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INNOVATION ACTIVITIES IN POLAND

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Abstract
The success of accompany on a competitive market depends on its ability to adapt to the continuous changes in the environment A conviction of that implementation of innovation is most increasingly reflected in the activities of Polish companies. This article analyses the level of innovation in the Polish economy, as well as the situation of companies operating in Poland.

Keywords: technological innovation, gained knowledge, strategy of the company.

JEL Classification: D83, D82.

Introduction

The change is the foundation for the company development, it is inevitable and unavoidable. Companies should be innovative to respond to

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the changes in the market, adapt to the customers' requirements and be competitive. Ch. Freeman said: "not to introduce innovations means dying" (Freeman Ch., 1982).

Through innovation, the company can create new consumer needs. Innovation is an essential condition for increasing the attractiveness of goods and services, which entails the development of the market and export, and thus determines the company's position in the environment.

The essence of innovation

The term 'innovation' is understood broadly. Innovation is defined by economists, researchers and scientists. Innovation is commonly understood as something new and different from past practices, it is associated with the change for the better. The concept of innovation was introduced in economic sciences in 1911 by Joseph Schumpeter and his definition of innovation is regarded as a classic.

According to Schumpeter, innovation is the introduction of new solutions to the practice leading to the emergence of more and more efficient economic structures. Technological innovation was primarily the subject of his considerations.

J. Schumpeter approached the concept of innovation in five cases (Schumpeter J., 1960):

a) introducing a new product unknown to the consumers or a new brand of a commodity;

b) introduction of new production methods that have not been yet applied in practice in the industry;

c) opening a new market to which a certain type of the production was not previously introduced;

d) acquiring a new source of raw materials or semi-finished products, regardless of whether the source has already been there, or has to be created;

e) carrying out new organization of some industry, for example, a monopoly or breaking it.

The interest in the problems of innovation has evolved over the years along with the changes in the global economy. During the 80-s and

90-s of the twentieth century, when there was intensive development of services, the scope of the concept of innovation significantly widened.

Contemporary definitions of innovation can be interpreted in a broad or narrow sense. Innovation in a broad sense means any change in production involving the assimilation of the gained knowledge, while innovation in a strictly defined sense means a change in manufacturing methods and products (in the organization of the production process). The group of authors' interpretative innovation in broad terms are: J. Schumpeter, AJ Harm, E. Hagen, J. Parker, P.R. Whitfield, P. Drucker. Innovation in narrower sense is defined by such authors as: S. Kuznets, Ch. Freeman, E. Mansfield (Kozioł K., 2007).

Sources and determinants of innovation

Sources of innovation can be considered at the macro-, meso- or micro economic levels. All knowledge and information which initiate innovative activities of enterprises, encourage the development of innovation in the region or state and play an important role in innovation processes taking place in the economy (Wysokińska Z., 2004).

A traditional division of sources of innovation leads to identifying the following types of innovation:

a) from the perspective of an individual country:

- internal: its own scientific research and inventive activities
- external: licenses, know-how, import of modern machinery and equipment, common scientific and production projects

b) from the perspective of enterprise an enterprise:

- internal: activity in the field of R & D, carrying marketing research of domestic and foreign market, stimulating the creativity of employees and management;
- external: scientific research of universities, advice given by consultancy firms banchmarking, fairs and exhibitions, the transfer of employees.

Peter F. Drucker distinguished seven sources of opportunities for innovation (Drucker P., 1992):

a) In an organization or industry:

- Unexpected success, unexpected failure, and unexpected external event;
- Clash between reality and expectations;
- Innovation resulting from the need to process;
- Changes in the industry structure or market structure;

b) On the surroundings of an organization or industry:

- Demography (changes in the population);
- Changes in perception, moods and values;
- New knowledge.

Robert D. Hisrich and Michael P. Peters suggest five sources of new ideas (Niedzielski P., Markiewicz J., Rychlik K., Rzewuski T.,2007):

- Consumers;
- Existing businesses;
- Distribution channels;
- Government decisions;
- Research and development.

Innovative activity is dependent on many factors. The literature describes a number of different models of circumstances. In general, these are models with a selective approach to the issue. They refer to external and internal factors. The subjects are more likely to impact on internal factors.

From the point of view of an economic subject, one can distinguish between four groups of factors affecting the innovative companies:

- Environmental factors;

- Organizational systems;
- Social influence;
- Psychological conditionings.

Innovation processes must be properly managed and closely related to the mission and strategy of the company and driven by the market and technological progress, and the company must become an intelligent organization, learning, in which knowledge and ideas are treated as strategic resources (Otto J., Stanisławski R., Maciaszczyk A., 2007).

Companies can not be content with occasional introduction of innovation, but must create a long-term framework for various activities fostering innovation and the appropriate organizational culture facilitating the implementation of new products. Successful innovation is not usually achieved by individuals or departments, but by the company as a whole.

Assumptions of the innovative economy

At its heart there are mutual relations in the cycle of innovation processes, the centre of which is an enterprise and its needs (see Figure 1). Innovations are reflected in the introduction of new products and services in enterprises, so the cycle of actions concerns the enterprise and its immediate surroundings. The first axis – Human resources for a modern economy – includes actions connected with the development of human resources capable of developing the knowledge-based economy. The human beings and their acceptance of novelties, as well as their creativity, constitute the key to development through innovation (Kierunki zwiększania innowacyjności gospodarki na lata 2007-2013, 2006)

The second direction - research activity is oriented to the needs of the economy. The results of positive tests should be completed in turn covered by legal protection. Important for developing modern knowledge-based economy is the protection of intellectual property, whose role was emphasized in the third line of action. The next step in the process of innovation is to get capital, supporting the projects.

The second axis – research activity–aimes at satisfying the needs of the economy. The results of positively completed research should then gain legal protection, so the protection of intellectual property plays a significant

role in the development of a modern knowledge economy, a fact that has been emphasised in the third axis. The next stage of the innovation process is the procedure whereby funding for the implementation of initiatives is obtained. The capital for innovation is then the fourth axis. This is extremely important, as the lack of financial means constitutes one of the main barriers to the implementation of innovation, and consequently results in a low level of innovation performance on the part of the Polish economy. (Kierunki zwiększania innowacyjności gospodarki na lata 2007-2013, 2006)

Infrastructure for innovation constitutes the basis, as well as the background, for the implementation of axes established previously. It provides training, consulting and access to new information technologies, as well as facilitates co-operation between entrepreneurs, increases co-operation between the R+D sector and the economy, and the transfer of new technologies and organisational solutions. The country's institutional and legal system and the infrastructure for innovation constitute the key elements of the National Innovation System. They specify the conditions which need to be fulfilled if there is to be efficient implementation of all the specified strategic areas, including the mechanisms for the co-ordination and implementation of the innovation policy provided by public institutions. (Kierunki zwiększania innowacyjności gospodarki na lata 2007-2013, 2006)

Innovativeness of Polish economy

Innovativeness of the Polish economy and Polish companies measured by various standard indicators such as the amount of investment in R & D, the number of innovative companies, the number of patents, the share of export of high-tech goods etc., is relatively low.

Although the economy of Poland does not qualify for the knowledge-based economies (GOW, knowledge-based economy), it did not reach a minimum level of the development of the sectors - media GOW28 - it should be pointed out that the high dynamics of development processes prove its significant potential.

Among the factors determining the level of innovation of the Polish economy there are the low level of employment in sectors which are the carriers of GOW (9.3% 29 in 2000) - significantly lower than in many EU Member States, one of the lowest participation rates of spendings on R & D

in the EU, insufficient economic and scientific cooperation, low number of implementations of new technologies and low number of new businesses created on the basis of new technologies (Przedsiębiorczość w Polsce w 2007, 2007)

According to the European Innovation Scoreboard 2006, the level of innovation in the Polish economy went up. Poland was promoted from the group of "losing ground" countries (loosing ground) to the group of catching up countries, which are among others, The Czech Republic, Lithuania, Latvia, Portugal, Greece, Slovenia and Bulgaria. This group is characterized by particularly high rate of imaging the dynamics of aggregate level of innovation - Summary Innovation Index (SII).

In the case of Poland, improvement was observed in 16 out of 25 SII sub-indexes, that is:

- more than 3-fold increase in the "Number of fixed links online (with capacity of at least 144 Kbit / s) per 100 inhabitants: from 0.5 to 1.9;
- more than 4-fold increase in the "Participation (%) of enterprises receiving public assistance with innovation in the total number of enterprises" of 0.7 to 3.1;
- more than 2-fold increase in the "Participation (%) of the sale of new or upgraded products for the market in total sales of enterprises": from 3.4 to 8.1;
- 3-fold increase in the "Number of patents granted by U.S. PTO per one million inhabitants: from 0.4 to 1.2;
- 5-fold increase in the "Number of new community industrial designs per one million of inhabitants: from 5.2 to 25.

Based on the European Innovation Scoreboard (EIS) 2008, Poland, like in previous years, was included in the group of catching up countries, characterized by the Summary Innovation Index (SII Summary Innovation Index) lower than the European Union average but higher than the EU average growth of this indicator. (see Figure 2). In the group of catching up countries Poland is placed a position behind Malta, Hungary and Slovakia

and before Lithuania, Romania, Latvia and Bulgaria. (EUROPEAN INNOVATION SCOREBOARD 2008, 2009)

Malta, Hungary, Slovakia, Poland, Lithuania, Romania, Latvia and Bulgaria are the catching-up countries with innovation performance well below the EU average. All of these countries have been catching up, with the exception of Lithuania. Bulgaria and Romania have been improving their performance the fastest.

Despite the low overall level of Innovation Index (SII) in Poland, the rate of increase of this ratio is higher than the EU average. Figure 3 illustrates this. The vertical axis represents the absolute value of overall Innovation Index (SII) in 2008, while the horizontal axis - the average annual growth rate of this indicator.

Compared to the previous report of the European Innovation Scoreboard (EIS) 2008, it should be noted that the following indicators have improved in Poland:

- Increase in the "student share per 100 inhabitants (in % of the population aged 25-64 years from 4.7 to 5.1,
- Increase in the "Venture capital as % of GDP" (Venture capital as % of GDP) from 0.001 to 0.017,
- Increase in the "innovations introduced in small and medium-sized enterprises (SMEs) '(SMEs innovating in-house) from 13.8 to 17.2,
- Increase in the "Number of new community trademarks per one million population" (Community trademarks per one million population) from 24.7 to 33.2.

As outlined in the European Innovation Scoreboard (EIS) 2008 in the last 5 years, a major condition of improving the level of innovation in Poland included mainly the following factors (see Table 1):

- The groups "Human Resources" in particular the increase in the number of persons having a doctoral degree in Science and Engineering and Social Sciences and Humanities per 1000 inhabitants aged 25 -- 34 years) from 0.53% in 2001 to 0.86% in 2006
- Groups of indicators related to the protection of intellectual property, referred to as "Throughputs", in particular an increase in

the number of: patent applications in the European Patent Office (European Patent Office - EPO) per one million population from 1.5 in 2001 to 3.1 in 2006, the new community trademarks per one million population "(Community trademarks per one million population) from 0.2 in 2001 to 33.2 in 2006, and the new community industrial designs per one million population" (Community industrial designs per one million population) from 2.0 in 2002 to 45.5 in 2007

It should be noted that in comparison with the other EU Member States, the Polish economy has developed very rapidly (over the last 4 years Poland noted the regular annual growth of the value of aggregate SII), however in terms of value of the SII index takes Poland penultimate place among the countries under study.

Although Polish economy developed rapidly compared to the "EU-15", it still has, in terms of SII rate, penultimate place among the countries under study. The significant gap between the level of innovation of the Polish economy and economy of developed countries shown by surveys carried out by the World Bank (The World Bank: Public financial support for commercial innovation, 2006)

World Bank's methodology for measuring the level of innovation of the economies in Europe and Central Asia is based on the Knowledge Assessment Methodology. The evaluation of the World Bank agrees to a large extent with the results obtained in a study conducted by the OECD. According to the Knowledge Assessment Methodology, Poland occupies the 26th place out of 31 countries under study (Przedsiębiorczość w Polsce w 2007, 2007)

R & D in Poland

The allocation of regional expenditure on R & D in Poland reflects the scientific and economic potential of each region. Large academic and industrial centers are characterized by high rates of R & D, while the agricultural areas by the lowest. Moreover, in areas with the lowest rates of R & D, there is rapid aging of the population and low mobility, while the regions with the highest population rates are dominated by the young. (Chojnicki Z., Czyż T.)

One can notice a clear dominance of the Mazowieckie voivodship. Voivodships with the lowest expenditure on research and development in this respect per one inhabitant Swietokrzyskie, Opole and Lubusz (see Figure 4). This uneven distribution of research and development potential affects the limited access to high technology companies in less developed areas. This situation is particularly disadvantageous in light of the so-called spillover effect that is the spread of the added value created by R & D investment not only in the context of one person but also in the area of their socio-economic environment.

Consequently, this causes the enlargement of the gap between more developed regions and peripheral regions in the country. Poland economy, according to the criteria used in the world, is not innovative. The share of expenditure on research and development (R & D) in gross domestic product (GDP) ranges us in one of the last places in the European Union. (see Figure 5)

Poland is not a developing country based on research and development (see Table 2, Table 3, Table 4). It is demonstrated not only by the share of spending on R & D in GDP, but also by employment in R & R. Poland is the fourth from the end in the EU in terms of the number of workers employed in the field of R & D (excluding the Austria and Britain, for which Eurostat does not provide data). Behind Poland there are only Cyprus, Bulgaria and Romania. (see Figure 6)

Analyzing these two indicators, EU countries can be divided into those that have a strategy for building a competitive position on innovation created primarily on the basis of its own R & D facilities (such as Luxembourg, Germany, Finland, Sweden) and those in which the effects of the use of purchased research results play an important role (such as Portugal, and most of new EU Member States) (Starczewska-Krzysztoszek M., 2008)

In Poland, relatively few employees are employed in the area of R & D (public and private). Furthermore, expenditures on research and development represent a small proportion of gross domestic product. Poland does not support the creation of its own R & D back-end; expenditures on the purchase of innovative solutions are small.

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Innovations in Polish enterprises

Innovative companies in Poland are characterized by great diversity, which, among others, increases with the size of the company and depends on the industry in which the firm operates as well as the structure of ownership (big foreign companies have a relatively high level of innovation, but small domestic enterprises from low investment have few technical capabilities).

The innovation of enterprises positively affects and develops innovation across the entire economy, increasing its competitiveness and consequently leading to the growth in Gross Domestic Product (GDP). Simultaneously, the level of expenditure on R&D, which conditions the innovative character of enterprises is determinated by the global level of the country's affluence reflected in the GDP index (Kierunki zwiększania innowacyjności gospodarki na lata 2007-2013,2006)

According to the Central Statistical Office, innovative business activities include scientific (research), technical, organizational, financial and commercial (commercial) activities, whose purpose is to develop and implement new or significantly improved products and processes, but these products and new processes have to be considered new at least from the point of view of the company that introduces them.

Innovation activities may be conducted by the company itself in its own territory (inside the company, the so-called in-house innovation), or may involve the purchase of goods, services, including consulting services, or knowledge from external sources (sometimes referred to as the acquisition of external technology in the material or immaterial form).

An innovative company - as defined in the methodology of Oslo[1] - is a company that during the researched period (usually of three years) launded at least one technical innovation (a new or significantly improved product or a new or significantly improved process).

An innovative company combines three key elements: it creates a new idea, implements it in practice, and finances its performance. An

[1] Oslo Methodology - Methodological guidelines for surveys of technical innovation in enterprises (Business Enterprise Sector) were published in an international handbook of methodology, called the Oslo Manual. It is a widely accepted international standard methodology currently used in all countries engaged in innovation surveys.

innovative company can also be described as the company that is able and willing to continuously search for and use in practice the results of scientific research, new concepts, ideas or inventions. The innovative company creates, absorbs and uses new products or services, and is also prepared to continuously adapt to changes in the environment.

Looking at an innovative company in a more tangible way, it can be assumed that this is an organization that:

- conducts a wide range of research and development, or buys new products or technologies;
- spends a relatively high amount of money on this activity, systematically implements new scientific and technological ideas;
- represents a large potential for new products and technology products in the volume of production and services;
- constantly introduces innovations on the market.

In the years 2002-2004 innovative enterprises constituted 42% of all enterprises in the European Union (EU-27). In Germany 65% of all companies, in Austria - 53%, whereas in Denmark, Luxembourg and Ireland 52%, while in Poland, the share of innovative enterprises was and still is lower by half. They represent only 25% of all businesses [Eurostat, 2007, GUS, 2008]. 52% of companies operating in Poland are building their competitive position, on the basis of the price, and only 0.2% - offering innovative products and services. The tendency of the companies to introduce new solutions to the practice (such as the use of advanced manufacturing technology, modern management methods, expertise and skills, improving the quality of products and services) increases, but the scale of innovation is still low. (Starczewska-Krzysztoszek M., 2008)

Empirical data show that innovativeness of companies is closely correlated to their size, i.e. to the increase in the size of the growing share of innovative enterprises in the group entities. Causes light to be found in a far better the availability of financial and human capital among the large entities.

In the years 2002-2004, 67% of large units, employing more than 249 workers, were innovative, while among small enterprises this share was of 17.7%. (Przedsiębiorczość w Polsce w 2007, 2007) According to the

study of the services sector, smaller entities devote a substantial proportion of their expenditures (without taking into account the investment) to the so-called "soft" infrastructure of the innovation process that is marketing and training, while larger entities do the opposite.

Such a situation should be linked to the type of projects undertaken, which in the case of larger companies are much more costly. Polish enterprises, especially SMEs, indicate as one of the main reasons for the limited resources for innovation the difficulty to obtain financing for more risky activities (implementation of innovative solutions). (Jasiński, 2006)

This is mainly due the fact that innovative activities are usually funded by the firm. The market and private equity / venture capital (PE / VC), which could be an additional source of funding, is not specially-developed in Poland, and you can talk about the problem of the equity gap, that is the lack of funds making relatively small investments during the early stage of company development.

The reasons for which Polish companies decide to introduce innovation are mainly as follows: improvement of the quality of products, opening new markets or increasing market share, widening the range of products. Other studies show that customers` forcing innovation is an important factor which makes businessmen increase expenses on innovation processes in the company. Additional reasons are the needs to reduce costs, increase efficiency, meet requirements of domestic competition as well as a desire to be the best. Innovation can also be forced by competitors and suppliers.

An unsatisfactory state of innovation of Polish enterprises forced the government to take measures to promote innovative actions among enterprises. They are set out in the strategy paper entitled, "Guidelines for Increasing Innovation Economy in the years 2007-2013", which includes assessment of innovativeness of the Polish economy and recommends lines of action whose implementation will enable the development of the knowledge economy in Polish realities. The proposed actions should mostly affect the GOW sector, such as education, science and research, branches of industry so-called high technology, business services associated with GOW and information society services sector.

The document points out that, taking into account level of development and structure of the Polish economy, the appropriate strategy

for the Poland to catch up with GOW is the simultaneous implementation of four ways of development:

- use of new technologies to increase competitiveness of traditional sectors;
- creation of new businesses based on innovative solutions and the development of small and medium-sized enterprises through the use of modern technology and methods of knowledge management;
- stimulation of development of cooperation between firms and institutions in the business environment in terms of innovative activity;
- motivation of large companies to pursue and implement the results of research.

The strategic objective of the *Strategy for increasing the innovativeness of the economy* is defined as follows: the growth of the innovativeness of enterprises in order to maintain the fast development of the economy and to create new, better jobs**. (**Kierunki zwiększania innowacyjności gospodarki na lata 2007-2013, 2006)

This aim will be achieved by implementing the following guidelines:

1. Humans resources for a modern economy;
2. Research for the benefit of the economy;
3. Intellectual property for innovation;
4. Capital for innovation;
5. Infrastructure for innovation. The essence of the above-mentioned directions is the process of mutual cycle of innovation processes which focus on the company and its needs.

Strengthening of attitudes among the innovative entrepreneurs will be encouraged by:

- Improving the system of innovation management at the national level through the construction of long-term planning in terms of

innovation as well as improving institutional coordination in the creation and implementation of innovation policy;

- Strengthening a scientific and technological base by focusing public funding on institutions and organizations with the greatest potential for successful research;
- Developing a system of incentives for implementation of business research and development by businessmen;
- Promoting the protection of industrial property rights;
- Creating incentives for researchers to undertake further training and cooperation with business;
- Developing a network of innovation services (especially the National Network for Innovation);
- Supporting the development and dissemination of the idea of clusters` formation, technology platforms and other cooperative links between entrepreneurs and between enterprises and research units focused on developing innovativeness;
- Stimulating innovation through a wider use of information and communication technology (ICT) and investment in these technologies.

Summary

The basic condition for strengthening the innovative attitudes among entrepreneurs is an effective institutional system to ensure effective support tools for businesses and the sphere of scientific research which ensures the free transfer of knowledge. The development of innovation, however, will not be possible without a significant improvement in the conditions of economy.

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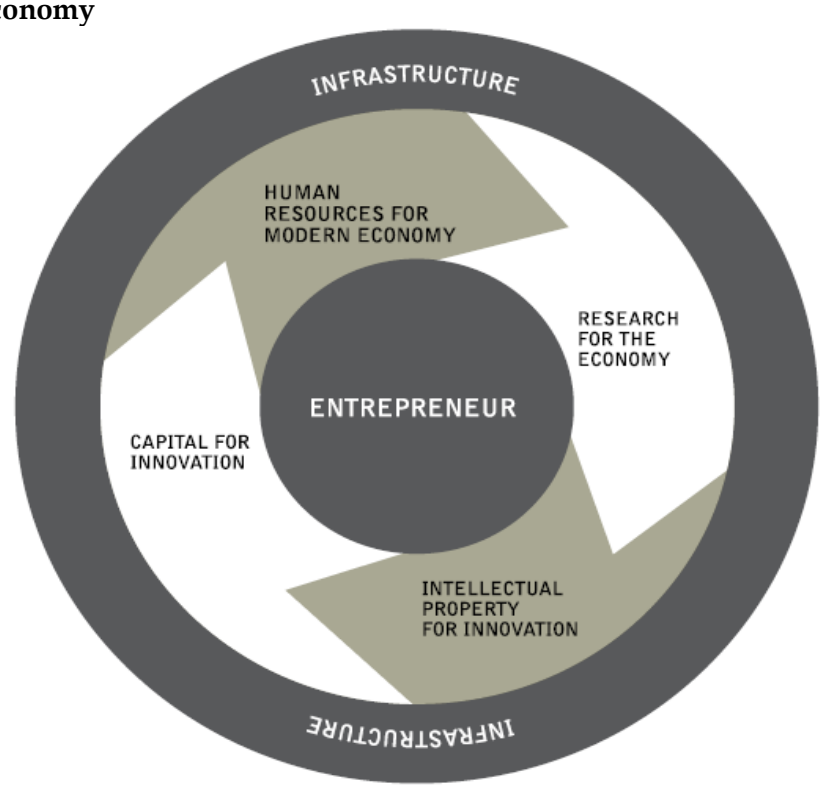
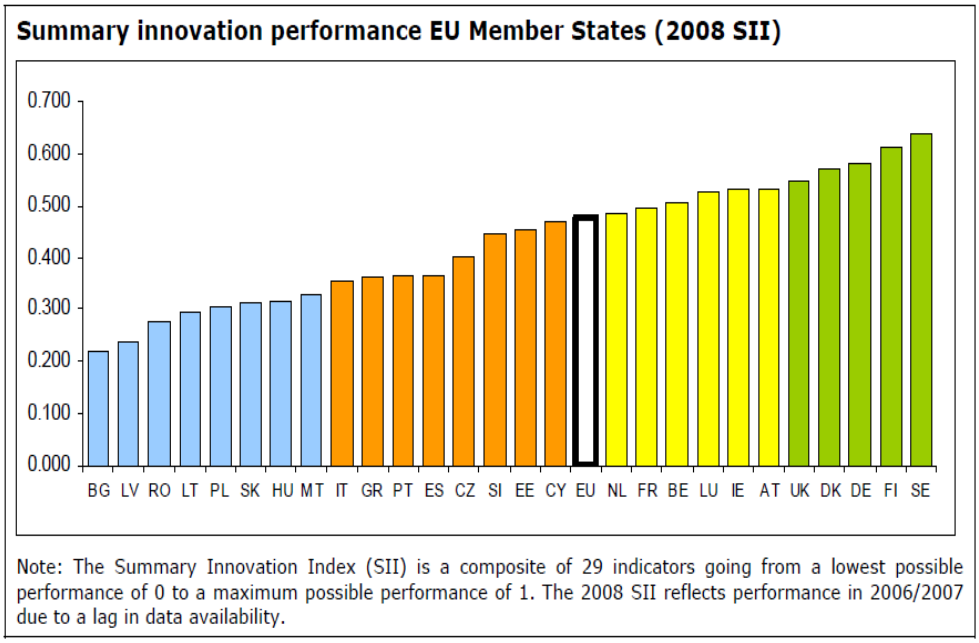
Figure 1. The structure of the axis aimed at increasing innovativeness of the economy



Source: Kierunki zwiększania innowacyjności gospodarki na lata 2007-2013, Ministerstwo Gospodarki, Warszawa 2006

Figure 2. The values of overall Innovation Index (Sumary Innovation Index - SII) for individual EU Member States



Source: EUROPEAN INNOVATION SCOREBOARD 2008, COMPARATIVE ANALYSIS OF INNOVATION PERFORMANCE, January 2009

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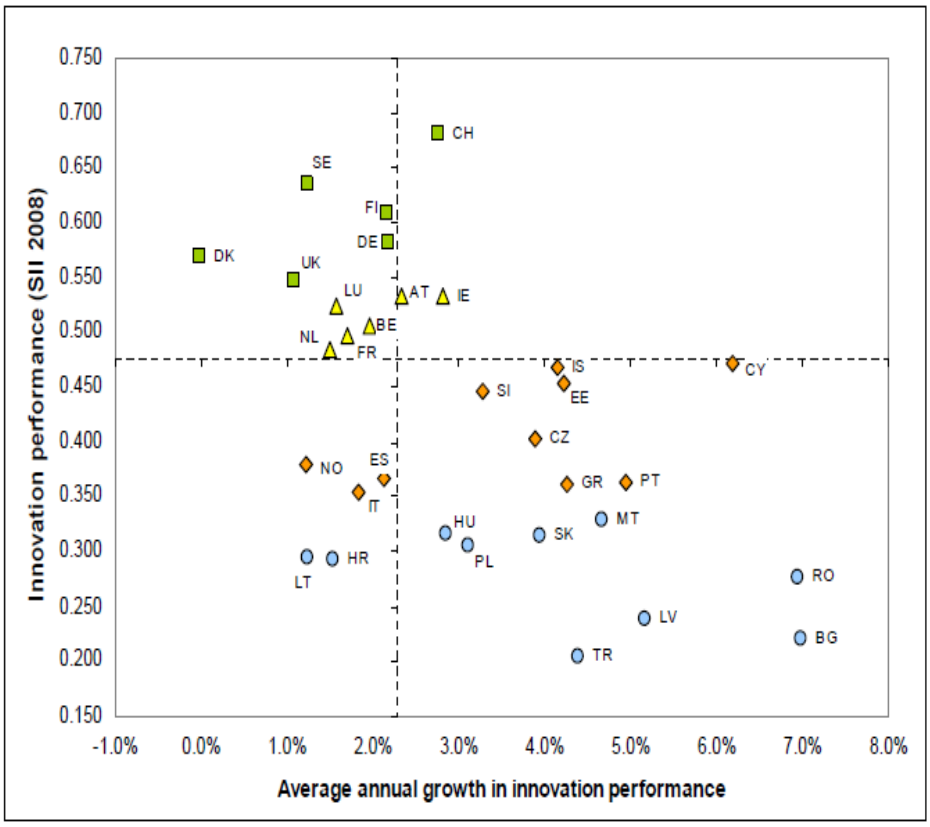
Figure 3. Convergence of innovation among Member States of the European Union by 2008 EIS



Colour coding matches the groups of countries identified in Section 3.1: green are the innovation leaders, yellow are the innovation followers, orange are the moderate innovators, blue are the catching-up countries. Average annual growth rates as calculated over a five-year period. The dotted lines show EU performance and growth.

Source: European Innovation Scoreboard 2008, Comparative Analysis of Innovation Performance, January 2009

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Table 1. Comparison of indicators of innovation for Poland and the enlarged European Union based on the EIS in 2008

	EIS dimension / indicator	Data source (reference year)2	Indicators for Poland	Indicators for EU-27
	ENABLERS			
	Human resources			
1.1.1	S&E and SSH graduates per 1000 population aged 20-29 (first stage of tertiary education)	Eurostat (2006)	52,9	40,3
1.1.2	S&E and SSH graduates per 1000 population aged 20-29 (first stage of tertiary education) Eurostat (2006)	Eurostat (2006)	0,86	1,11
1.1.3	Population with tertiary education per 100 population aged 25-64	Eurostat (2007)	18,7	23,5
1.1.4	Participation in life-long learning per 100 population aged 25-64	Eurostat (2007)	5,1	9,7
1.1.5	Youth education attainment level	Eurostat (2007)	91,6	78,1
	Finance and support			
1.2.1	Public R&D expenditures (% of GDP	Eurostat (2006)	0,38	0,65
1.2.2	Venture capital (% of GDP) EVCA)	EVCA / Eurostat (2007)	0,017	0,107
1.2.3	Private credits (% of GDP)	IMF (2007)	0,40	1,31
1.2.4	Broadband access by firms (% of firms)	Eurostat (2007)	53,0	77,0

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	Business investments			
2.1.1	2.1.1 Business R&D expenditures (% of GDP)	Eurostat (2006)	0,18	1,17
2.1.2	IT expenditures (% of GDP) EITO /	EITO / Eurostat (2006)	2,6	2,7
2.1.3	Non-R&D innovation expenditures (% of turnover)	Eurostat (2006)	1,03	1,03
	Linkages & entrepreneurship			
2.2.1	SMEs innovating in-house (% of SMEs	Eurostat (2006)	17,2	30,0
2.2.2	Innovative SMEs cooperating with others (% of SMEs)	Eurostat (2006)	9,3	9,5
2.2.3	Business renewal (SME entries plus exits) (% of SMEs)	Eurostat (2005)	-	5,1
2.2.4	Public-private co-publications per one million population	Thomson Reuters / CWTS (2006)	1,3	31,4
	***Throughputs*– Indexes of protection of intellectual property**			
2.3.1	EPO patents per one million population Eurostat	Eurostat (2005)	3,0	105,7
2.3.2	Community trademarks per one million population OHIM	OHIM / Eurostat (2007)	33,2	124,6
2.3.3	Community designs per one million population	OHIM / Eurostat (2007)	45,5	121,8
2.3.4	Technology Balance of Payments flows (% of GDP)	World Bank (2006)	0,40	1,07
OUTPUTS				
	Innovators			

3.1.1	SMEs introducing product or process innovations (% of SMEs)	Eurostat (2006)	20,4	33,7
3.1.2	SMEs introducing marketing or organisational innovations (% of SMEs)	Eurostat (2006)	29,1	40,0
3.1.3	Resource efficiency innovators, average of 2 indexes:		-	
	Share of innovators whose innovation has significantly reduced labour costs (% of firms)	Eurostat (2006)	13,8	18,0
	Share of innovators whose innovation has significantly reduced the use of materials and energy (% of firms)	Eurostat (2006)	11,6	9,6
	Economic effects			
3.2.1	Employment in medium-high & high-tech manufacturing (% of workforce)	Eurostat (2006)	5,50	6,69
3.2.2	Employment in knowledge-intensive services (% of workforce) Eurostat (2007)	Eurostat (2006)	10,33	14,51
3.2.3	Medium and high-tech manufacturing exports (% of total exports)	Eurostat (2006)	48,9	48,1
3.2.4	Knowledge-intensive services exports (% of total services exports)	Eurostat (2006)	27,9	48,7
3.2.5	New-to-market sales (% of turnover)	Eurostat (2006)	4,56	8,60
3.2.6	New-to-firm sales (% of turnover)	Eurostat (2006)	5,55	6,28

Source: EUROPEAN INNOVATION SCOREBOARD 2008, COMPARATIVE ANALYSIS OF INNOVATION PERFORMANCE, January 2009

Figure 4 Voivodship in Poland

Voivodships

- dolnośląskie
- kujawsko-pomorskie
- lubelskie
- lubuskie
- łódzkie
- małopolskie
- mazowieckie
- opolskie
- podkarpackie
- podlaskie
- pomorskie
- śląskie
- świętokrzyskie
- warmińsko-mazurskie
- wielkopolskie
- zachodniopomorskie

Source:: Central Statistical Office, http://www.stat.gov.pl/gus/5840_5961_PLK_HTML.htm

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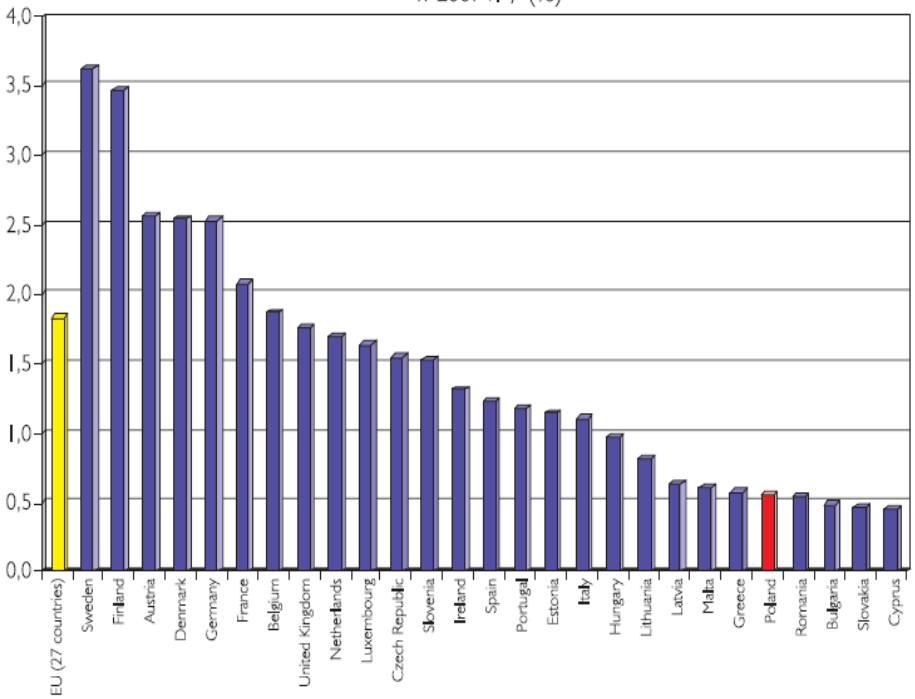
Figure 5 Share of R & D expenses in GDP in the EU-27 in 2007 (%)



(Poland and UK-2006, Italy-2005)
Source: Eurostat 2008

Table 2. Units in research and development activity in 1995, 2000-2007 as of 31 XII

Specification	1995	2000	2001	2002	2003	2004	2005	2006	2007
Total	**738**	**860**	**920**	**838**	**925**	**957**	**1097**	**1085**	**1144**
Scientific and research--developments units	**334**	**321**	**313**	**338**	**314**	**300**	**296**	**313**	**280**
Scientific units of Polish Academy of Sciences	**81**	**81**	**81**	**81**	**80**	**78**	**76**	**78**	**75**
scientific institutes	54	58	58	57	58	58	59	59	59
independent research departments	27	23	23	24	22	20	17	19	16
Branch research-development units	**218**	**222**	**215**	**211**	**201**	**197**	**194**	**190**	**180**
research institutes	128	137	136	139	135	135	133	132	127
central laboratories	10	11	11	10	8	7	8	8	6
research-development centres	80	74	68	62	58	55	53	50	47
Others	**35**	**18**	**17**	**46**	**33**	**25**	**26**	**45**	**25**
Science support units	**4**	**18**	**18**	**29**	**31**	**30**	**34**	**31**	**26**
Development units	**296**	**402**	**463**	**345**	**446**	**480**	**603**	**573**	**670**
Higher education institutions	**104**	**114**	**121**	**119**	**128**	**128**	**143**	**147**	**150**
Other units	**–**	**5**	**5**	**7**	**6**	**19**	**21**	**21**	**18**

Source: Science and Technology In Poland In 2007, Statistical Information And Elaborations, Central Statistical Office, Warsaw 2009

Table 3. Main research and development activity indicators in 1995, 2000–2007

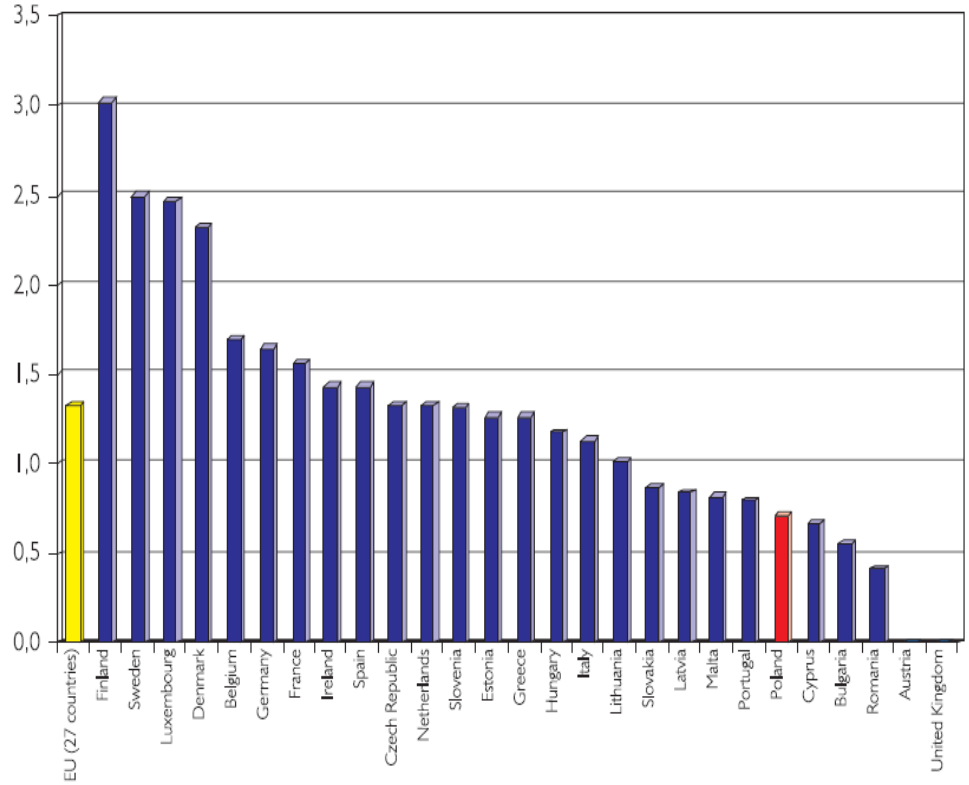
Specification	1995	2000	2001	2002	2003	2004	2005	2006	2007
Gross domestic expenditure on research and development activity (current prices)*	**2132,8**	**4796,1**	**4858,1**	**4522,1**	**4558,3**	**5155,4**	**5574,6**	**5892,8**	**6673,0**
ratio to gross domestic product (GERD/GDP) in %	0,63	0,64	0,64	0,58	0,56	0,56	0,57	0,56	0,57
per capita in zl	55	125	126	118	119	135	146	155	175
Employment in research and development activity									
per 1000 economically active persons**	4,9	4,6	4,5	4,5	4,5	4,6	4,4	4,3	4,6
of which researchers	2,9	3,2	3,3	3,3	3,4	3,6	3,6	3,5	3,6

**Excluding depreciation of fixed assets.*

*** Employment - in full-time equivalents, economically active persons (included employed and unemployed persons) - on the basis of the Labour Force Survey (LFS): in 1995 may, in 2000-2007 IV quarter.*

Source: Science And Technology In Poland In 2007, Statistical Information And Elaborations, Central Statistical Office, Warsaw 2009

Figure 6. The share of R & D employees in total employment in EU-27 in 2005 * / in (%)



* EU 27, Czeech Republic, Estonia, Ireland, Spain, Lithuania, Hungary, Malta, Poland, Romania, Slovenia, Slovakia, Finland-2006, Austria, UK-without data

Source: Eurostat 2008

Table 4 Employment in research and development activity in 2000, 2004-2007/HC data - as of 31 XII

Years	Total*	Of which full-time paid employees	Researchers*	
			total	of which women
2000	125614	116824	88189	33572
2004	127356	116779	96531	37594
2005	123431	113907	97875	38426
2006	121283	113842	96374	38065
2007	121623	112956	97289	38802

**Full-time and part-time paid employees without converting into full-time paid employees.*

Source: Science and Technology in Poland in 2007, Statistical Information And Elaborations, Central Statistical Office, Warsaw 2009.