning. They help companies gain maturity and ability to function independently in the market reality. Academic business incubators operate on a tertiary education level and in mid-2012 there have been 73 such institutions, which are functioning on the basis of contracts with 45 academic centers (Bąkowski, Mażewska, 2012, p. 56).

Moreover there is a developed business angels network in Poland, just as in the USA and Western Europe countries. Currently it consists of 10 different subjects, out of which 4 have their headquarters in Warsaw. The main goal of such network is to support in the early stage of their development, where future entrepreneurs do not possess sufficient funds to set them up, not to mention about proper conducting of them.

With accordance with the Act on selected forms of innovative activity support, meeting clearly defined criteria enables an entrepreneur to gain the status of so-called Research and Development Center. It then allows him to receive a real estate tax exemption. Furthermore, a businessman can create an innovation fund and even have a opportunity for accelerated depreciation (Bąkowski et al., 2012, p. 13).

Besides, there is a tax relief for the new technology purchase. Each entrepreneur who acquires it is eligible for the deduction of 50% of a value of acquired technology. The opinions of the effectiveness of this relief differ, so Ministry of Economy plans to introduce a new deduction which would replace the present one. The proposal suggests deducting from taxes 26% of all expenditures on R&D incurred by a company. This relief would come into force from 2014.

Moreover, the National Economy Bank offers preferential technology loans to small and medium enterprises and they are designated for a purchase of new technologies. The financial assets derive from the European Funds. A support for a company (so-called technology bonus) constitutes a repayment of a part of technology loan principal which is granted by commercial banks.

There is also a plan to implement another tax relief which will enable entrepreneurs to deduct 1% of their CIT for supporting the chosen scientific entities is now being elaborated on. For the time being the details of this proposal are not known yet, as this idea is still being elaborated on the level of particular Ministries.

6 The key acts ratified by the government:
1) Act as of 8 December 2004 on the principles for funding science;
2) Act of March 4, 2005 on National Capital Fund;
3) Act of July 29, 2005 on selected forms of innovative activity support

7 Technology loan is co-financed by European Regional Development Fund and OP III
3.5. Innovation position of Poland against other EU member states

In spite of ambitious goals, EU Funds, appropriate instruments or means, applicable normative acts or government’s official documents, Polish economy is ranked on the distant position in comparison with other EU member countries. To make matters worse, this position has not changed radically for the better over the last few years and there are no prospects for upward trend in this respect.

The most well-known study on innovation policy and its potential in the particular EU countries is the Innovation Union Scoreboard rating. It monitors the progress in the implementation of strategic goals connected with innovativeness formulated in the Europe 2020 strategy. In the last rating elaborated in 2013, Poland is ranked on 23rd place amongst the EU-27, preceding such countries as Bulgaria, Romania and Latvia. The authors qualified Poland as so-called modest innovators group with the ratios much lower than the EU average.

Figure 2. Position of Poland in the Innovation Union Scoreboard 2013 rating

3. General profile of Polish innovation policy

The report indicates a distinct imbalance in the Polish innovative position, in which its main strength is human resources. The most unfavorable figures concern the implementation of new technologies in enterprises, low level of of R&D expenditures among Polish companies and a small number of patents that have been applied by them. Furthermore, too low level of R&D outlays in a public sector, few relations between public institutions and business environment and insufficient PE/VC (Private Equity/Venture Capital) financing are also disappointing (European Commission, 2013, Innovation Union Scoreboard 2013, p. 47).

A low position of Polish innovation policy is also confirmed by the global innovation ratings. In the Global Innovation Index Poland takes 44th place (28th in Europe), in the Global Creativity Index 2012 – 44th, in the Economist Intelligence Unit – 44th, in The Global Competitiveness Index 2012-2013 – also 44th position, and in the Knowledge Economy Index 2012 – 38th, and it was a decline in comparison with the 2000 rating by three position.

A very low level of expenditures on R&D in total (GERD – Gross Expenditure on Research and Development) is really alarming (Figure 3). What is worse, Poland belongs to a small number of member countries which in fact have not increased outlays on R&D with reference to GDP (Figure 3) since 2000. In 2010 the spending designed for this goal amounted to just 0,74% of GDP whereas the EU-27 average rate accounts for 2% of GDP. For Poland it means 20th place among all EU member countries.

Figure 3. Gross domestic expenditure on R&D, 2000-2010 (% share of GDP)


* Innovation Union Scoreboard rating replaced European Innovation Scoreboard ranking in 2011. They differ over i.a. the methodology of calculating innovativeness indexes
* just 12% of average for all EU member countries
* only 55% of an average value for all European Union
* It concerns all European countries, not only EU member states
As far as business expenditures on R&D are concerned (BERD – business expenditures on R&D), in 2012 they constituted only 27% of all expenses intended for that goal (GERD). The result is surprising, as this indicator amounts to over 50% for the countries with more innovation-oriented economies.

Poland takes the penultimate position in EU regarding the amount of innovative enterprises. Only 27% of Polish companies can be considered innovative, which is a double worse result than the EU-27 average rate. In order to show the discrepancy between Polish enterprises and their West European equivalents, one has to remark that nearly 80% of German companies, circa 60% of Swedish and over a half of Czech ones are perceived as innovative.

In terms of the type of new technology implemented in enterprises, the tendency in Poland differs from that in other EU nations as well. In other EU members the companies introduce simultaneously both innovations connected with organizational changes and these closely related to new products or processes. In Poland there is a trend to initiate only one type of innovation, either organizational or product/process (Figure 5, p16). It may be caused by funding shortages which hinder more comprehensive actions in this scope.

3. General profile of Polish innovation policy

When one takes the technical infrastructure into consideration, it undoubtedly needs modernization and further development. However, it may be difficult under conditions of the existence of a natural monopoly ICT in supply of telecommunications services. A distant position of Poland in comparison with other countries in this field is reflected in global ratings. However, it is worth highlighting that when entities can benefit from making use of different services on the open market (e.g. mobile telephony), then a country’s position is much higher (Table 1) (Geodecki et al., 2012, p. 32).

In the Europe strategy 2000 it was assumed that by the end of the decade the proportion of people aged 30-34 who completed higher education studies would have reached 40%. What is interesting, in 2012 Poland nearly reached this level (the proportion amounted to 39%) superseding the EU-27 average rate. However, scrutinizing the quality of education and putting it into economic practice, it turns out that this result is not a feather in its cap. The possibility of studying in Poland became open for general use, frequently for people whose knowledge and abilities do not allow them to continue higher education. Therefore, the higher education reform is one of the top priorities, which is mirrored in strategic goals for the nearest years.
Great Britain is aware of the opportunity in raising the innovativeness level of its economy and exceeding some competitive countries like the US, Germany or Japan. Its R&D potential allows the UK to hope that a well thought-out strategy and its implementation will bring it closer to the desirable goal within a few years. It is worth pointing out that the BRIICS countries (Brazil, the Russian Federation, India, Indonesia, China, South Africa) compete in this field more and more persistently.

The ecosystem of British innovation policy is very complex and its construction enables the authorities to pursue it very effectively. Its solutions can be the role model for the countries with less innovative economies such as Poland. Close connections between the particular elements of British ecosystem allow to cooperate on the regional, national and even global level.

1) research institutes (e.g. the Laboratory of Molecular Biology);
2) research and innovation campuses (e.g. at Daresbury or Harwell);
3) innovation infrastructure organizations, (e.g. the National Measurement Office, British Standards Institution);
4) public and third sector bodies providing specialist support (e.g. the National Endowment for Science, Technology and the Arts – NESTA);
5) private sector research and technology organizations (RTOs) (e.g. QinetiQ and LGC);
6) Public Sector Research Establishments (PSREs)16.

An essential role in this model is played by social network and knowledge transfer between its entities: fifteen Knowledge Transfer Networks (KTNs)13 and Knowledge Transfer Partnerships (KTPs)18. Therefore, it is supposed that any actions taken by these entities within innovation policy are coherent, properly coordinated and each body is aware of the tasks which it performs.

In December 2011 the British government published a strategic document setting the framework of innovation policy development for the next few years: “Innovation and Research Strategy for Growth”. According to its guidelines, several British economy sectors are particularly relevant from the innovativeness point of view (Department for Business Innovation & Skills, Innovation and..., 2011, pp. 21-22):

1) Life Sciences (pharmaceutical and biotechnology sector);
2) High Value Manufacturing (automotive, aerospace and electronics);
3) Nanotechnology;
4) Digital Technologies (e.g. systems and software engineering, intelligent systems, high performance computing).

As in the above mentioned economic sectors not each technology cannot be developed and it is not possible to equally finance all studies or research, The Technology Strategy Board established the key technologies which can be financially supported most generously by the government. The focus was on so-called general purpose technologies which can be defined as the innovations with the biggest development potential and their commercialization would be the most profitable from the economic standpoint. These are: Synthetic Biology, Energy-Efficient Computing (designing of hardware and software to reduce energy consumption), Energy Harvesting, Graphene.

Innovations are elaborated within the so-called Catapults, that are select scientific centers and by the end of 2013 the government will have invested £200m in the development of seven entities of this kind19. Their main objective is to carry out research on new technology solutions and implementing them into economic practice. A great importance is also attached to tightening bonds between Catapults and private sector other innovative centers from all over the world. Total value of investments of private and state entities supporting Catapults is amount to over £1bn in the following years.

Apart from foregoing solution the financing of research sector is mostly based on public funds and consists of the two elements:

1) seven Research Councils operating in various scientific fields and donating grants for research projects and programs18,
2) four higher education funding bodies for each part of the UK, offering funds for research studies at universities19.

One of foundations of the British innovation policy is higher education system. Universities are the main innovation centers and one of the main employers in the particular regions. The number of the British scientists’ cited articles grow year by year and in 2010 it amounted to 10.9% of global citation. The global share of British publications (6.4% in 2010) is also impressive, which places the UK on the 3rd position in the world. The researchers are vigorously interested in the fields such as: clinical sciences, health & medical sciences, social sciences, business and humanities (Department for Business Innovation & Skills, 2011, International Comparative…).

The government allocates £4.5bn to the development of sciences and between 2011-2015 it is planned to increase this sum up to £20bn in total (Department for Business Innovation & Skills, Innovation and..., 2011, p. 17).

13 LEPs are partnerships between local authorities and a private sector
14 PSREs are the public bodies carrying out research sponsored either by government or the NHS Regions or heritage organizations
15 KTNs joint subjects of private sector, universities, research institutes, finance and technology organizations
16 KTPs is a platform for knowledge and technology transfer between business environment and higher education facilities
17 The first Catapult was set up in October 2010.
18 1) Arts and Humanities Research Council (AHRC); 2) Biotechnology and Biological Sciences Research Council (BBSRC); 3) Engineering and Physical Sciences Research Council (EPSRC); 4) Economic and Social Research Council (ESRC); 5) Medical Research Council (MRC); 6) Natural Environment Research Council (NERC); 7) Science and Technology Facilities Council (STFC).
19 1) Higher Education Funding Council for England (HEFCE); 2) Higher Education Funding Council for Wales (HEFCW); 3) Scottish Funding Council (SFC); 4) Department for Employment and Learning, Northern Ireland (DELNI).
The British put a high emphasis on the extension of connections between tertiary education and business environment, being thoroughly aware that it is one of the best ideas in order to raise innovativeness level of the country. This process is supervised by the Higher Education Innovation Funding (HEIF) which annually channels £200m to higher education and in the years 2011-2015 it will allocate extra £150m for intensifying the relationships between universities and a private sector. Furthermore, the Confederation of British Industry’s takes care of progress and advancement of students who will apply for the posts in British enterprises after completing studies, by offering beneficial scholarships and apprenticeship.

In 2011 the cooperation with private sector brought the universities total revenue of £3,3bn, which means doubling this sum compared to 2001. In the next three years the government is planning to achieve the revenue growth on this account by further 10%.

British authorities realize that one of the barriers in innovation progress of small and medium enterprises is shortage of the capital at the initial stage of their development. Therefore, on the government’s initiative, is setting up several institutions of financial support for SMEs, in agreement with private investors. The two major funds: Enterprise Capital Fund Programme and UK Innovation Investment Fund are able to capitalize SMEs with the amount of over £650m, out of which approximately 60% derives from public funds. Moreover, the state supports the guarantee Fund, which guarantees loans owing by SMEs (Enterprise Finance Guarantee) and succors joint ventures with business angel network (Business Angel Co-investment Fund).

One of the incentives encouraging enterprises to search for new technology solutions is tax reliefs from expenditures on R&D, so-called Research and Development Allowances20. Initially it allowed for deduction of 100% of capital allocations onR&D, but from the 1st April 2012 this value rose up to 225% for SMEs and 130% for big companies. The firms which for many reasons do not reveal their actual profits have a possibility of pre-payment in cash on account of this tax relief21. It is estimated that total value of such reliefs which SMEs have benefited from so far amounted to over £1bn and approximately 10,000 companies took advantage of this opportunity.

An interesting program for supporting new innovative enterprises is Small Business Research Initiative (SBRI). Its idea bases on the assumption that public procurements may be an incentive for innovation progress. It consists in an open contest in which private companies try to figure innovative solutions for British public institutions. The best companies are rewarded by grants for their R&D developments up to £1bn for maximum two years.

SMEs can also receive versatile support of Growth Accelerator. The overriding aim of the program is to generate the growth of small and medium enterprises valued at £2bn and to create 70,000 new workplaces. The support concerns financing, management, strategy development, raising qualifications of employees and commercialization of innovations.

Another attractive spur for SMEs is the Innovation Vouchers program. Companies can gain funds of maximum £5000 if they purchase a new technology or an innovative knowledge element from other party for the first time.

British authorities attach huge importance to the investments in human resources. Great Britain realizes that only well-prepared, appropriately skilled and qualified staff will be able to meet requirements of contemporary economy and will help in increasing the level of its innovativeness. In order to achieve this goal several grants are offered for young scientists and because its value is sufficient enough, young researchers can exclusively focus on conducting research. Thanks to the Growth and Innovation Fund (GIF) SMEs can gain funds for trainings, courses or apprenticeship for employees who want to raise their qualifications.

One has to enhance that the model of the British innovation policy is not a closed system, on the contrary, it is widely open for cooperation with other nations in the field of research and new technologies. In addition, the government wishes to promote the significance of British enterprises on the international market, deepen relationships between science centers and innovation support institutions worldwide, as well creating closer relations with some emerging economies (i.a. China, India). One of the further priorities constitutes the promotion of British research and technologies and their dissemination abroad. The leading role will be played by i.a. Catapults.

Besides, the UK wants to fulfill the commitments towards EU and implement the objectives included in The Europe 2020 and Innovation Union by offering support for British entrepreneurs. The country also plans to reach an agreement on EU Patent, which will contribute to reducing administration costs and charges connected with the intellectual property protection.

As far as the innovative economy rankings are concerned, it is worth highlighting that Great Britain has been in the forefront for many years (Table 2). However, taking British innovation policy strategy for the nearest years into account the confrontation with i.a. USA or European potentates in terms of innovation implementation (e.g. Sweden, Denmark) must be worrisome. In particular the 6th position in the Innovation Union Scoreboard 2013 rating can motivate the government to conduct innovation policy more efficiently and effectively, which will definitely result in higher rank in the next years.

| Table 2. Position of the UK in global innovation ratings |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
|                                  | Global Innovation Index 2012 (141 countries) | Global Creativity Index 2011 (82 countries) | Knowledge Economy Index 2012 (130 countries) | Innovation Union Scoreboard 2013 (27 countries) |
| USA                              | 20              | 2               | 12              | -               |
| UK                               | 5               | 13              | 14              | 8               |
| Poland                           | 44              | 41              | 38              | 23              |

Source: Own elaboration

20 The tax relief was introduced in 2000 for SMEs, and in 2002 – so-called Research and Development Allowances for big enterprises.
21 From April 2013 ‘Above the Line’ credit for R&D investments by large companies will be implemented.
Government budget appropriations or outlays for R&D (so-called GBAORD indicator) has increased significantly in the recent 20 years and they reached in 2010 nearly £9.5bn. In 2010 total GERD amounted to over £26bn, which poses about 1.8% of GDP. The result is similar to the European average, but on the other hand it is almost twice as low as the most innovative European economies – Denmark, Sweden and Germany where the ratio reached 2.8% - 3.6% (Figure 7). This share is far from the objectives of European Union which assume an allocation 3% of GDP for R&D by the end of 2020.

Approximately 11 out of 1000 workers employed in British enterprises are hired in R&D sectors, likewise the EU-27 average. However, comparing this result to the figures of other nations which the UK competes with within innovation policy, there is no reason to instill optimism. Great Britain is left behind Denmark where there are nearly twice as many R&D employees as the UK. The better result was also achieved by Japan, Austria, Germany, Finland and even Slovenia (Figure 8).

The figures clearly indicate the growth of higher education facilities and non-profit organization’s share in overall expenditures on R&D (Figure 9). In the last two decades the share rose by 8 percentage points and as in 2011 it accounted for nearly a quarter of all allocations. It happens at the expense of funds coming from private sector companies and the government’s resources. It proves a very strong position of British academic centers and their crucial role in innovation policy. An effectively operating model for cooperation between universities and a private sector is significant as well.

As for the number of patents raised in the Patent Cooperation Treaty (PTC), applications of British scientists constitute 3.3% of the total number all over the world, over 11% in all Europe. In spite of such a good result, in comparison with other highly-innovated countries, Great Britain should take some appropriate measures in order to increase the number of patents. Its number is eight times lower in comparison with USA and seven with Japan. Obviously, it can be justified by fewer citizens and a smaller number of academic centers in reference to forgoing countries. However, if we compare the outcome with other crucial European economies, this weak result of the UK should motivate all British authorities to change this proportion (Figure 10).
5. Conclusions and recommendations for Polish innovation policy

For a few years in Poland a heated debate has been taken place and it concerns the model of creating competitiveness of the Polish economy as seen as a general vision of economic growth. The two contradictory viewpoints collide with each other (Bukowski et al., 2012, p. 6).

The first standpoint upholds that public expenditures designated for innovative solutions are ineffective and hence one has to begin with creating appropriate conditions for enterprises. Innovation policy ought to hinge mainly upon infrastructure development and improvement of regulatory environment for companies, especially these connected with deregulation which would facilitate running a business activity.

A part of adversaries strongly criticize the legitimacy of applying in Poland the same mechanisms as in the West European developed countries. Polish companies are rather imitators than creators which successfully create and implement new technologies on their own. Apart from legal deregulations, which would undoubtedly make conducting business easier, one has to focus on raising Polish companies’ competitiveness through activities supporting export (i.e. low tariff and non-tariff barriers, more effective absorption of macro-economic negative events (Bukowski et al., 2012, p. 6).

The adherents of the opposing approach to innovation policy claim that pro-innovative policy should be the domain of the state and that the government should consistently increase allocations for R&D year by year. According to them nothing but funds coming directly from the state budget can develop R&D sector most effectively.

Polish authorities must be aware that the country inevitably approaches such a moment when previous competitive advantages of the moderately developed country (mainly low labor costs and low costs of raw materials) weaken as per capita income grows. Higher labor costs will undoubtedly entail a considerable decline of the country’s competitiveness on the international market. It is called middle-income trap. Observations of economic situations in many countries of the Southern Europe indicate that if the country lacks innovative solutions after reaching a given income level, the economic growth slows down and in some cases it even stops (Bukowski et al., 2012, pp. 8-10). If the effectiveness of innovation policy implemented by Polish authorities does not improve, it is highly probable that the above described situation will negatively affect Poland. Therefore, it is crucial to implement of successful innovation policy with appropriate pre-planning. Then, it is possible to react when some alarming symptoms have been identified which means that the growth potential starts to weaken.

At first glance the scrutiny of Polish innovation policy; its priorities, adopted strategies, and instruments of support implemented by public institutions, shows that Poland should be quite well-prepared for achieving the main policy objectives. The two Ministries supervise the main Strategy implementation, financial assets are assured by the National Capital Fund and the National Economy Bank. A great deal of entrepreneurs can also gain extra funds from European Union. Moreover, a tax relief from the purchase of new technologies was introduced. Comparing the Polish innovation system do the British one, one can have an impression that they are pretty similar in some respects.

So why is Poland ranked on such distant positions in any innovativeness ratings? Why is it at a disadvantage not only in comparison with Great Britain but also with other EU member states, including its nearest neighbors such as Czech Republic or Slovakia?

The reasons of this state of being are complex. Firstly, there is a divergence between the innovation policy priorities declared by the authorities. The willingness to increase allocations for R&D sector up to 1.7% of GDP in 2020 does not go hand in hand with the government’s activities, which is reflected in the government’s official documents. According to the Long-term National Financial Plan for the years 2011-2014, the growth of public expenditures on R&D (apart from European funds) is supposed to amount to 8% annually. However, considering inflation and economic growth it turns out that the proportion of R&D allocations against GDP will not grow significantly (Bukowski et al., 2012, p. 16). Consequently, The European Commission, in one of its documents addressed to the Polish authorities (May 2012), reproached Poland with too low allocations for R&D sector and not too innovative economy (Komisja Europejska, 2012, Ocena krajowego…, p. 4).

Secondly, public institutions were not fully reformed and therefore they could not substantially change the approach to innovation policy. Most institutions are still dealing with eradication of underdevelopment towards the Western European countries stems from the previous economic system. Instead of taking exclusively some corrective measures these bodies’ actions should have been directed for pro-innovative activity. Paradoxically, Polish universities and Polish Academy of Science (Polska Akademia Nauk) seem to be the least innovative and these are the entities for which pro-innovative activities should be of utmost significance (Bukowski et al., 2012, p. 6).

Coordination of actions within innovation policy is not efficacious, what is more, there is no institution which would propel pro-innovative activity and deal with its surveillance. In Great Britain the Technology Strategy Board plays such a role. Any strong non-governmental organization, which would favor more effective innovation policy of Polish authorities, was not brought into existence. Innovation Portal (Portal Innowacji) and Polish Agency for Enterprise Development (Polska Agencja Rozwoju Przedsiębiorczości) do not consist in a sufficient amount of pro-innovative institutions.

Another allegation is ineffective disbursement of public funds, both national and the European. This hypothesis can be right paying attention to the fact that Poland has not improved its position in any innovative economies’ rankings, although it has been a member of European Community for nearly 10 years. European funds cannot constitute a foundation of national innovation policy, but only its supplement. To some extent, EU funds limit the creativity in implementation of national policy bringing it only to co-financing European ventures. Furthermore, too big contribution of non-returnable aid is negative (e.g. grants within EU funds). Common application of this instrument is justified only at initial stages of supporting innovations. However, succor of this kind seems to be needless during disseminating of new technologies. A better solution could be a wider variety of tax reliefs (Bukowski et al., 2012, p. 26). The currently applicable tax relief enables entrepreneurs to deduct only 50% of purchase of the concrete technology or innovative solution.

On the government’s initiative, in order to make the tax benefits on account of new technology application more attractive, entrepreneurs will be able to deduct 26% of all allocations for R&D. A perfect role model is the solution applied in Great Britain which allows British companies deduct from 130% to 225% of expenditures on R&D.

Besides, the analysis of the funds allocated within OP IE revealed that a vast majority of them were directed to big companies instead of enterprises from SME sector. It turns out that the smaller enterprise is, the more seldom it succeeds in gaining EU funds. This proportion should be radically changed because smaller companies are characterized by funding shortages, which respectively hampers their pro-innovative activity.

Moreover, Polish authorities have not formed any sufficient instruments of support for venture-capital or seed and start-up capital. This mechanism functions perfectly in the UK and its government dedicated nearly £400m to that goal. In Poland there is an equivalent of Enterprise Capital Fund Programme or UK Innovation Investment Fund – the National Capital Fund or the National Economy Bank, however, the funds that can be intended for the SMEs are not substantial.

What actions should be taken then so as to Poland belongs to the innovation leaders? What challenges should the policy of innovation support face in the nearest years?
First of all, the reform of tertiary education is indispensable. The quality of education should improve whereas service and product range of higher education facilities ought to be adjusted to the job market needs in order to respond to new skills and jobs demand. The system operating within student private sector is just shaping. At colleges, academics or universities so-called "Business Councils" start to arise and they constitute representatives of many local and regional enterprises, offering scholarships and apprenticeship for students, but the range of these actions is not wide enough to bring Poland the effect in the form of the growth of the economy innovativeness in the short run. Hence, one of the possible solutions could be a creation of a large institution (like the Confederation of British Industry's in the UK) federating enterprises on the national level and coordinating actions which are now divided into plenty of smaller academic centers.

It is also vital to stop financing entities (so-called statutory financing) in favor of funding the specific projects. The research being the subject of private sector interest should be widely promoted. An insufficient number of relations between universities and private companies causes that higher education facilities which are the beneficiaries of public funds will lose motivation to carry out effective research. The Higher Education Innovation Funding, which succors tightening the relationship with a private sector can pose a good example. A big financial incentive for Polish universities and a kind of stimulator to create bonds between colleges and business environment could be a possibility of donating 1% of CIT to bonds between colleges and business environment universities and a kind of stimulator to create good example. A big financial incentive for Polish universities and a kind of stimulator to create bonds between colleges and business environment could be a possibility of donating 1% of CIT to bonds between colleges and business environment.

In other words, the implementation of essential structural reforms is necessary. Tightening cooperation between universities and a private sector, which could bring some measurable benefits for both parties, should be definitely cultivated. As the British model shows, higher education facilities could rely on the additional source of considerable funds which Polish universities lack and enterprises could have a sort of stimulus to run R&D activity on a larger scale. Polish authorities cannot forget about support for SMEs, especially at the initial stage of their development and creation of some institutions which would capitalize companies with cash flow shortages. Besides, coordination of innovation policy on a national and regional level is indispensable as well.

The government has a couple of interesting ideas on how to intensify the evolution of this policy i.e. new tax reliefs, possibility of deducting CIT on how to intensify the evolution of this policy. The government has a couple of interesting ideas on how to intensify the evolution of this policy i.e. new tax reliefs, possibility of deducting CIT on how to intensify the evolution of this policy. The government has a couple of interesting ideas on how to intensify the evolution of this policy i.e. new tax reliefs, possibility of deducting CIT on how to intensify the evolution of this policy. The government has a couple of interesting ideas on how to intensify the evolution of this policy i.e. new tax reliefs, possibility of deducting CIT on how to intensify the evolution of this policy. The government has a couple of interesting ideas on how to intensify the evolution of this policy i.e. new tax reliefs, possibility of deducting CIT on how to intensify the evolution of this policy. The government has a couple of interesting ideas on how to intensify the evolution of this policy i.e. new tax reliefs, possibility of deducting CIT on how to intensify the evolution of this policy. The government has a couple of interesting ideas on how to intensify the evolution of this policy i.e. new tax reliefs, possibility of deducting CIT on how to intensify the evolution of this policy.
The potential and quality of human capital, as well as research and development activities, play an extremely important role in the development of the knowledge-based economy. Information, intellectual capital, technologies and innovations are significant factors in this development. At the same time, knowledge and science are treated as elements that shape the structure of production and economic progress at the advanced stage of the socioeconomic development. The European Union, which aims at creating the most competitive and dynamic economy in the world, capable of generating new jobs and ensuring social cohesion, grants a unique position to higher education institutions and scientific research units. It is highlighted, for example, in the “Europe 2020” strategy, in which one of the main objectives is to achieve the level of R&D expenditure of 3% GDP, or in the document “The role of the universities in the Europe of knowledge” where the European Union “… must have a first-class university system – with universities recognised internationally as the best in the various fields of activities and areas in which they are involved”. Moreover, in the framework “Excellence in the Science Base” priority in the “Horizon 2020” programme, the European Union aims to increase the level of the European scientific base and ensure a continuous source of the socioeconomic development. The modern function of the university is “strategic” and “long-term” and it “penetrates into various sectors, so it is indispensable to the survival and development of a nation”. Transfer of knowledge and – above all – its commercialisation bring many benefits to the society. Thus, the questions continuously arise concerning the possibility and methods to link science with the other, important areas of economic life, e.g. manufacturing, commerce, finances or even aspects of corporate social responsibility. In addition, the issue of the application of results of researchers’ work and the transformation if their discoveries and achievements into practical innovations is also important.

In the era of knowledge-based economy, the development of enterprises requires a continuous exchange of research and technical ideas, access to modern technologies and laboratories which scientific units, including higher education institutions, have. Studies carried out by many economists, among others T. Kodama, F. Khalozadeh et al. and K.H. Mok, indicate that the cooperation of science and business is the driving force of innovation, as well as the modern competition, and that it has become a necessity as a result of processes of growing globalisation.

Moreover, in the framework “The role of intermediation and absorptive capacity in facilitating University–industry linkages an empirical study of TAMA in Japan,” it seems clear, therefore, that the academic nature of science should be replaced with science that responds to actual needs of the market and economy, offering – as always – theory, yet above all the sort of theory that will have practical implications.

In this context, various measures are taken emphasising the role of higher education institutions and other units in the process of commercialisation of knowledge, as well as transfer of technology and innovation from science to business. Although the number of entities involved in the R&D sector is growing (e.g.: technology transfer centres, clusters, entrepreneurship incubators, etc.), higher education institutions mark their presence at many stages of cooperation between science and business, from generating knowledge, through its dissemination, for instance, in the process of education, to the creation of patents and commercial deployments. Academic research assumes even greater importance in the light of the so called “third mission”, i.e. the cooperation of the university with business and the external environment in order to create and commercialise innovations, as well as to disseminate knowledge and its practical application.

The paper aims at presenting research and development activity carried out in Poland and in the United Kingdom, showing its current potential and determinants of its development. Particular attention will be paid to higher education institutions whose role and importance in the research and development sphere is growing.

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For many countries, promoting and supporting enterprises and economic sectors that implement innovations is a priority and companies also invest in R&D activities which may provide them with a competitive advantage.

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2. Research overview

The R&D sphere plays a very important role in the process of the creation of knowledge and technology, as well as their transfer into the real economy. This approach can be seen, among others, in the works of J.W. Spencer30 or K. Krystkowski. The latter, on the basis of studies conducted by many economists, states that the level of development of science in a particular country determines success in the process of knowledge absorption by companies.31 It is worth, therefore, in this context, to draw attention to the role of the state as a stimulator for establishing ties between institutions of the R&D sector and enterprises.

K. Łącka observes that the creation of links between participants of innovation processes in the region in accordance with the concept of the so-called triple helix32 requires support from the state which plays the role of the instigator, co-organiser and promoter of cooperation between researchers and entrepreneurs. The actions taken by the state should be related, for example, to incurring development expenditure on funding basic and applied research along with development activities (in public scientific units, i.e. higher education institutions, scientific and research institutes) the results of which are used in the economy.33 According to A. Buchner-Jeziorska, pressure groups consisting of representatives of the academic and business communities should even be created to exert pressure on political elites to promote science and higher education in the development of the country and its individual regions.34

Many other authors, for instance E.G. Methene and A. Pomykalski, also confirm the role of the state in the creation of the strategy for the development of science and technology, as well as the innovation policy, stressing that these policies chart directions of development and are factors that determine innovativeness of companies.35 According to K. Szopik, it is the economic policy of the state that creates appropriate conditions for innovation and knowledge transfer, financing and creating R&D activities, which reduces the risk of destabilisation and promotes rapid economic growth.36 It should be remembered, however, that whether a particular enterprise decides to cooperate with the university depends mainly on the company’s strategy, in particular its openness and ability to take advantage of external sources, as evidenced by works of, among others, K. Laursen and A. Salter.37

As mentioned earlier, the contemporary knowledge-based economy necessitates the search for new solutions in scientific research and business, which mostly comes down to the implementation of innovations. According to E. Stawasz, the sources of new solutions for the enterprise include: the transfer of technology, R&D activity, marketing research conducted in the foreign and domestic markets, the use of methods of collecting ideas (e.g.: “brainstorming”), advisory support from consulting firms and the stimulation of attitudes of employees and management.38 In this context, the role of the university is important as it is indisputably a part of activity classified as the research and development sphere.39

Knowledge transfer between the university and industry is carried out with the use of a variety of mechanisms. M. Perkmann and K. Walsh determine two most important ways through which companies gain access to academic knowledge and expertise: partnership and contracting.40 The former involves a close and continuous cooperation between participants, while contracting requires only small commitment to the mutual relations. Apart from these two basic methods, D. Gill et al. also draw attention to the crucial significance of relationships in which people are the most important factor, for example, internships for graduates, faculty secondments to industry or invitations to university laboratories extended to industrial specialists, etc.41

K. Santrek et al. list a number of forms of technology transfer from the university to industry, among which the most important are (apart from the aforementioned human factor) opinions, expert evaluations, reports of applications or projects prepared by university staff for companies, invention applications and descriptions of patents owned by the university and its faculty, commissioned research (contract, service) carried out by universities for industry, targeted and commissioned scientific research projects undertaken in the cooperation with

36 Szopik K., Klasifikacja uwarunkowań innowacyjności przedsiębiorstw, Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania no. 1, 2008, p. 33
39 R&D entities are “all institutions (including self-employed individuals) engaged in creative work undertaken in order to increase knowledge, as well as to find new applications for this knowledge”. The R&D sphere in Poland includes:
• entities whose primary activity is classified in division 72 of the Polish Classification of Activities (PCA) 2007 as “Scientific research and development activities”: State organisational units – scientific units of the Polish Academy of Sciences and research institutes are of particular importance in the Polish scientific system. These also include entities that operate in other legal frameworks, such as capital companies, associations, foundations and natural persons engaged in business activity. These entities are known as scientific institutions, as well as research and development institutions;
• higher education institutions: public and non-public ones conducting R&D activity along with their principal activities – systematically or incidentally, including enterprises classified in PCA divisions others than 72. See: Nauka i technika w 2011 r. (Science and technology in 2011), Central Statistical Office in Poland, Szczecin Statistical Office Press, Szczecin, 2012, p. 12.
41 Gill D., Minshall T., Pickering C., Bigbyet M., Funding Technology: Britain Forty Years on, University of Cambridge Institute for Manufacturing, 2007, p. 50.
enterprises, joint projects realised in the framework of consortia, strategic partnerships, the agreement on supply and use of know-how or licence purchase.40

Although the range of methods of cooperation seems to be impressive, not all forms of cooperation are very popular. Entrepreneurs most often take advantages of expert evaluations or opinions of the university, although according to W. M. Cohen et al., A. Cosk et al. and J. H. Grossman, in practice it rarely results in joint patents or licences.41

Relationships between science and business are especially strong in the areas of technology. K. Laursen and A. Salter show that the chemical, machinery and electronics sectors were the most willing to make use of the knowledge of partner universities in Great Britain at the turn of the 20th and 21st centuries, whereas the least active in this respect was the paper industry.42 According to K. Kaymaz and K.Y. Eryiğit, some sectors, for instance biotech or pharmaceutical ones, are practically “dependent” on knowledge provided by higher education institutions as without research their development would not be possible.43 The results of analyses conducted by W. M. Cohen and D.A. Levinthal suggest that companies in sectors characterised by a high level of investment in R&D or other scientific or technological activities are more prone to cooperate with universities. This means that the level of absorptive capacity in the sector may affect the propensity of enterprises to make use of scientific knowledge.44

Universities may engage in cooperation with companies for many various reasons. According to T. Bjerrregaard, the most important motives include an increase in the science development rate, adaptation of research for business needs, access to enterprise data and the ability to test new scientific solutions in practice.45 Due to this cooperation, universities shorten the time of the implementation of new technologies and have an additional source of funding for their new research programmes, e.g. by the sales of licences. Moreover, according to H. Breen and N. Hing, universities can also engage additional funds in improving the quality of educational systems.46

2. Research overview

F. Meyer-Krahmer, U. Schmoch and N. Carayol stress that access to information and flexibility are also important for the university.47 This is confirmed by studies of Y.S. Lee who has shown that academics cooperate with industry to be able to use modern equipment, to improve the chance for the development of their scientific career and to concentrate on working on their own proprietary research.48 According to A. Agrawal and R. Henderson, as well as E. Mansfield, the establishment of relations and cooperation between researchers and companies may provide an inspiration to undertake new scientific projects in the future.49 In addition, K. Santarek et al. think that the university that cooperates with business is perceived in the industrial community as a purveyor of practical and useful knowledge, which in the long run causes a greater interest of students in studying in this particular institution.50

Many publications also explore the motives behind the cooperation between companies and universities. Even early works indicate growing benefits that industry may derive from commissioning academic research. E. Mansfield, based on the survey carried out among 76 American companies, has noted that approx. 10% of new products and processes prevalent in the years 1975–85 would have been discovered much later but for academic research.51 Their contribution was particularly important in certain industries such as: pharmaceutical or information technology. M. Beise and H. Stahl analysing the results of the survey carried out in German companies, have drawn similar conclusions.52 They have estimated that approx. 1/10 of the enterprises introducing innovative products or processes in the years 1993–1995 would not have been able to do so if not for the research conducted in the public sphere. I. Cockburn and R. Henderson, who have concentrated on the pharmaceutical industry, emphasise that there is a clear correlation between financing R&D activity from public funds and introducing new drugs onto the market.53 A.A. Toole calculates that a 10% increase in investment in scientific research leads to a 6.4% increase in the number of new drugs that enter the market.54

Although studies mostly show benefits of the cooperation with universities, customers, competitors, conferences or professional magazines still remain the main source of knowledge about innovative solutions for companies. This opinion is shared by K. Laursen, A. Salter, L.E. Weber and J.J. Duderstadt. Based on the studies of M. Fritsch and Ch. Schwitren, they state that if there are closer relationships between the university and business, these arise from personal contacts of the interested parties (39%), targeted search for a partner (29%) and meetings in the framework of conferences or fairs (14%).

Enterprises that try to engage in the cooperation with the science sector indicate that the opportunity to strengthen their position in the foreign and domestic market, for instance, by introducing new products or modernising the products offered, as the source of their motivation. According to D.C. Dan, M. Xia et al. and W.M. Cohen et al., access to knowledge, research results, new solutions and research infrastructure, as well as the possibility to hire highly qualified employees are further advantages of the cooperation with higher education institutions. The company, while commissioning the execution of certain tasks by the university, may count on lower costs of the research project or tax relief. Literature in this field also explores relationships between the geographical proximity of the university and business, as well as the frequency, hence the weight, of the correlations. According to K. Laursen et al., the geographical proximity increases the probability of interactions between the university and industry. P. Maskell and A. Malmberg, as well as E. E. Learner and M. Storper, state that also cultural and linguistic similarities are important, particularly when the flow of knowledge and technology is determined by the necessity of personal meetings. This opinion is confirmed by A. Arundel and A. Geuna who add that the proximity weight is smaller when knowledge transfer is carried out through these forms of cooperation that do not require direct relations, e.g.: publications or purchase of patents. In addition, it should be remembered that for the enterprise, particularly a large one, the reputation of research conducted by the university in the given field is the most important motive for cooperation, whereas small companies may need only consultations or routine services that can be usually obtained from universities in the immediate area.

K.B. Matusiak stresses that the cooperation between the university and entrepreneurs is difficult to organise since there exist profound differences in the approach to undertaken tasks, which leads to a specific “communication gap”. It is confirmed, among others, by the research of A.K. Klevorick et al., T. Davey et al., K.B. Matusiak and J. Guliński, as well as J. Machnik-Słomki, J. David, P. Dasgupta, D. Foray and W. E. Steinmueller even argue that the approach to scientific research, and above all the mode of its disclosure, is completely different in the case of academics and industry. Academics are mostly focused on gaining recognition and promotion – the priority in the publication of results is often related to it. The company which introduces innovation onto the market will seek to hide research results due to the existence of potential competitors. In addition, according to W. Masiak, entrepreneurs, who have to predict and assess each venture in terms of its economic viability, expect “guaranteed” results in their pre-established budget and time, while researchers are more accustomed to academic exploration of issues, which should not be rushed.

According to J. Adamska, L. Mytelka and F. Farinelli, clusters, which are created in practically all economic sectors, can be seen as one of potential sources of improvement in relations between the university and business, stimulating the development of science and innovation. M. J. Enright, E. Skawińska and T. Zalewski state that clusters can be found, for example, in manufacturing and services, in both high-tech industries and traditional ones. In these organisations, the involvement in the process of transfer of knowledge and the ability to use it in manufacturing or services is a priority. Hence, they increase awareness of the need to collaborate and communicate with multiple environments and may provide very strong support for state institutions, as universities, as well as for private enterprises.
Numerous studies, for instance, conducted by the Polish Agency for Enterprise Development (PAED), indicate that the link between clusters and R&D centres is obvious since they are local innovation systems and have a wide technical base which enables scientific work and experiments, as well as mechanisms of diffusion and information transfer. Thus, the characteristic feature of leading clusters must be higher intensity of research and development activities and their use, transfer of employees and knowledge or joint R&D projects. If it is additionally connected with financial state aid (e.g. grants), the chances of success of these organisations are high according to K. Skokan, E. Poledníková, M. Staničková.

The cooperation of the university and business may also stimulate activity of, for instance, academic entrepreneurship incubators which are usually established due to the initiative of academic communities. According to M. Mażewska, they are to assist in the preparations for the establishment of a company and the preliminary assessment of its opportunity for market success. In addition, incubators carry out their statutory duties in the field of education and the promotion of entrepreneurship, as well as support for commercialisation of new products and technologies.

Poland

The Polish economy is characterised by a low level of innovativeness compared to the countries of the European Union, which is reflected in the annual report of the European Commission entitled Innovation Union Scoreboard. In the latest report of 2013, Poland ranked fourth from the end in the ranking of the EU member states in the area of innovation and was classified in group four (Modest innovators) of innovators with modest results. The potential for innovation in Poland is mainly based on human resources with a very low propensity for the introduction of innovation and little cooperation between science and business. This may be due to low levels of expenditure on research and development (R&D), one of the lowest in the OECD countries, which is indicated by Gross Domestic Expenditures on Research & Development (GERD), the index informing about the total expenditures on R&D activities in relation to GDP. The value of this index in Poland is changing very slightly, which deviates from the standards and directions of change observed in the most developed global economies.

Figure 1. The structure of R&D expenditures in Poland in the years 2007-2011 (%)

Source: The authors’ own compilation based on data from: Nauka i technika w 2011 r. (Science and technology in 2011), Central Statistical Office in Poland, Szczecin Statistical Office Press, Szczecin 2012.
Expenditures on R&D in Poland in 2011 amounted to 11.7 billion PLN and had a slight tendency to increase in relation to 2010. The structure of these expenditures indicates the continued balance between different types of research described in Fig. 1. It is believed that directions of basic research that are different from research and development directions can become a threat to the development of innovation in the long-term perspective as the intermediary stage of basic research that are different from research and development activities in Poland when it is associated with a high degree of involvement of qualified staff and a high degree of sophistication of the tasks and processes implemented.

In Poland, units that conduct R&D activities according to the methodology adopted by the OECD countries include: enterprises, institutions and universities that are divided into four sectors: business enterprise sector (RES), government sector (GOV), higher education sector (HES) and private non-profit sector (PNP). In Poland, internal expenditures on R&D by sector were as follows: the largest investment was in higher education – 35.1%, followed by 34.6% in the government sector, 30.1% in the business enterprise sector and 0.2% in the sector of private, non-profit institutions.

In Poland, the rate of growth of expenditures on R&D is significantly above the European Union average, which indicates the development of this sector. The main source of its funding is state aid in the form of the government programme and support extended in the framework of the Special Economic Zones. The programme adopted by the Council of Ministers in 2011 entitled “Programme to Support Investments of High Importance to the Polish Economy in the Years 2011-2020” provides for support for enterprises that invest in research and development activity in Poland when it is associated with a high degree of sophistication of the tasks and processes implemented, which is favourable for the development of the Polish economy. Moreover, the state aid may still be awarded from the European Union funds, national funds, the European Commission programmes and private programmes, as well as in the framework of bilateral research cooperation programmes.

Analysing expenditures on R&D by the field of science, engineering and technical sciences accounted for the largest share – 5.5 billion PLN, followed by natural sciences – 3.0 billion PLN, as well as medical and health sciences with the expenditure of 1.3 billion PLN. 1.9 billion PLN was allocated to the remaining science groups (agricultural, human and social sciences). Research and development activities in 2011 were financed mainly from the resources of the government sector (6.5 billion PLN), which funded 55.8% of the expenditure of all entities; the largest portion of these funds – 47.6% – was allocated for research and development work carried out by the government sector and higher education – 45.6%, representing a large potential in terms of total resources for the development of the R&D sector.

In Poland, in the academic year 2011/2012, 460 different types of higher education institutions operated, including 132 public and 328 private schools, which educated the total of 1,764,100 students. The largest academic centres with more than 100 thousand students are: Warsaw, Cracow, Wroclaw and Poznan. The number of higher education institutions in the academic year 2000/2001 compared to the academic year 2011/2012 showed an upward trend from 310 to 460. The number of students, however, since the academic year 2005/2006, when it was the highest and reached 1,953,800, showed a downward trend and amounted to 1,764,100 in 2011/2012. This is due to changes in the Law on Higher Education restricting the operations of these institutions, as well as due to a decreasing population of people aged between 19 and 24.

Figure 2. Students by school types (%)


Table: Students by school types (%)

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other schools</td>
<td>20.2%</td>
</tr>
<tr>
<td>Schools of the Ministry of Defense and the Ministry of Interior Affairs</td>
<td>1.6%</td>
</tr>
<tr>
<td>Theological colleges</td>
<td>0.4%</td>
</tr>
<tr>
<td>Higher schools of art</td>
<td>1.0%</td>
</tr>
<tr>
<td>Academies of physical education</td>
<td>1.5%</td>
</tr>
<tr>
<td>Maritime academies</td>
<td>0.6%</td>
</tr>
<tr>
<td>Medical universities/medical academies</td>
<td>3.5%</td>
</tr>
<tr>
<td>Higher schools of pedagogy</td>
<td>4.2%</td>
</tr>
<tr>
<td>Academies of economics</td>
<td>14.1%</td>
</tr>
<tr>
<td>Agricultural colleges</td>
<td>4.6%</td>
</tr>
<tr>
<td>Universities</td>
<td>29.2%</td>
</tr>
<tr>
<td>Universities</td>
<td>29.3%</td>
</tr>
</tbody>
</table>

In Poland, the Law on Higher Education of 27th July 2005 (O. J. no. 1365 with further amendments)
Most people studied at universities (29.3%), then at technology (19.2%) and economics universities (14.1%) (see: Fig. 2), studying economics and administration (21.9%), education and social sciences (respectively 11.2%). These fields produced the largest number of graduates. Compared to the academic year 2010/2011, medical sciences, technical sciences and engineering accounted for the largest share of university graduates, while the largest decrease was observed in the number of graduates in the field of pedagogy, administration, social and economic sciences.

The number of people that enrolled in postgraduate studies, as well as doctoral studies, also increased in the academic year 2011/2012 compared with the previous year. Among the doctorate studies, the most popular were the humanities (11,000 participants), technical sciences (6,500 participants), economics (4,900 participants), law (3,200 participants) and medical sciences (3,100 participants).

In the academic year 2011/2012, a total of 99,341 academic teachers were employed, including 42,751 women. The largest number of people worked as an associate lecturer – 42,542 people (42.8% of total employment) and as a professor – 23,884 people (24% of total employment), including a full professor – 8,276 people, an associate professor – 15,389 people and a visiting professor – 219 (see: Fig. 3). Language teachers (1.3% of total employment), instructors (0.9% of total employment) and qualified librarians (0.4% of total employment) constituted the smallest group of academic teachers.

3. Research and development activity in Poland and the UK

Teachers employed in public schools in 2011 amounted to 83.6% of the total number of people employed in higher education institutions, while teachers at non-public universities – 16.4%. The majority of the academic teachers were women – 43.1% (44,300). In comparison with the previous year, there was a decrease in the number of academic teachers working in higher education (by 0.7%).

Among the 132 public universities operating in the academic year 2011/2012, 105 (78.9%) incurred expenditures on research and development, while among 328 private universities – 92 (29.3%). In 2011, public universities incurred expenditure on R&D in the amount of 3.8 billion PLN, which accounted for 28.0% of total expenditures, while private universities spent 0.3 billion PLN, which amounted to 10.3% of total expenditures. The data demonstrate the great potential of higher education institutions in the development of R&D activities in Poland.

The number of people employed in research and development (R&D) in Poland in 2011 amounted to 134,551 people, including 54,556 women. There was an increase in employment of technicians and equivalent staff working on R&D by 25.3% more than in 2010. Academics employed with the title of professor constituted 7.7%, with the degree of habilitated doctor – 10.0% and with the doctoral degree – 34.5%, the rest were employees with a higher education diploma – 36.7% and those without higher education – 11.1%.
The United Kingdom

The UK economy is characterised by a high level of innovativeness compared to the countries of the European Union. According to Innovation Union Scoreboard 2013, the UK takes the 8th place in the ranking of the EU member states in the field of innovation and is classified in group two (Innovation followers) of countries catching up to the leaders. The UK innovation capacity is founded mainly on a strong scientific base and highly innovative SME sector, particularly in the area of services.

In 2010, the UK invested 26.362 million GBP in R&D activity in real terms. R&D intensity (GERD/GDP) in the UK amounted to 1.77% in 2010 and was lower than the EU average. R&D activity (GERD/GDP) in the UK amounted to 16,067 million GBP, which constituted 61% of expenditures on R&D in the UK. Expenditures on R&D as percent of GDP in the UK in 2011 showed a downward trend and amounted to 1.77% of GDP compared to 2009 when they accounted for 1.85% of GDP. Analysing expenditures on R&D by sector, the largest expenditures in 2007-2011 were incurred in the business sector (average: 1.1% of GDP) and in the higher education sector (average: 0.48% of GDP) (see: Fig. 4).

R&D activity in the UK is strengthened by the number of researchers – in 2011, 262,303 persons were employed full-time, the largest number – 163,506 people – in the higher education sector and 85,948 people in the business sector (see: Fig. 5). Such a significant share of researchers employed in the sector of higher education may indicate a strong involvement of this sector in conducting and implementing R&D activities.

As of August 2011, there were 165 institutions, including 115 universities, in the UK and in 2010, 1.9 million students studied there, of which approximately 70% were full-time students. The environment of the higher education sector is international, more than half of the students come from countries outside the EU, 42% from Asia. The number of students from outside the UK amounted to 40,5805, which accounted for over 20% of full-time students.

UK universities are autonomous organisations with charitable status, funded by means of a dual support system. In the framework of this system, the Higher Education Funding Councils provide general funding (‘block grants’) to individual HEIs. These grants contribute towards academic salaries, support infrastructure and some non-specific research in the universities and colleges. Research Councils also support universities by financing specific research and programmes throughout the UK, mainly on the basis of competitive bids from researchers and research groups in HEIs. In addition, the Higher Education Innovation Fund introduced the so-called “third-leg” funding stream which funds HEI interaction with business and the local community. In 2009/2010, the UK HE sector received 26.8 billion GBP of funds for research support. 16% came from research councils, 34% from the Higher Education Funding councils and approx. 8% from the government directly. Approx. 20% was obtained from tuition fees and 18% from other sources (incl. private sector funding).


3. Research and development activity in Poland and the UK

<table>
<thead>
<tr>
<th>Year</th>
<th>Business sector</th>
<th>Higher education sector</th>
<th>Government sector</th>
<th>Private non-profit sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>0.45</td>
<td>0.36</td>
<td>0.21</td>
<td>0.05</td>
</tr>
<tr>
<td>2008</td>
<td>0.45</td>
<td>0.36</td>
<td>0.21</td>
<td>0.05</td>
</tr>
<tr>
<td>2009</td>
<td>0.45</td>
<td>0.36</td>
<td>0.21</td>
<td>0.05</td>
</tr>
<tr>
<td>2010</td>
<td>0.45</td>
<td>0.36</td>
<td>0.21</td>
<td>0.05</td>
</tr>
<tr>
<td>2011</td>
<td>0.45</td>
<td>0.36</td>
<td>0.21</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Source: The authors' own compilation based on Eurostat data
According to data of the Central Statistical Office, expenditures on research and development in Poland in the years 2003-2011 grew visibly every year, although the spending is still significantly smaller than the EU average. Over that period, the expenditures increased 2.5 times, while there was an approximately 20% increase in the United Kingdom (see: Fig. 6). It is also apparent when comparing the rates of GERD for both countries. According to Eurostat, in Poland in 2003 it amounted to 27.1 EUR per capita and 74.2 in 2011. However, it accounted for 483.8 EUR per capita in 2003 and 495.9 in 2011. If only R&D activity conducted by higher education institutions is taken into consideration, in Poland in 2011 GERD was 26.1 EUR per capita, while in the UK it was 133.2. The average for the EU at that time amounted to 122.5 EUR per capita and the undisputed leaders in the value of national expenditures on R&D incurred by higher education institutions were Norway (400) and Denmark (399.2).89

According to Eurostat, GBAORD index (as a % of total general government expenditure) in 2009 in Poland amounted to 0.76, while for the UK it was 1.3591, which confirms the earlier presented trends.

When comparing the number of employees working in R&D in Poland and the United Kingdom, an upward trend can be clearly seen in both countries. In Poland, in the years 2003-2011, the number of R&D employees increased by 10%, whereas in the UK by approx. 13%.

This may be due to a large extent to the current objective of the EU to increase employment and expenditures in the R&D sector by 2020. In 2011, 358,585 people were employed in research and development in the UK, while at the same time in Poland – 85,219 (see: Fig. 7).

The number of researchers per 1,000 employees was also higher in the UK than in Poland. Annual average for the period of 2003-2011 per 1,000 employees was 4.1 employees in the R&D sector in Poland and 7.9 in the UK (see: Fig. 8).

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89 Eurostat data, (as of 18.04.2013).

91 In 2011 it amounted to 1.22 in the UK, there are no data in this field for Poland for the years 2010-2011.
Patent activity in Poland is very low. According to Eurostat data, in the years 1996-2007, the European countries submitted on average approx. 100 patent applications per 1 million inhabitants to the European Patent Office annually, while Poland submitted only two applications per 1 million inhabitants. If compared to patent activity in the UK, which is not the leader in this area\textsuperscript{92} (89.5 annual average), this difference is staggering.

In Poland in the years 2002-2010, the number of invention patent applications submitted to the European Patent Office increased more than 3.5 times (from 83.5 to 308.0). This number, however, is still not satisfactory compared to the other EU countries. The comparison of annual patent activity in Poland and the UK is illustrated by Fig. 9.

This small number of patents from Poland may result from the low level of cooperation between the university and business in the area of technology transfer and commercialisation of knowledge. Higher education institutions, despite their potential, rarely decide to cooperate with business, which is reflected by the 67\textsuperscript{th} place (out of 144 countries) in the ranking of university-industry cooperation in the area of R&D according to The Global Competitiveness Report 2012-2013, published by the World Economic Forum\textsuperscript{91}. The UK takes the 2\textsuperscript{nd} place, just behind Switzerland.

![Figure 9. The number of patent applications submitted to the European Patent Office](image)

Source: The authors’ own compilation based on Eurostat data

\textsuperscript{91} Among the European countries, the following positively stood out in terms of their patent activity and high innovativeness in the years 1996-2007: Germany (257 applications per 1 million inhabitants annually), Finland (242) and Switzerland (369).


5. Conclusions

The European Union clearly emphasises the need to convert the European knowledge into market products and services with the aid of the R&D sector through stimulating transfer of knowledge and the removal of barriers to the commercialisation of new ideas. European higher education institutions are becoming increasingly more open to the business sector and more often adapt their offer to the specific needs of companies. Clusters, entrepreneurship incubators and technology transfer centres, whose operations have a positive impact on the development of regions, are the example illustrating successful cooperation between science and business. Research and development activities in the EU are conducted mainly by higher education institutions and enterprises, which is confirmed by the example of Poland and the UK. Both countries are gradually advancing in the innovation rankings, which is the result of not only the growing number of research and development centres, patents received and incurred expenditures on R&D but is also the consequence of the actions of the business environment promoting effective commercialisation of knowledge and technology.

The Polish world of science, encompassing more than 400 higher education institutions, approx. 2 million students, almost 100,000 researchers (including enterprises, the government sector, higher education and private institutions) or the British scientific world, with its 165 higher education institutions, approx. 2 million students and more than 260,000 employees of the R&D sector, represent a significant potential which should be used for the purpose of expanding the development of the local and national economy. Especially since research and development activities, as well as commercialisation of knowledge, may benefit from financial support from the government, the EU funds or various scientific institutions and the European Commission in a number of documents, reports or guidelines stresses the need to create the knowledge-based economy.

The R&D sector in Poland compared to the other European countries looks unfavourable in terms of expenditures on R&D or the process of commercialisation of science. The cooperation between the university and business is also unsuccessful. The main barriers to cooperation between these two sectors include: lack of government incentives (e.g. tax incentives), lack of specific offers from the scientific community and little interest on the part of companies which do not recognise the benefits of this cooperation. It is also worth noting that the entrepreneurship of Polish higher education institutions is aimed at the development of paid educational services and other basic functions of a higher education institution, such as cooperation with business or transfer and commercialisation of knowledge, are of little importance. This is due to, among others, lack of regulations for transfer of ownership or excessive bureaucracy. For this reason, the Polish science should draw on the best practices developed in other countries. Nowadays, an increasing number of countries all over the world develop and implement various systems of incentives to create conditions necessary to carry out and develop research and development activity. The actions taken include, among others: the creation of databases of customers and researchers in order to establish cooperation, developing instruments for protection of intellectual property and ensuring access to information infrastructure. The solutions mentioned facilitate optimisation of R&D activities and are part of the development strategy based on building the innovative economy.
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52. Rynek B+R w Polsce. Wsparcie działalności badawczo-rozwojowej przedsiębiorstw, Warsaw, October 2012


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Innovations are an important source of competitive advantage for companies on domestic and international markets. By implementing innovations in various areas of their activities, companies may respond to changes in their immediate and more distant environment. Innovation strategy is a pre-condition for effective implementation of innovations in a company. Such strategy is decisive for some decisions that identify strategic orientation of a company and its development policy based on the implementation of broadly understood innovations. Market remains an important source of inspiration for innovation as it may facilitate taking a decision on the application of new technology, on the date of launching a new product, on territorial scope of sales, on how innovations are implemented, etc.

Innovation activities of companies are also significantly influenced by the innovativeness of the economy in question, defined as the ability and will of its economic operators to constantly search for results of scientific research and R&D works, new concepts, ideas, inventions, improvements and development of technologies used in material and non-material production (services), implementation of new methods and techniques in organisation and management, improvement and expansion of the infrastructure and the stock of knowledge and apply them in practice. Results of studies on innovativeness of the EU member states demonstrate the improvement of innovativeness of the Polish economy, however, Poland still has to make up for the gap dividing it from other EU countries.

The objective of this paper is to analyse and assess innovation activities of companies from the Lodz Region. Its first part focuses on identification and ranking factors that impact innovation activities in companies based on the literature of the subject. The second part studies main areas of innovation activities of companies in the Lodz Region based on the results of a questionnaire survey conducted in 2012 on a group of randomly selected 500 economic operators from the Region.
Innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. Innovation may take a different form depending on the specificity of a business. Some companies have clearly identified innovative projects, e.g. they develop and launch new products, while others continuously improve their products, processes and operations. Innovation activities are aimed at:

- expanding the assortment of products or services;
- replacing outdated products or processes;
- entering new markets or increasing market share;
- improving the quality of products or services;
- improving the flexibility of production;

- increasing the capacity to produce products or render services;
- reducing personnel cost per production unit;
- reducing the consumption of materials and energy per production unit;
- reducing the burden for the environment;
- improving health and safety at work.

Innovation activities can lead both to the development and implementation of innovations over the short term and to improvements in the innovative capacity of the firm. Their main areas include: research activities and development works, activities undertaken for the needs of product or process innovation, excluding R&D, activities leading to marketing and organisational innovation (see Fig.1).

Figure 1. Innovation areas

**R&D**
- internal (own) R&D consists in systematic, creative work in a company aimed at expanding the stock of knowledge and its use to devise new applications;
- R&D acquisition from external resources is identical as in the case above, but in this case R&D is acquired from public or private research institutions or companies.

**PRO-INNOVATION AREAS IN PRODUCTS AND SERVICES, EXCEPT R&D**
- acquisition of other external knowledge, i.e. the rights to use patents and non-patented inventions, trademarks, know how and other knowledge from other companies or organisations, e.g. universities;
- acquisition of machinery, equipment and other capital goods (land, buildings) necessary to implement innovation;
- other preparations to product or process innovations include e.g. development, planning and testing new products or production processes and supply methods;
- market preparation for product innovations, new or significantly improved goods and services;
- training.

**MARKETING AND ORGANISATIONAL INNOVATION**
- preparations for marketing innovations comprise activities related to the development and implementation of new marketing methods or acquisition of knowledge or capital goods connected with marketing innovations;
- preparations for organisational innovations include planning and implementation of new organisational methods and also acquisition of knowledge or capital goods related to organisational innovations.


Innovation activities are influenced by many factors usually divided into two categories: internal and external ones. The first category focuses on a company as the unit the most vital for innovation and it encompasses:

- resources,
- staff experience and skills,
- knowledge necessary to absorb and apply innovations, i.e. to establish company’s competitive position on the market,
- management system and institutional solutions,
- systematic and continuous searching for sources and opportunities for innovation.

Clear innovation strategy of a company is also an important internal factor. In literature there are many classifications of innovation strategies but quite often they are divided in two groups: introversion and extroversive strategies. Among introversion strategies we can find: (i) strategies increasing product attractiveness, reinforcing the market share; (ii) product strategies, and (iii) strategies of capital productivity and capital resources. Extroversive strategies include:

- offensive strategies – connected with operators specifically positioned on the market due to their significant competitive advantage resulting from innovation,
- defensive strategies – applied by market leaders who protect their position and do not wish to strengthen it,
- counteroffensive strategies – aimed in a particular moment of time at modifying and developing products based on innovation to expand their life cycle on the market and to be ahead of competitors.

Other criteria to distinguish innovation strategy are: material effects, market effects, and environmental effects. According to the first criterion, material effects (product, technology, and organisational system), we can specify: strategy of product improvement consisting in the introduction of new products, refining of already existing ones, and withdrawing products, strategy of technological processes designed to select an appropriate technology and to assess its impact upon reduction of costs and increase in production, strategy to improve organisational and management systems connected with new management techniques. Market effects criterion for product strategy analyses market environment using various methods of strategic analysis and selects market segment. Environmental criterion, in turn, should be analysed together with other criteria and consider values like saving natural resources, care for the environment, reduction of production costs, etc.
The most important characteristics of an innovation strategy are: identification of innovation portfolio correlated with a long-term strategy of a company, taking account of the strategic area, adjustment of R&D activity to market needs, integration of development and business strategies.

Implementation of innovation strategies calls for financial support, which should be differentiated depending upon company's stage of development (see Table 1). Such needs are the biggest in the first stage of innovation process linked with research and this stage is also the most risky.

Companies may finance their innovation activities in various ways. Selection of the best source depends upon a particular situation of the company and the cost of receiving the capital or risk linked to a given choice.

<table>
<thead>
<tr>
<th>Development stages</th>
<th>Financing objective</th>
<th>Financing characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sowing</td>
<td>Financing activities preceding the establishment of a company, such as: - working out the idea of the undertaking, - identification of market potential, - identification of competitors and regulatory framework, - final stages of research, - tests of product/technology, - certification and market authorisation.</td>
<td>In this stage of company development: - it is the most difficult to get financing, - high technical, market and management risks, - demand for capital is relatively low.</td>
</tr>
<tr>
<td>Start-up</td>
<td>Financing activities connected with the entry of a company into the market: - starting operational activities (setting up production base, organisational structure), - placing test lot of product on the market, - launching mass production.</td>
<td>In this stage of company development: - financial needs are substantial, - there is a risk of product's being rejected by the market.</td>
</tr>
<tr>
<td>Early growth</td>
<td>Financing the building of strong market position: - intense market operations, - expansion of production capacity, - building and expanding sales network, - recruiting new employees.</td>
<td>In this stage of company development: - financial needs are substantial, - risk of financing is much lower than in previous stages.</td>
</tr>
<tr>
<td>Sustainable growth</td>
<td>Financing activities connected with expanded scope of operations: - introduction of new products, - expansion to new markets, - implementation of new technologies.</td>
<td>In the stage of company's expansion: - financial and market position of a company is rather stable, - market operations require the highest financing, - the least risky stage of financing and development of innovative companies.</td>
</tr>
</tbody>
</table>


Table 1. Development stages of an innovative company and their financing

Regular statistical studies by the Main Office of Statistics (Polish abbr. GUS) of innovation activities in companies are based on international methodology referred to as the Oslo system or methodology105. According to the system, studies include industrial companies employing more than 49 workers and operators in the service sector employing between 10 and 49 workers.

In accordance with the definition by GUS104, innovation activities cover a range of scientific (research), technical, organisational, financial and commercial operations aimed at developing and implementing innovation. Innovation means implementing the below listed activities in economic practice, in an organisation, at a workplace, or in relation to the environment: • a new or significantly improved product, • a new or significantly improved process, • a new organisational method, • a new marketing method.

New or significantly improved products are implemented when they are introduced on the market, while new processes, organisational or marketing methods are implemented when they are brought into actual use in company's operations.

Classic classification of innovations implemented by companies encompasses technological innovations and improvements. Product innovations consist in improving of an existing product or introducing a new product on the market (goods or services). Improvement activities include technical specifications, components, materials and other functional characteristics. Process innovations introduce new or significantly improved production or supply method, also changes in technology, equipment and software. Moreover, there are also non-technological innovations: organisational and marketing ones. R&D are considered a special type of innovation activities in companies106.

According to literature an innovative company is a company which107: • conducts broad R&D works (or purchases designs of new products or technologies), • makes relatively high appropriations for outlays on such activities, • systematically implements new scientific and technical solutions • novelties represent a high share in its revenue from sales, • constantly implements innovations on the market.

The above features are mostly characteristic of companies operating in high-tech sectors where high technological competence, flexibility and striving for continuous development are required. Less stringent requirements vis-a-vis company's innovativeness are adopted in the already mentioned Oslo system108, where an innovative company is: a company which in the period under review (usually 3 years) has implemented at least one technical innovation on the market, i.e. a new or significantly improved product or a new or significantly improved technological process.

101 See Oslo-Manual – Proposed guidelines for collecting and interpreting technological innovation data
102 See Nauka i technika w 2006r. [Science and Technology in 2006], GUS, Warsaw 2007 pp.127-128
103 See Innowacyjność 2010r. [Innovativeness in 2010], PARP Warsaw 2010 p. 10
104 See Jasiński A.H. Innowacje i transfer techniki w procesie transformacji [Innovation and technology transfer in transformation], Wyd. Difin, Warsaw p.41
105 See Oslo-Manual – Proposed guidelines for collecting and interpreting technological innovation data
106 See Nauka i technika w 2006r., GUS, Warsaw 2007 pp.127-128
107 See Jasiński A.H. Innowacje i transfer techniki w procesie transformacji [Innovation and technology transfer in transformation], Wyd. Difin, Warsaw p.41
108 See Oslo-Manual – Proposed guidelines for collecting and interpreting technological innovation data

To assess innovativeness in companies we usually use the percentage of operators who implement product or process innovations. Between 2006-2008 out of 32 K industrial companies covered by the study by GUS, innovation criterion was met by only 21.3% of all the studied population. Analysed indicator was lower by 1.7 percentage points (pp) compared to the period of 2004-2006, when it amounted to 23%. Taking account of economic and financial crisis which started in 2008 contributed to the low level of the indicator. Limited demand for industrial goods, such as e.g. cars significantly influenced financial results of Polish industrial companies, which had to restrict their expenditure on innovations.

Table 2. Innovative companies by types of implemented innovations and by regions in 2006-2008 and 2008-2010

<table>
<thead>
<tr>
<th>Region</th>
<th>Innovative companies as a share of total population of companies in 2006-2008</th>
<th>New or significantly improved products</th>
<th>New or significantly improved products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total 2006-2008</td>
<td>New or significantly improved products 2006-2008</td>
<td>Total 2008-2010</td>
</tr>
<tr>
<td>Poland</td>
<td>23.3%</td>
<td>15.5%</td>
<td>22.1%</td>
</tr>
<tr>
<td>Lower Silesia</td>
<td>24.4%</td>
<td>16.2%</td>
<td>22.7%</td>
</tr>
<tr>
<td>Kuyavia – Pomerania</td>
<td>20.7%</td>
<td>16.1%</td>
<td>19.1%</td>
</tr>
<tr>
<td>Lublin</td>
<td>22.2%</td>
<td>14.8%</td>
<td>19.3%</td>
</tr>
<tr>
<td>Lubusz</td>
<td>14.4%</td>
<td>9.5%</td>
<td>13.5%</td>
</tr>
<tr>
<td>Lodz</td>
<td>14.8%</td>
<td>13.4%</td>
<td>12.3%</td>
</tr>
<tr>
<td>Malopolska</td>
<td>22.2%</td>
<td>16.4%</td>
<td>18.1%</td>
</tr>
<tr>
<td>Mazovia</td>
<td>25.3%</td>
<td>17.3%</td>
<td>20.9%</td>
</tr>
<tr>
<td>Opole</td>
<td>22.9%</td>
<td>19.3%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Subcarpathia</td>
<td>23.5%</td>
<td>18.5%</td>
<td>17.4%</td>
</tr>
<tr>
<td>Podlaskie</td>
<td>23.7%</td>
<td>15.0%</td>
<td>20.3%</td>
</tr>
<tr>
<td>Pomerania</td>
<td>25.1%</td>
<td>18.0%</td>
<td>19.8%</td>
</tr>
<tr>
<td>Silesia</td>
<td>22.4%</td>
<td>17.3%</td>
<td>17.4%</td>
</tr>
<tr>
<td>Swietokrzyskie</td>
<td>20.2%</td>
<td>16.1%</td>
<td>16.0%</td>
</tr>
<tr>
<td>Warmia-Mazurian</td>
<td>18.1%</td>
<td>13.3%</td>
<td>14.1%</td>
</tr>
<tr>
<td>Wielkopolska</td>
<td>18.5%</td>
<td>13.3%</td>
<td>15.0%</td>
</tr>
<tr>
<td>West Pomerania</td>
<td>17.1%</td>
<td>10.7%</td>
<td>14.2%</td>
</tr>
</tbody>
</table>

By analysing the share of industrial companies engaged in innovation activities in the periods 2006-2008 and 2008-2010 in individual regions of Poland we may observe substantial differences. The highest share of innovative companies in 2006-2008 was recorded in Mazovia Region (25.3%), Pomerania Region (25.1%), and Lower Silesia (24.2%). The lowest indicator characterised two Regions: Lubusz (14.4%) and Lodz (14.8%). In 2008-2010 the most innovative companies could be found in the Region of Subcarpathia (20.7%), Silesia (20.3%), and Opole (19.3%). The lowest indicator was again recorded for the Lodz Region, where only 13.4% companies declared an implementation of process or product innovation.

Polish industrial companies, independently of the region where they operate, more often implement process innovations, i.e. improvements in the way goods are manufactured or implementations of new processes, rather than introduce new or improved products. Leaders in process and product innovations are companies from the Regions of Subcarpathia, Opole, and Silesia (see Table 2).

Data presented in the above table can be considered worrying for the companies from the Lodz Region. In recent years the Region has been one of the least developing when it comes to innovation and it continues to rank last in the latest GUS studies. Only 10.1% of companies included in the study declare implemented product innovations while 9.8% implemented process innovations, which resulted in the lowest value of the indicator among all studied regions.

In 2008-2009 the study on innovation activities in industry included more than 2500 companies in the Lodz Region. In 2008 product or process innovations were implemented by 14.9%, while organisational or marketing innovations by 16.9% of the total population of companies – participants to the study. In the following year the share of companies implementing non-technical innovations dropped to as little as 9.7%, while technological innovations connected with production and the product itself were implemented by over 14% of companies.

Table 3. Innovative companies in industry by types of implemented innovations in the Lodz Region in 2008 - 2009

<table>
<thead>
<tr>
<th>List</th>
<th>Number</th>
<th>%</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total studied companies</td>
<td>2546</td>
<td>100,0</td>
<td>2584</td>
<td>100,0</td>
</tr>
<tr>
<td>Product or process innovations in companies employing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-49</td>
<td>144</td>
<td>7.4</td>
<td>146</td>
<td>7.6</td>
</tr>
<tr>
<td>50-249</td>
<td>171</td>
<td>8.2</td>
<td>155</td>
<td>7.3</td>
</tr>
<tr>
<td>250 and more people</td>
<td>58</td>
<td>2.7</td>
<td>51</td>
<td>2.1</td>
</tr>
<tr>
<td>Organisational or marketing innovations in companies employing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-49</td>
<td>231</td>
<td>11.7</td>
<td>98</td>
<td>5.1</td>
</tr>
<tr>
<td>50-249</td>
<td>137</td>
<td>6.6</td>
<td>104</td>
<td>4.9</td>
</tr>
<tr>
<td>250 and more people</td>
<td>54</td>
<td>2.3</td>
<td>39</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Source: own study based on: Działalność innowacyjna przedsiębiorstw w latach 2006-2008 [Innovation activities in companies in 2006-2008], GUS, Warszawa 2010, p.89; Działalność innowacyjna przedsiębiorstw w latach 2008-2010 [Innovation activities in companies in 2008-2010], GUS, Warszawa 2012, Annex p.27 Table 2.5,
Taking account of the size of companies included in the study, innovations are the most often implemented by large companies. In the Lodz Region more than half of companies employing over 250 people implemented product or process innovations and organisational and marketing innovations. That confirms the rule that the bigger a company the more often it engages in innovation activities. The reason is bigger potential of large companies to implement innovations, their better access to highly specialised staff and to various sources of funding. Besides, large companies usually operate on more demanding markets where the competition of big internationals is very strong. Fierce competition on domestic or international market stimulates and forces out innovative behaviour of big Polish companies. Small and medium-sized companies in the region are less innovative, they implement fewer technological innovations as they offer smaller variety of products compared to big companies. SMEs also have limited access to resources that enable innovation activities.

The above indicator shows the share of innovators in the total population of companies included in the study. However, it provides no information on the real scale of innovation activities of these companies. Hence outlays on innovation activities are considered the most reliable measure of innovativeness of national or regional economy.

According to GUS data, in 2009 in Poland innovation outlays per one industrial company engaged in innovative activities amounted to PLN 5.3 Mio and were higher by 12.2% (PLN 4.8 Mio) compared to 2008. The highest innovation outlays in 2008 per company engaged in innovation activities were recorded in the Lodz Region (PLN 8,433.7 K), while the lowest in Warmia and Mazurian Region (PLN 1602.1 K). In 2010 the highest innovation outlays per industrial company were reported in Mazovia Region (PLN 12,363.9 K). The lowest outlays per company were in Warmia and Mazurian region. High ranking (the second with outlays of PLN 10,837.7 K) of the Lodz Region may mean that if a company from the Lodz Region gets involved into innovation activities, their scale is big.

Table 4 presents the scale and structure of outlays for innovation activities in companies in the Lodz Region.

When analysing the size and structure of outlays for innovation activities in the companies in the Lodz Region we should pay attention to the significant reduction of total outlays in 2009, by more than 14% compared to the previous period. That was due to lower outlays on investment in fixed assets, in particular in buildings and facilities. On the other hand, when it comes to the structure, companies increased the share of outlays on: R&D activities (from 3.5% in 2007 to 4% in 2009), acquisition of software (from 0.4% in 2007 to 1.4 in 2009), and other outlays (e.g. staff training) up to 4.4% at the end of 2009.

The above short characteristics of innovation activities of companies in the Lodz Region allows for the following conclusion: the share of companies implementing product or process activities is one of the lowest in Poland but if innovation activities are undertaken, Lodz companies engage much higher outlays than companies from other regions of the country.

Table 4. Innovation outlays in companies in the Lodz Region in 2007-2009

<table>
<thead>
<tr>
<th>Item</th>
<th>2007</th>
<th>%</th>
<th>2008</th>
<th>%</th>
<th>2009</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2,339.7</td>
<td>100.0</td>
<td>2,339.7</td>
<td>100.0</td>
<td>2,009.5</td>
<td>100.0</td>
</tr>
<tr>
<td>R&amp;D activities</td>
<td>77.2</td>
<td>3.3</td>
<td>65.4</td>
<td>2.8</td>
<td>73.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Acquisition of knowledge from external sources</td>
<td>9.8</td>
<td>0.4</td>
<td>33.6</td>
<td>1.5</td>
<td>33.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Acquisition of software</td>
<td>8.2</td>
<td>0.4</td>
<td>17.0</td>
<td>0.7</td>
<td>17.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Investment outlays on fixed assets</td>
<td>2,084.5</td>
<td>92.5</td>
<td>2,084.5</td>
<td>92.5</td>
<td>1,806.3</td>
<td>90.9</td>
</tr>
<tr>
<td>Other outlays*</td>
<td>33.6</td>
<td>1.5</td>
<td>33.6</td>
<td>1.5</td>
<td>87.5</td>
<td>4.4</td>
</tr>
</tbody>
</table>


See Działalność innowacyjna przedsiębiorstwa w latach 2006-2008, GUS, Warsaw 2010, p.23
See Działalność innowacyjna przedsiębiorstwa w latach 2008-2010, GUS, Warsaw 2012 p. 59
4. Questionnaire survey analysis

4.1 Questionnaire survey analysis

Source material collected between May and July 2012 by trained interviewers in the form of questionnaires filled out using the PAPI method (paper and pencil interview) was statistically processed using the IBM SPSS Statistics software. Together with tables and diagrams we calculated structure indicators, Cramer’s V coefficient (v), and minimum probability (p) to test statistical hypotheses on the significance of correlation links between more important data.

The survey included 500 business people, 343 (68.1%) from manufacturing and 157 (31.4%) from service companies. Clear majority of respondents were sole traders – 42.8% and private limited liability companies – 27.5%. Partnerships, registered partnerships and public limited companies represented respectively 12.5%, 11.9%, and 3.1% of the studied population. Partnerships in commendam, in commendam – joint stock companies, and others represented only 2.2% of respondents. Detailed structure of operators examined from the point of view of their legal and organisational structure and broken down by types of activities (manufacturing, services) is presented on Diagram 1.

The next studied feature was the way a company started. Most of companies in the study started from the very beginning as entirely new entities, 89.3%. The answer was given by both manufacturing and service companies, which is shown on Diagram 2. Only a small fraction of enterprises (ca. 5%) declare they emerged as a result of merger or a takeover by/with other entities. In the group of manufacturing companies there were operators formed of a partnership of a Polish and foreign entities. Detailed distribution of answers on how their companies started is presented on Diagram 2.

Capital structure is another important characteristic of operators participating in the study. When answering the question concerning capital structure, the most frequent choice was “100% Polish capital” – 92.9% answers. Only 3% of companies are wholly owned by foreign capital and this group is dominated by service companies. Other respondents were entities with mixed capital.

Diagram 1. Organisational and legal setup of companies broken down by sectors of activity

Diagram 2. How companies included in the study started

Diagram 3. Capital structure of studied companies
4. Questionnaire survey analysis

The majority of companies are small businesses employing between 10 and 49 people. They represent 56% in the population covered by the study. The share of micro businesses was 24%, medium sized companies – 15%, and big companies – 4.8%. Detailed structure of employment broken down by activity sectors is presented on Diagram 4.

For the objectives of the project it is also important to analyse companies included in the study from the point of view of the share of women in their employment. Detailed distribution of answers given by companies to the question concerning the involvement of women is presented in Table 5.

Table 5. No. of employed women

<table>
<thead>
<tr>
<th>Size</th>
<th>Sector of activity</th>
<th>manufacturing companies</th>
<th>service companies</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 5</td>
<td></td>
<td>34.8%</td>
<td>45.5%</td>
<td>38.0%</td>
</tr>
<tr>
<td>5-25</td>
<td></td>
<td>48.6%</td>
<td>35.5%</td>
<td>45.5%</td>
</tr>
<tr>
<td>26-100</td>
<td></td>
<td>14.3%</td>
<td>11.9%</td>
<td>13.5%</td>
</tr>
<tr>
<td>more than 100</td>
<td></td>
<td>2.5%</td>
<td>4.2%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: own study

Next surveyed variable was the scope of economic operations pursued by operators included in the study. Most entities operate regionally – 87.8%, with 73.8% operating nationally. European scale of operations was declared by 41%, and 12.8% companies selected global market in their answers. International operations are declared predominantly by manufacturing companies, which can be noticed on the following four diagrams.
Considering the sector of activities pursued by businesses included in the study, the scope of operations significantly varies. Service companies most often offer their services regionally and domestically. Only 10% from this group declare international operations. For manufacturing companies the picture is different as they operate at a larger scale, mostly on the European market (over 51% respondents).

### 3.2 Investment potential of analysed companies

Subsequent questions were designed to identify investment potential of analysed companies. Respondents were asked to specify the importance of innovations for their growth. Clear majority of business people stated they were important (49.1%) and very important (30.3%). Negative answer to this question was given by 7.5% respondents. Thus it seems that there is a dependence between the sector in which a business operates and the importance of innovations for its growth. The dependence is not very strong ($r=0.123$) but it is statistically significant ($p=0.05$). Diagram 9 shows the distribution of answers broken down by sector of activity (manufacturing, services).
4. Questionnaire survey analysis

Out of the total population of respondents in the study, ca. 69.2% had no investment plan (programme), and the sector in which a given company operates is rather irrelevant in this case. Those who had plans were asked to specify them by selecting three answers the most important to them in a ranking order (1 – the most important, 2 – very important, 3 – important). Most of manufacturing companies selected diversification of production by the introduction of new products as the most important objective of their investment plans (71.4%). Other answers mentioned substantial modifications of manufacturing process, expansion of a company (branches, affiliates) and new areas of operation. Service companies considered production diversification with new products, company’s expansion and new areas of activities the most important. Detailed responses to this question are presented in Table 6.

Table 6. Investment plans

<table>
<thead>
<tr>
<th>Goal</th>
<th>manufacturing companies (in %)</th>
<th>service companies (in %)</th>
<th>Total (w %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company’s expansion – affiliates, branches</td>
<td>45.2%</td>
<td>60.0%</td>
<td>49.6%</td>
</tr>
<tr>
<td>Production diversification – introduction of new products</td>
<td>76.3%</td>
<td>60.0%</td>
<td>71.4%</td>
</tr>
<tr>
<td>Substantial modifications of manufacturing process</td>
<td>58.1%</td>
<td>25.0%</td>
<td>48.1%</td>
</tr>
<tr>
<td>New activities</td>
<td>43.0%</td>
<td>57.5%</td>
<td>47.4%</td>
</tr>
<tr>
<td>Other</td>
<td>8.6%</td>
<td>20.0%</td>
<td>12.0%</td>
</tr>
</tbody>
</table>

Source: own study

The question concerning own R&D activities of the company received mainly negative answers (89%). Over half of companies (53%), which conduct R&D works employ not more than 5 people for these operations, mainly women (in the group “not more than 5 people” women account for 75%). Manufacturing companies prevail among companies which declare their own R&D activities, which is shown on Diagram 10.

Detailed analysis of the distribution of answers reveals that correlation between the sector and own R&D activity is statistically significant (v=0.10; p=0.03).

For most companies which conduct their own R&D works this is not a priority. The share of R&D expenditure in revenue from sales in 2011 was 0–4% (66% of responses), 10.6% companies spend on R&D more than 15% of their revenue. Detailed answers of business community are presented in Diagram 11.

Diagram 10. Does a company conduct its own research and development activity (R&D)

Diagram 11. Share of R&D expenditure in revenue from sales in 2011

Source: own study
Respondents were also asked about the implementation of all sorts of innovations in the years 2009-2011. Product innovations were implemented by a half of companies (50.4%), most of them from the manufacturing sector. Correlation analysis confirms differences resulting from types of operations pursued by companies included in the study and their propensity to implement product innovations ($v=0.188$; $p=0.000$). Manufacturing companies implement product innovations more often than service companies.

Ca. 40.2% of companies implemented process innovations, 41.3% - organisational and 31.7% marketing innovations. Process innovations prevail in manufacturing companies while the other two types in service companies. Differences in the implementation of concrete types of innovations are sector-specific and typical for the type of activities. Diagrams 13,14 and 15 show the distribution of answers for analysed variables.

For process and organisational innovations correlation analysis did not confirm any statistically significant dependences. Differences were significant for marketing innovations, more often implemented by service companies ($v=0.116$; $p=0.014$).

In case of product innovations, 55.3% respondents decided they were new at company level. Other most popular answers were: new on national market (22.1%), and new on international market (14.5%). Other types of innovations were in their majority referred to as new at company level, e.g. process (72.3%), organisational (84.3%), and marketing innovations (64.2%). No clear differences were observed in responses to the question by companies representing various sectors. The only exception are marketing innovations which manufacturing companies more frequently referred to as "new on international market".

![Diagram 12. Did your company implement product innovations in 2009-2011](source)

![Diagram 13. Did your company implement process innovations in 2009-2011](source)

![Diagram 14. Did your company implement organisational innovations in 2009-2011](source)

![Diagram 15. Did your company implement marketing innovations in 2009-2011](source)
Respondents were also asked about the turnover generated by innovations implemented in the company in 2011. 76.6% of studied companies ticked the answer "up to 20%" and no sector-specific differences were observed.

Next question related to where the ideas for new products, processes, organisational and marketing changes in a company originated from. Here operators could choose three the most important sources, identifying them as 1 – the most important, 2 – very important, and 3 – important. Respondents most often opted for "own ideas and resources (R&D works, etc.)" (88.6%). The next most popular answers were "copying solutions of others" (48.2%), and "purchase of a licence, patent, know-how" (12.4%), with the last answer prevailing among service companies (18.9% against 9.7%). The least often companies declared they took over a company with innovations – only 1.5% responses. Detailed answers are included in Table 7.

Table 7. Where do ideas for new products, processes, organisational and marketing changes in a company originate from

<table>
<thead>
<tr>
<th>Source</th>
<th>manufacturing companies (in %)</th>
<th>service companies (in %)</th>
<th>Total (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own ideas and resources (R&amp;D works, etc.)</td>
<td>89.2%</td>
<td>97.7%</td>
<td>88.6%</td>
</tr>
<tr>
<td>Copying solutions of others</td>
<td>47.3%</td>
<td>50.0%</td>
<td>48.2%</td>
</tr>
<tr>
<td>Hiring specialist(s) (experts, researchers)</td>
<td>20.1%</td>
<td>18.9%</td>
<td>19.7%</td>
</tr>
<tr>
<td>Purchase of a licence, patent, know-how</td>
<td>19.7%</td>
<td>18.2%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Taking over a company with innovations</td>
<td>1.1%</td>
<td>2.3%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Co-generation with other companies</td>
<td>20.1%</td>
<td>15.9%</td>
<td>18.7%</td>
</tr>
<tr>
<td>Co-generation with research institutions or universities</td>
<td>8.2%</td>
<td>2.3%</td>
<td>6.3%</td>
</tr>
<tr>
<td>Cooperation with companies which own innovations</td>
<td>11.1%</td>
<td>15.2%</td>
<td>12.4%</td>
</tr>
<tr>
<td>Other</td>
<td>2.2%</td>
<td>3.0%</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

Source: own study

Product innovations are important and very important mostly for manufacturing companies, 33.1% and 48.7% respectively (for service companies: 29.9% and 28.5% answers). Almost half respondents, independently of the sector in which they operate, claimed process (40.3%) and organisational (46.8%) innovations were important for their interests. Marketing innovations, in turn, are of no importance for 28.2% companies (30.8% manufacturing and 23% service companies), but they are more important for the service sector, which is illustrated on Diagram 17.
Companies finance innovation outlays (they could select three the most important sources) mostly from retained profit (58.4%), partners’ contributions (44.2%), and bank loans (43.2%). They rarely issue bonds (0.5%) or shares (2.6%), and use venture capital funds or business angels (1.0%). Differences in sources of funding for innovation activities between sectors are slightly visible, which is reflected in Table 9.

High costs of developing and implementing innovations are, in the opinion of business community, important factors that hinder innovation activities (three the most important barriers could be identified), which were highlighted in as many as 82.2% of answers given by both manufacturing and service sector. Almost one third of companies covered by the survey decided that the lack of adequately skilled personnel and insufficient technology base are barriers to innovativeness and the first was more important for service companies (38.1% compared to 26.1%). Detailed analysis of barriers to funding innovations is presented in Table 10.

5. Conclusions

Innovation activities in companies in Poland face numerous barriers resulting from both internal factors relating to the company and external circumstances in the surrounding environment. Lack of financial resources for the implementation of innovations is the top ranking barrier. The following are also mentioned:

- market barriers connected with regional demand fluctuations, in particular with its reduction or strong competition from local and international companies,
- barriers connected with production and production factors (little innovative equipment, limited capacity, inappropriate management), employment (lack of appropriate skills and motivation among workers, incorrect labour market policy), and technical infrastructure (too little space representing too high exploitation cost),
- barriers connected with access to information, e.g. legal, economic, technological as well as access to business services that support innovation activities.

At present, innovation policy of the state and efficient innovation environment, which should offer a wide range of services to support innovation potential in companies and take care of their needs, are of vital importance for innovation activities of companies. Services promoting innovation should instigate absorption of innovation by improving access to knowledge through initiating contacts between science and business, developing technology implementation strategy, ensuring funding for the implementation and dissemination of innovation, improving subsidies schemes, and creating additional incentives for companies to invest in innovations.


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1. Introduction

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. 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. 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. 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

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. The aftereffects of the partnership can be for the reinforcement of partners’ competitive position, access to the latest knowledge and scientific information, or development of partners’ resources etc. 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. 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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.

References:
112 The partner of project is a team of scientists at the University of Manchester
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-use solutions as something better 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 diversified forms – for example:

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”.

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

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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 academics 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)\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 [online], 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”


\textsuperscript{121} Gestrelius S., Birck A., Cross Border Research and Innovation in Medicon Valle, Medicon Valley Academy, Lund 2004, pp. 1-4
Poland concentrates on any activities tending to increase scientists and entrepreneurs’ awareness in the scope of knowledge transfer, i.e. 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 academy 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 purposes124.

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 advantage125.

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.

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 and educational materials;
• 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.

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). 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 and technical and organizational innovations.

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:

• 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:

• 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:

• 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 “System transferu technologii i komercjalizacji wiedzy w Polsce – Sily 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.

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
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”
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.16

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.17

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 a product into the market and generate commercialization-related profits.18

4. Business-science cooperation in Poland in view of the hitherto studies

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.19

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.20

16 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”


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

19 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”

20
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 1. Structure of the surveyed enterprises by establishment date

**Source:** own elaboration

35%
30%
25%
20%
15%
10%
5%
0%


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

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.

92
93
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>20.4%</td>
</tr>
<tr>
<td>Organizational</td>
<td>41.3%</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.

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

<table>
<thead>
<tr>
<th>Source</th>
<th>% of indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on own ideas and resources (R&amp;D works etc.)</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>76.0%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>10.4%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>9.4%</td>
</tr>
<tr>
<td>Taking over an enterprise having innovations implemented</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>7.0%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>1.0%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>0.0%</td>
</tr>
<tr>
<td>Copying other solutions</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>6.0%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>42.5%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>24.4%</td>
</tr>
<tr>
<td>Co-creation with other enterprises</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>4.3%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>13.4%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>13.3%</td>
</tr>
<tr>
<td>Hiring specialists (experts/scientists)</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>3.6%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>13.1%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>13.0%</td>
</tr>
<tr>
<td>Cooperation with enterprises having innovations implemented</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>3.1%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>5.8%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>11.1%</td>
</tr>
<tr>
<td>Purchase of license, patent or knowledge</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>1.9%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>8.1%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>10.0%</td>
</tr>
<tr>
<td>Co-creation with research and higher education institutions</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>1.6%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>2.9%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>7.2%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>1.0%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>1.3%</td>
</tr>
<tr>
<td>3rd answer</td>
<td>1.1%</td>
</tr>
<tr>
<td>&quot;often&quot;</td>
<td></td>
</tr>
<tr>
<td>1st answer</td>
<td>24.0%</td>
</tr>
<tr>
<td>2nd answer</td>
<td>76.0%</td>
</tr>
</tbody>
</table>

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

<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>20.9%</td>
<td>91.3%</td>
<td>69.8%</td>
<td>2.8%</td>
</tr>
<tr>
<td>JBB</td>
<td>4.9%</td>
<td>7.0%</td>
<td>82.7%</td>
<td>31.2%</td>
<td>7.4%</td>
</tr>
<tr>
<td>industrial research institutes</td>
<td>4.4%</td>
<td>4.6%</td>
<td>41.1%</td>
<td>84.3%</td>
<td>2.9%</td>
</tr>
<tr>
<td>science foundations</td>
<td>0.3%</td>
<td>1.1%</td>
<td>2.4%</td>
<td>93.9%</td>
<td>3.1%</td>
</tr>
<tr>
<td>technology parks</td>
<td>0.3%</td>
<td>2.7%</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>2.4%</td>
<td>94.2%</td>
<td>3.1%</td>
</tr>
<tr>
<td>technology transfer centers</td>
<td>0.0%</td>
<td>0.6%</td>
<td>0.8%</td>
<td>95.3%</td>
<td>3.1%</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 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 town 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).

### 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 (enterprises/ R&amp;D entities/ technology transfer entities)</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>0,5%</td>
<td></td>
</tr>
<tr>
<td>Ordering to conduct research by university/ R&amp;D entity for an enterprise</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>2,5%</td>
<td>2,7%</td>
<td>2,1%</td>
</tr>
<tr>
<td>Using university laboratories by an enterprise</td>
<td>0,8%</td>
<td>3,5%</td>
<td>2,1%</td>
</tr>
<tr>
<td>Staff participation in academic procedures at university</td>
<td>0,8%</td>
<td>1,9%</td>
<td>0,7%</td>
</tr>
<tr>
<td>Licence agreement</td>
<td>0,6%</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>

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).

### Table 6. Main reasons of offer inadequacy

<table>
<thead>
<tr>
<th>Reason</th>
<th>1st answer</th>
<th>2nd answer</th>
<th>3rd answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>An enterprises 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>26,3%</td>
<td>13,5%</td>
<td>9,5%</td>
</tr>
<tr>
<td>Suggested solutions are too expensive</td>
<td>13,4%</td>
<td>13,4%</td>
<td>7,1%</td>
</tr>
<tr>
<td>Implementation of the suggested solutions is too time-consuming</td>
<td>10,9%</td>
<td>10,8%</td>
<td>8,3%</td>
</tr>
<tr>
<td>An offer is not detailed enough</td>
<td>1,6%</td>
<td>13,4%</td>
<td>5,6%</td>
</tr>
<tr>
<td>Suggested solutions are not innovative enough for an enterprise</td>
<td>1,6%</td>
<td>5,9%</td>
<td>10,1%</td>
</tr>
</tbody>
</table>

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 7. Benefits from business-science cooperation

<table>
<thead>
<tr>
<th>Benefit</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>12,1%</td>
<td>9,0%</td>
</tr>
<tr>
<td>Access to the latest expert knowledge</td>
<td>17,5%</td>
<td>12,7%</td>
<td>4,5%</td>
</tr>
<tr>
<td>Competitiveness growth</td>
<td>12,0%</td>
<td>13,6%</td>
<td>13,0%</td>
</tr>
<tr>
<td>Possibilities of cost reduction through efficiency growth</td>
<td>6,7%</td>
<td>11,8%</td>
<td>9,0%</td>
</tr>
<tr>
<td>Opportunities of own HR development</td>
<td>6,1%</td>
<td>5,5%</td>
<td>8,5%</td>
</tr>
<tr>
<td>Enterprise prestige growth</td>
<td>4,5%</td>
<td>7,1%</td>
<td>8,5%</td>
</tr>
<tr>
<td>Acquiring new clients and/ or markets</td>
<td>3,7%</td>
<td>8,2%</td>
<td>12,4%</td>
</tr>
<tr>
<td>Export-led growth</td>
<td>6,9%</td>
<td>6,9%</td>
<td>6,2%</td>
</tr>
</tbody>
</table>
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?

<table>
<thead>
<tr>
<th>Source: own elaboration</th>
<th>1st answer</th>
<th>2nd answer</th>
<th>3rd answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>We stay at present level of cooperation</td>
<td>39,9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, by increasing area of cooperation</td>
<td>11,4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No, by restricting number of partners</td>
<td>11,4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, by increasing number of partners</td>
<td>7,4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No, by restricting area of cooperation</td>
<td>7,0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9. Intended form of cooperation

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

7. Cooperation with science

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.
8. References

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