Evolution of Priorities in Higher Education and R&D in the European Union: Case of Poland

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Abstract

After joining the European Union, many aspects of economic and social development are changing in Poland. Change is necessary in many areas, including the areas of research and education and their links to practice as it is broadly understood practice. Some areas seem neglected by the policy-makers. This article will refer to the question of "two cultures," showing the development priorities present in strategic Polish documents, with the focus mainly on research and higher education policies. It will comprise the following aspects: priority setting referring to "two cultures," identification of different sources of finance, expenditure on particular research areas in Poland, as well as the impact of the Europeanization process on the policy making.

Introduction

C.P. Snow's distinction of two cultures still inspires many academics and practitioners. [Snow C.P., 2007] Arts and humanities, or science, that is a question, one may paraphrase. However is this necessarily a real clash between those two? Are they rather two parts of one complexity? This complexity one may name "knowledge". Nowadays, the world is knowledge-based. In today's globalizing world, knowledge is the real factor of economic and social progress. It is perceived as a chance to sustain development for better developed countries or groups of entities or a chance to achieve better results for less developed ones. Knowledge can be accumulated in the form of human capital, more efficient capital goods, organizational methods, in innovative products or production techniques. [Soete L.; 2006].

Such understanding of knowledge and its forms led to formulation of many policies in different regions of the world. In Europe a new instrument was created—the Lisbon Strategy (revised in 2005) which aimed at strengthening the knowledge based economy and protecting the environment. The set of postulates referring to innovation, research and development, entrepreneurship, competitiveness and environmental protection was incorporated by all European Union Member States in their national policies.

The Lisbon goals also created a higher education area. The so-called Bologna Process, based on the method of open coordination, touches each university in the European Union. The process is deep-rooted in European tradition, history and identity.

Two processes, one aimed at creating the European Research Area (ERA) and another at the European Higher Education Area (EHEA), strongly influenced the choice of priorities in majority of European countries. The creation of those two areas is supported by legal and financial instruments, and each of them includes its own list of objectives. In order to be within a mainstream policy, the Member States (including the New Member States) have to balance and adjust the education and research priorities in their own countries to compliment those set up at the European level. The following section of the article will refer to the European Union solutions adopted in the higher education and research and development areas.

1. The European Union Context

1.1. European Higher Education Area and the Bologna Process

The European Union continuously integrates different policy areas, including education policy. That policy includes at least three aspects: one related to the knowledge, competences and skills gaining by each individual, the second related to labour market needs and the knowledge-based economy and the third related to the delivery of education as a public good and service.

In the 1990s one major problem started to dominate the EU economy: jobless growth. Besides, insufficient competences and skills of employees were identified as well as the relatively low level of entrepreneurship in some Member States when compared to some non-European countries. In order to answer to the problem of insufficient job creation and mobility of workers in Europe, legal and financial instruments were provided.

The answer in the sphere of higher education to the problems defined appeared in a form of the Bologna Declaration, in which the European Union states:

> **"**A Europe of Knowledge is now widely recognised as an irreplaceable factor for social and human growth and as an indispensable component to consolidate and enrich the European citizenship, capable of giving its citizens the necessary competences to face the challenges of the new millennium, together with an awareness of shared values and belonging to a common social and cultural space". [The Bologna Declaration, 1999]

From the legal point of view the higher education policy is only coordinated (as far as the main goals are set down) at the European level, while national governments have the right to pursue their own policies. However, in practice, this coordination process forces national authorities to adjust their solutions to those proposed at the supranational level. One may observe this coordination in:

1. higher education division into terms/ levels
2. number of credits given after graduating from particular level of HE in almost all EU universities
3. indication of certain competencies that graduates should acquire after finishing a particular level of HE.

Those actions aim at facilitating mobility and teaching in multicultural Europe and to ease entry into the labour market.

The first common actions, aimed at increasing integration of higher education institutions in the European Union, are included in the Bologna Magna Charta Universitatum from 1988. [The Bologna …,1999]

In 1998 several Member States of the European Union signed the Sorbonne Declaration that underlined the key role of the universities in shaping European cultural development. Europe decided to reinforce its intellectual, cultural, social, scientific and technological dimensions.[1]

One year later, in 1999, the reinforcement of the Sorbonne Declaration was expressed in new document signed by the Ministries of Education from the EU countries—the Bologna Declaration. The main assumptions made in the declaration were the following:

"1. Adoption of a system of "**easily readable and comparable degrees"**, also through the implementation of the Diploma Supplement, in order to promote European citizens' employability and the international competitiveness of the European higher education system

2. Adoption of a system essentially based on **two main cycles**, undergraduate and graduate. Access to the second cycle shall require successful completion of first cycle studies, lasting a minimum of three years. The degree awarded after the first cycle shall also be relevant to the European labour market as an appropriate level of qualification. The second cycle should lead to the master and/or doctorate degree in many European countries.

3. Establishment of a **system of credits** (the European Credit Transfer System—ECTS) that promotes student mobility.[2]

[1] The first European Community started to function in 1951 after signing the Paris Treaty. In 1957 the Rome Treaies were signed. European integration phases end, according to Bela Balassa, with political integration. Many questions in that sphere arise today, including the failure of ratification of the next integration treaty.

[2] According to the Declaration, credits could also be acquired in non-higher education contexts, including lifelong learning, provided they are recognised by receiving Universities concerned.

4. Promotion of **mobility** by overcoming obstacles to the effective exercise of free movement[3] with particular attention to:

- access to study and training opportunities and to related services for students,
- recognition and valorisation of periods spent in a European context researching, teaching and training, for teachers, researchers and administrative staff,.

5. Promotion of **European cooperation in quality assurance** with a view to developing comparable criteria and methodologies.

6. Promotion of the **necessary European dimensions in higher education**, particularly with regards to curricular development[4], inter-institutional cooperation, mobility schemes and integrated programmes of study, training and research." [The Bologna Declaration, 1999]

Subsequent communiqués, developing priorities set in Bologna, appeared in the higher education area; the Prague Communiqué (2001), the Berlin Communiqué (2003), the Bergen Communiqué (2005) and the London Communiqué (2007).

All those documents were the results of bi-annual meetings aimed at measuring progress in the Bologna Declaration. Higher education reforms were incorporated in the Lisbon Strategy for Growth and Jobs and are accompanied by the so-called Copenhagen Process aiming at the vocational education and training. In order to establish a link between the Copenhagen Process and the Bologna Declaration, the European Commission brought forward its proposal for the European Qualifications Framework for lifelong learning (EQF). This is linked to and supported by other initiatives and instruments mentioned in the Bologna Declaration:

– in the fields of transparency of qualifications—EUROPASS—set of five documents confirming education and skills acquired by given person,
– credit transfer—ECTS-ECVET (European Credit Transfer System–European Credit system for Vocational Education and Training) system that allows recognition of diplomas or part of study terms finished in host universities
– quality assurance ENQA–ENQAVET (European National Quality Assurance–European National Quality Assurance in Vocational Education and Training).[European Commission, 2008 a]

Those common actions undertaken in the majority of the EU Member States are derivatives of the Open Method of Coordination pursued in higher education. They are enriched also by benchmarking among universities and the introduction of certain models of management of the universities.

The European Commission supports efforts in the EHEA creation with the:

- Lifelong Learning Programme including programmes for the promotion of mobility of university staff and students like Erasmus, Tempus in respect of neighbouring countries, and globally through Erasmus Mundus, programmes for schools, vocational training and adults.
- 7th EU Framework Programme for Research

[3] That statement reinforced set of regulations at the Single European Market that is based upon four freedoms of movements of: goods, services, people and capital. The free movement of students and workers are also underlined as one of the basic rights of the EU citizen and strengthened in the form of regulations enabling easier admission to the university or obtaining work permission.

[4] C.P.Snow's dilemma refers also to development of the curricula. Taking into consideration the European studies cycles one may observe the incorporation of the idea of lifelong-learning. In fact there are mainly 3 cycles: undergraduate that should be response to labour market needs, graduate and postgraduate that impose on a graduate the "necessity" to be creative and adaptable to knowledge-based-economy changes. Many questions arise around the choice of educational content and deciding which courses are most important from the point of view of the graduates in the 3-cycle system.

- the Competitiveness and Innovation Programme for strengthening co-operation between universities, research entities and enterprises,
- the Cohesion Policy and its financial instruments. These are structural Funds devoted especially for less developed regions in the EU through supporting human resources development, investment in universities infrastructure as well as the curricula.
- the European Investment Bank resources.

The European Commission contributed to the Bologna Stocktaking exercise also through the Eurydice network, which produced country analyses as well as comparative overviews. In 2007 an Eurobarometer Survey was published, which shows strong support for modernisation among teaching professionals in higher education. [European Commission, 2008 a]

1.2. European Research Area and the Lisbon Agenda

Apart from the knowledge based economy notion, the role of innovation and research are more keywords in the Lisbon Strategy. Innovative applied research and development projects are as the top priorities within the EU actions.

In 2000, the European Union decided to create the European Research Area (ERA)—a unified area all across Europe, in which main goals are the following:

– "to enable researchers to move and interact seamlessly, benefit from world-class infrastructures and work with excellent networks of research institutions;
– to share, teach, value and use knowledge effectively for social, business and policy purposes;
– to optimise and open European, national and regional research programmes in order to support the best research throughout Europe and coordinate these programmes to address major challenges together;
– to develop strong links with partners around the world so that Europe benefits from the worldwide progress of knowledge, contributes to global development and takes a leading role in international initiatives to solve global issues."[DG Research ERA, 2008 b]

The existence of ERA should:

– inspire the best researchers to enter careers in Europe,
– encourage industry to invest more in European research (according to the Lisbon Strategy goal investment on R&D should reach 3% of GDP by 2010)
– contribute to the creation of sustainable growth and jobs.

As mentioned before, the creation of ERA has become a central pillar of the EU Lisbon Strategy for Growth and Jobs, together with the completion of the Single European Market, the European "broad-based innovation strategy" and the creation of European Higher Education Area.

Despite many initiatives taken by the EU and its Member States, there are still strong national and institutional barriers preventing ERA from becoming a reality. It is extremely important is to overcome the fragmentation of the European public research base. Fragmentation "prevents Europe from fulfilling its research and innovation potential, at a huge cost to European taxpayers, consumers, and citizens". [European Commission, 2008 c] Problems are defined as follows:

– legal and practical barriers hampering researchers' mobility across institutions, sectors and countries;
– difficulties for businesses trying to cooperate and enter into partnerships with research institutions in Europe, particularly across countries.
– largely uncoordinated national and regional research funding. "This leads to dispersion of resources, excessive duplication, unrealised benefits from potential spillovers, and failure

to play the global role that Europe's R&D capability would otherwise allow, notably in addressing major global challenges". [Ibidem]

– lack a true European perspective and transnational coherence in reforms undertaken at national level.[Ibidem]

As the European Commission declares, a strong need to revisit ERA stems from the globalisation of research, the acceleration of technology and the expansion of new scientific and technological powers. China, India and other emerging economies are attracting considerable and increasing amounts of R&D investments. These developments bring new opportunities for the whole world but at the same time, might be perceived as a threat to Europe's ability to sustain competitive in knowledge and innovation.

A progress review and debate among the EU countries was included in the European Commission's Green Paper on ERA. In 2007 public consultation on new solutions to improve implementation took place. Following the consultation results, in 2008 new initiatives to develop ERA were launched, including an enhanced political governance of ERA (called the "Ljubljana Process"), and five initiatives on specific areas of the ERA Green Paper. [European Commission, 2008 c]

Since 2000, many actions and financial instruments were devoted to progress in creating ERA:

– the EU Research Framework Programme—explicitly designed to support the creation of ERA. New initiatives launched in conjunction with the 7th Framework Programme (2007-2013), such as the European Research Council and the creation of the European Institute of Technology, should have an important impact on the ERA operating.
– initiatives to improve the coordination of research activities and programmes: the European Technology Platforms, through which industry and other stakeholders develop shared long-term visions and strategic research agendas in areas of business interest; the bottom-up 'ERA-Net' scheme which supports the coordination of national and regional programmes.
– Open Method of Coordination promoting overcoming the problem of insufficient policy coordination[5].
– a 'broad-based innovation strategy', which aims at improvement of the framework conditions for research and innovation. In this context: a modernised framework for State aid for research and innovation and guidance for a more effective use of tax incentives for R&D were adopted, a European patent strategy was proposed, and initiatives prepared to support the emergence of European 'lead markets' in promising technology-intensive sectors.
– EU cohesion policy and its financial instruments—the Structural Funds—that support strongly development of research and innovation capacities, particularly in less developed regions. [European Commission, 2008 b]

In the context of the Lisbon Strategy the EU stresses the importance of the link between the European Higher Education Area and the European Research Area. As a consequence of the ERA and EHEA, many universities and research entities have to cope with prioritization of their research areas. In that context one may observe promotion of "purely" scientific areas as well as an interdisciplinary approach among i.e. humanities/arts and science. Another important aspect is implementation of the scientific results. It is also worth mentioning that some of the instruments are common for building the EHEA and ERA i.e. 7th EU Framework Programme for Research, Structural Funds within the European Cohesion Policy.

[5] Open Method of Coordination is addressed through the use of voluntary guidelines and recommendations by the EU Member States. The process of debate and reforms at national level has resulted in all Member States setting national R&D investment targets in the context of the overall EU 3% of GDP R&D investment objective and taking measures to improve their research and innovation systems.

A new EU Member State, Poland, has emphasized adjusting to the EU requirements and setting priorities in higher education and R&D. Even if the integration instruments in those spheres seem to be weaker than others, from the legal point of view (open method of coordination) Poland is actively taking part in discussion and introduction of the EU EHEA and ERA. Moreover, Poland is currently the biggest beneficiary of the EU financial aid within its Cohesion Policy. This forces Poland to include the Lisbon Strategy goals into many strategies and documents. The use of Structural Funds is regulated by legal acts, which influences the policy-makers more than "softer" methods of operating used in the ERA or EHEA.

2. The Polish experience in reforming higher education and research

Polish universities originate from the 14th century, when the foundation of the Kraków Academy (now the Jagiellonian University) with its faculties of law and theology was laid. In the renaissance it attracted students and researchers from all over Europe. It was recognized as a scientific centre in the fields of astronomy, mathematics, geography or law.

"Further universities were created in Lvov and Vilnius (then part of Poland-Lithuania) by the 17th century. In the early 19th century a number of general universities and several specialist technical institutions were created in the partitioned countries. Until the late 19th century the universities were centres of Polish national culture and key contributors to the emergence of a Polish social and intellectual elite. After regaining independence in 1919, Poland found itself with five state universities in Krakow, Lvov, Poznan, Vilnius and Warsaw, a number of state technical institutions and several private tertiary institutions including the Catholic University of Lublin. By 1938 there were a total of 25 university-type institutions, with almost 48 000 students, and numerous tertiary vocational colleges. The university-level state institutions were 'autonomous and self-governing' universities, mainly on the German model.[6] During the Second World War the universities were closed by the German occupation but became centres of resistance through their 'underground' activities."[OECD, 2007]. During the communist system, even while the ideological constraints were put on the whole education system, quality in many educational fields was maintained. However, in the 80s and 90s many qualified people left the country, creating effects still felt today.

After the collapse of communism in 1989 Poland has started to shift towards democracy and market economy. Many efforts and structural changes are still needed to repair the failures of the previous system. Due to diplomatic relations with "Western" countries and international organizations, as well as financial support from the countries-in-transition, those changes have appeared. After entrance to NATO in 1999, democracy was guaranteed. The Europe Agreement signed by the Polish government and the European Communities in 1991 showed the directions of further changes. According to the EU "Copenhagen criteria" Poland had to fulfill requirements concerning a market economy, a functioning democracy, protection for human rights and the freedom for the media. The next 10 years were devoted to preparing to fulfill basic socio-economic requirements. In May 2004, together with 9 other countries, Poland became an EU Member.

The changes and active participation of the Polish representatives in the EU meetings were seen also in the areas of higher education, research and science.

[6] The model was characterized by a strong element of academic self-government under state control and regulation, and one could identify it with Humboldtian traditions of teaching, research and academic freedom. [OECD, 2007]

2.1. Higher education in Poland after 1989

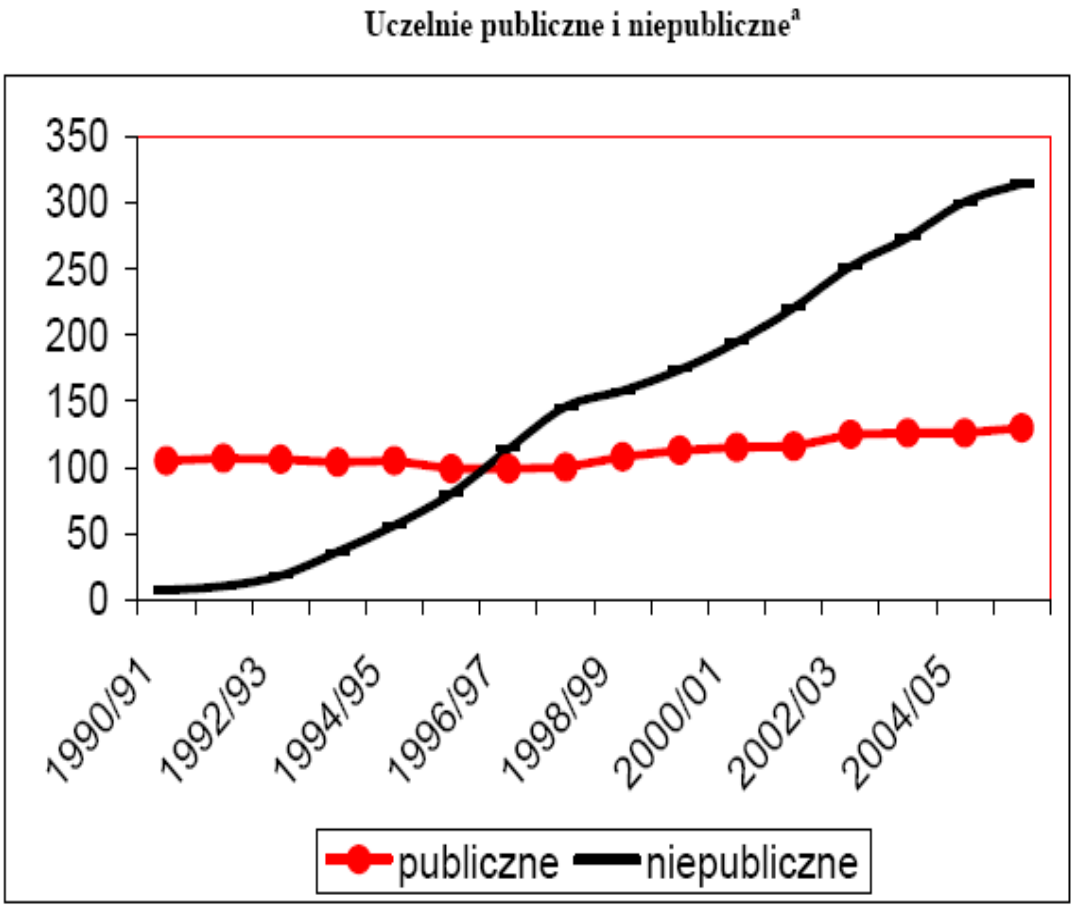
In the first years of transition, new socio-economic conditions and the creation of a market economy revealed needs for an educated labour force. The New Legal Act on the Higher Education was adopted in 1990. The act allowed for the establishment of private universities. In 2006/2007 Poland had 448 universities, compared with 97 in 1989/1990, of which two had religious affiliations. Of these, 130 were public and 318 private (14 with religious affiliations). The post-communist period has seen a roughly 30% increase in the number of public universities and the creation of a very large number of private, not-for-profit institutions. However, the private universities are much smaller in size: until 2006/7 the public institutions enrolled approximately 70% of all students and the private, 30%. (Graph 1). Total index of gross scholarisation grew to 49,1% in 2006/2007 from 12,9% in 1990/1991. (Table 1) Total number of students in 2006/2007 was 1 941 400.[OECD 2007 Report; GUS 2007]

Table 1. Indexes of scholarisation in Poland 1990-2006

Index	1990/ 1991	1995/ 1996	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007
Gross	12,9	22,3	40,7	43,6	45,6	46,4	47,8	48,9	49,9
Net	9,8	17,2	30,6	32,7	34,5	35,3	36,8	38,0	No data

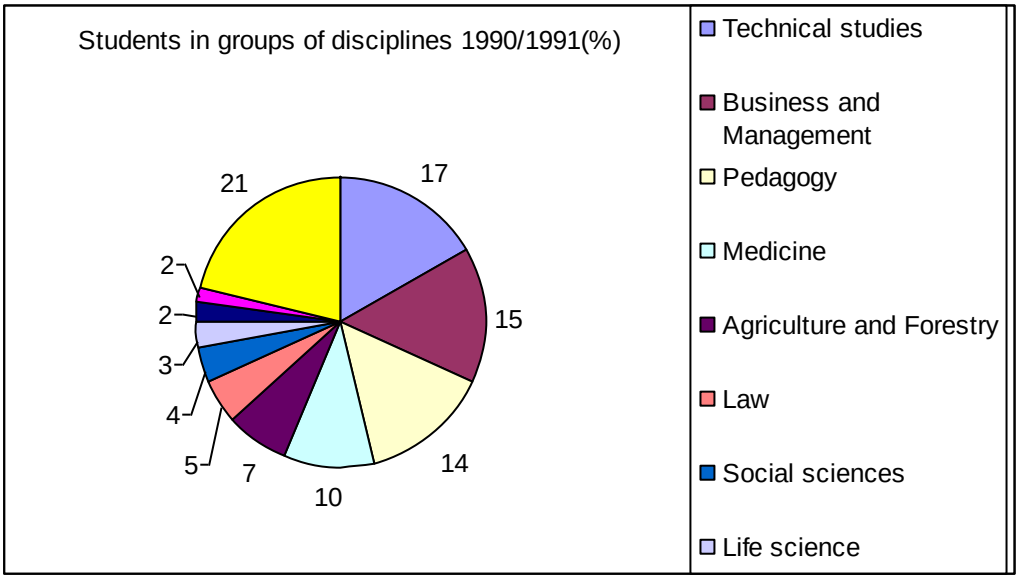
Source: Szkoły wyższe i ich finanse w 2005 r., GUS Poland 2006; Szkoły wyższe i ich finanse w 2006 r., GUS Poland 2007

Graph 1. Number of public and private universities in Poland



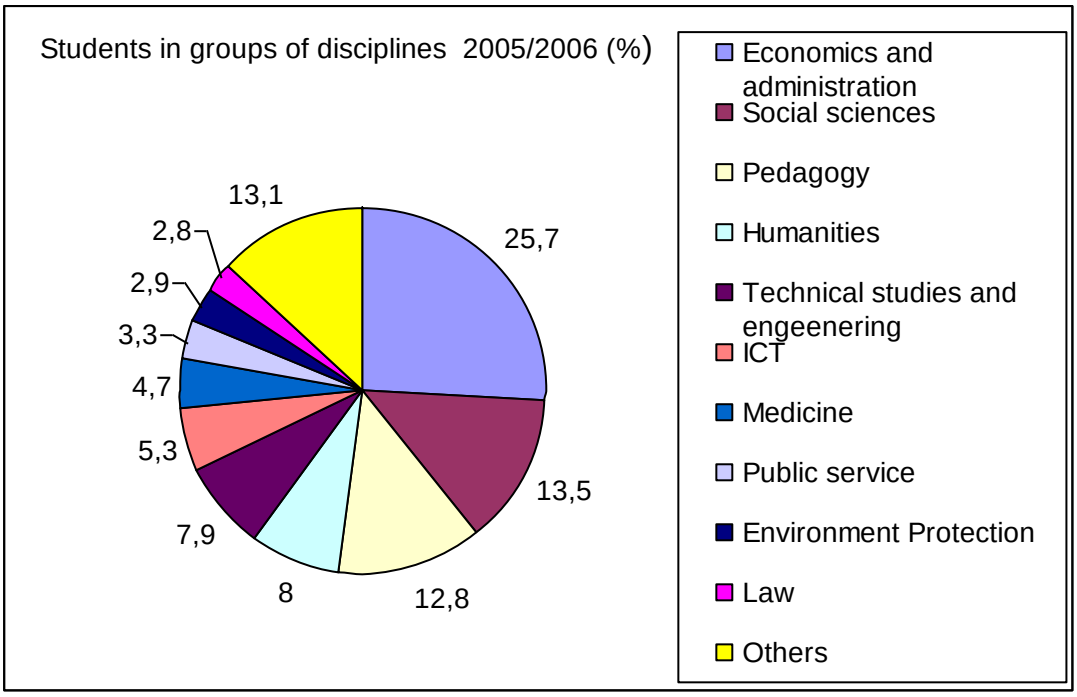
Source: Source: Szkoły wyższe i ich finanse w 2005 r., GUS Poland 2006
Red—Public universities;
Black—Private universities

Graph 2. Disciplines of studies 1990/1991 in Poland (%)



Own elaboration on basis: Szkoły wyższe i ich finance w 2005 r., GUS, Poland, 2006

Graph 3. Disciplines of studies 2005/2006 in Poland (%)



Own elaboration on basis: Szkoły wyższe i ich finance w 2005 r., GUS, Poland, 2006

In response to the market needs the structure of chosen disciplines of studies has changed. In 2005/2006 the majority of students graduated from the economics (25,7%), social sciences (13,5%), pedagogy (12,8%) and humanities (including languages; 8% in total). (Graph 2). The number of students in technical studies dropped from 17,9% in

1990/1991 to 7,9% in 2005/2006[7], also the number of law graduates dropped twice in analysed period.(Graph 2, Graph 3). Even if demand for managerial and linguistic skills was very high in the transition period, today the market seems to be quite satisfied with the need for those abilities. To improve a knowledge based economy in Poland the number of students and graduates of technical studies and engineering has been unsatisfactory, as well as the life science specialists. Innovations and competitive advantages of particular economies are embedded in the new R&D solutions present mainly in those disciplines.

Provoked by the implementation of the Bologna Process and the Lisbon Strategy, changes to the Polish studies curricula have been made. The first experiences of three level studies are analysed. A strong emphasis was put on the question of broad vs. specialist knowledge. If one takes into consideration the aims and results of particular study term, the necessity of acquiring the specialist and more technical knowledge appears in the context of undergraduate studies. That cycle aims at quite easy entrance into the labour market. The second and third levels (graduate and postgraduate) studies aim at creativity and functioning in the information society, which is an attribute of the knowledge based economy. Here, broader knowledge and ability to think abstractly is expected from a graduate. In that context such understanding of C.P. Snow's dilemma on humanities vs. science is still relevant. There are also some attempts to bridge the gap between the two, including the introduction of interdisciplinary courses for students, who specialize in different fields or the possibility of studying at different universities with having part of study accepted on the basis of credits gained at "home" university.

2.2. Science in Poland after transition [subchapter based on Musiałkowska I., 2008]

As it is described earlier, the European Commission stressed the adoption and implementation of the revised Lisbon Strategy. It obliged the EU Members to spend money on their objectives, within the framework of the cohesion/regional policy. Also Poland decided to show its willingness to reinforce the R&D sector with the use of additional resources. Many strategic documents prepared before the EU 2007-2013 financial perspective contain goals of an increase in innovation, raising R&D expenditure and higher education reforms. The basic strategic document which integrates assumptions of the renewed Lisbon Strategy and of the Cohesion Policy for the years 2007-2013 is the Community Strategic Guidelines (CSG). Within the framework of the CSG, the Commission proposed to concentrate intervention measures of the Cohesion Policy on the objectives of the renewed Lisbon Strategy, namely on stimulating growth of economy competitiveness and on increasing the employment level.

Referring to the research area, the Polish government elaborated the Strategy for Development of Science in Poland until 2015[8]. Its general aim is "an increase of international competitiveness of the Polish science, which is understood as:

[7] It is worth mentioning that fall in the number of technical studies graduates stems also from the higher costs of their education. When the increase in the number of private universities is concerned one may notice that their offerings focus on economics, administration and humanities that allow for a relatively low cost-education and higher income. [Jurek, 2008]

[8] Other Polish strategic documents referring to the R&D and priority research areas for Poland are the following:

- *Proposed areas of the development of science and technology in Poland until 2020* (policy document of the Minister of Science and Information Society Technologies, November 2004),
- *Aims of the national research, science and technology, and innovation policy until 2020* (adopted by the Government in December 2004),
- *The strategy for the development of science in Poland until 2020* (adopted by the Government in June 2005). In: M. Dąbrowa-Szefler, J. Jabłecka-Prysłopska OECD Thematic Overview of the Tertiary Education, Country Background Report for Poland, Warsaw 2006

- ability to solve research problems at the level recognized as "high"
- ability to create solutions that can be applied taking into account the international supply of competitive socio-economic innovations in the enterprise, education and public administration sectors.

Other similar objectives are included in the Country's Development Strategy for the years 2007-2015, and many Operational Programmes[9] (OPs). Analysis of the programmes show many R&D and higher education actions in the majority of sector and regional OPs. Therefore, the following questions arise:

- will those activities be coordinated properly?
- will financial resources from the country's budget and the EU Funds be concentrated or dispersed?

The questions conform exactly to the debates and public consultation on the ERA creation across the EU. The latter question is extremely important due to the low level of R&D spending in Poland.

A gap exists between Poland and better developed countries in the research and development field. The three main problems are a shortage of financial resources, an unsatisfactory structure of financing, and institutional weakness.

1. The major problem described in the Strategy for Development of Science in Poland until 2015 is a **shortage of financial resources** for the research in Poland. In 1991-2004 the relation between total expenditure from the Polish budget and GDP (Gross Domestic Product) was systematically dropping. In 2005 the amount was at the nominal level of the 2004 expenditure, while in 2006 and 2007 increased by 15% and 10% respectively. In 2004 the indicator, measured in PPP (Purchasing Power Parity), was 0,38% of GDP and that level was two times lower than the EU average, which reached 0,63% of GDP. The most developed countries however had the indicator at the 0,90% of GDP, where the best performers in the EU were Finland and Sweden (0,90% of GDP) and France (0,87% of GDP). In 2005, a country spending on the R&D (GERD[10]) was 0,57% of GDP with EU-25 average—1,86% of GDP, and the OECD countries—2,26% of GDP.

2. Another important problem is **unsatisfactory structure of financing** of R&D in Poland. In the majority of high developed countries R&D is financed from non-budgetary resources, mainly—private entities budgets. In Poland in 2005 the structure was the following:

- 57% of total amount came from the state budget
- 26% of total amount was financed by the enterprises
- 7% of total amount comes from the budgets of scientific entities (i.e. the Polish Academy of Sciences, R&D entities.

In comparison, in the EU countries the share of the public money is 35% and OECD, 30%. According to the tendencies observed, the Polish decision-makers assumed the increase in total expenditure on the disciplines that have been underfinanced when taking into consideration the similar amounts spent in better developed countries.[11] [The Strategy…, 2007]. Those priority-disciplines are, namely: mathematics, engineering, ICT, biology, chemistry and physics, which are driving forces of the innovative and competitive economy. The choice of such scientific areas can have also impact on the change of the structure of

[9] Documents that allow for spending money from the EU Structural Funds on priority areas set down in the country national strategies.

[10] GERD—Gross Domestic Expenditure on R&D

[11] In 2005 the structure of spending on R&D on the more prospective disciplines was the following: 43,3% of total amount was development projects in engineering and technology, 24,4% natural science: i.e. biology, chemistry, physics, 15,2 % medical science, 3,6% social sciences and humanities, 13,5% agriculture. In: The Strategy of Development of the Science until 2015.

financing R&D. The solutions and technologies should be in the field of interest of many companies, which can contribute to finance R&D, when its implementation may give a potential comparative advantage to them.

Another consequence of current system of research financing in Poland is domination of basic research upon applied research.

3. Third major problem defined in the Strategy is "**institutional weakness"** in the sphere of financing R&D from public resources. The majority of individual decisions on the financing of research projects are taken by the Minister for the Science and Higher Education and the management of finance is undertaken by the Ministry of Science and Higher Education. This results in the almost complete centralization of decision-making. Only a small part of competences was delegated to the external entity—the Federation of Scientific and Technical Associations (NOT)—that distributed financial resources for the implementation of the results of research projects to small and medium enterprises.

In 2006 the majority of means (68% in 2006) was assigned within the framework of statutory activity for the protection of basic needs of scientific entities. The remaining resources were assigned mainly for: research projects (17,7%), goal-oriented projects (4,18%), investments (6,52%) and international scientific and technological cooperation (1,96%). Such a distribution of resources indicates that the budgetary financing is to a very small extent linked to the effectiveness and applicability of research performed by subsided scientific entities, with respect to the needs of the economy. It should be stressed that changes in this scope consisting in a substantial increase of demand for competition—"project" funding (it refers both to enterprises and scientific entities) would not be possible in a short period of time because this requires wider systemic reforms. [Operational Programme IE, 2006]

Until 2007 there was no executive agency (with legal personality) with the right to direct the budgetary resources to particular beneficiaries dealing with the R&D (i.e. research entities). The result of this situation is non-optimal efficiency of the investment made, mainly due to administrative constraints put on the whole process. The described problem is another example of lagging behind more developed countries.

The answer to the problems diagnosed in the Strategy is the formulation of institutional and financial proposals that aim at reducing the gap existing between Poland and the leaders in R&D sphere. Referring to the problem of insufficient expenditure on R&D, in the strategic documents, priority areas of development of the Polish science were indicated together with respective and possible areas of their implementation. (Table 2)

Table 2. Driving force of the Polish science until 2015

Areas of science / **Areas of implementation**	**Biotechnology**	**Nanotechnology**	**ICT**
Health	+++	++	+
Energy	++	+++	+
Physical Production	++	+++	+
Innovative services			+++
Society			+++

Source: The Strategy for Development of Science in Poland until 2015

In the documents and Operational Programmes also main goals resulting from the tendencies in the science sector were presented. Those tendencies comprise:

- civilization trends that influence scientific development, stress the popularization of the research results as well as networking between science and the economy.
- research trends, technology development and innovation that focus on the areas of science show in the Table 2.
- research and innovation policy instruments, promoting calls for proposals and a grant system while applying for money; implementation of the research effects, clustering, use of the joint-ventures, seed capital and start-ups.
- trends in the R&D and innovation sector that stress the raising of private capital in financing research; the growing role of the universities in research (financed from the public resources), the change of the character of R&D in companies; joining the European Research Area.

In order to create an innovative economy, in the Country's Development Strategy for the years 2007-2015 a postulate "to concentrate public resources on "implementation of strategic research and development programmes, that should end with commercialization of the Polish products" appeared. The State should support and encourage the entrepreneurs to use their own resources for the R&D and the final result should be a meausre of their innovativeness. The optimal financing structure is that 2/3 of all investment on R&D derives from the non-budgetary sectors, mainly form the industry sector. [The Country Development…; 2006][12]

The increase in private expenditure on R&D is estimated from current level of 0,15% of GDP to 0,6% of GDP in 2015. The private sector should finance mainly applied research and development.

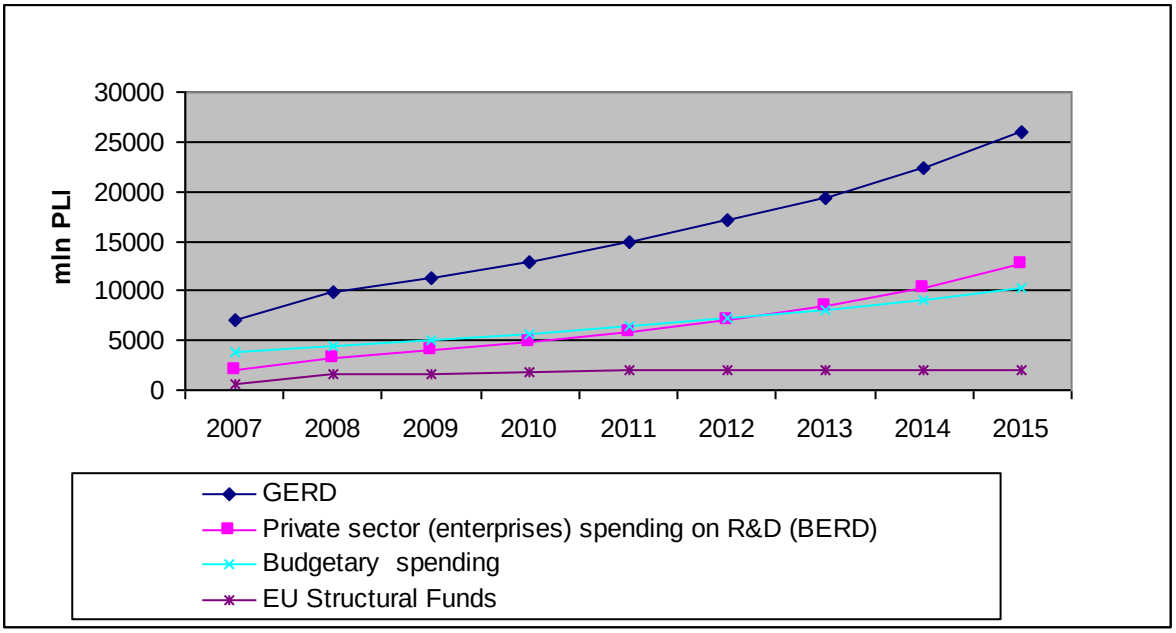
At the same time there is strong pressure to increase public expenditure on R&D (according to the obligation to implement the Lisbon Strategy—see Chart 1) as well as improvement in the quality of research conducted by the Polish scientists, access to research infrastructure and the creation of an efficient institutional environment that operates R&D financing from the public resources.

On April 17th 2007 The Polish Council of Minister adopted the goal of increasing of R&D spending in Poland (Chart 1.)

Expenditure on R&D in Poland should be four times as much in 2015 when compared to the 2007 level. The share of private sector should be six times higher, while the percentage of BERD in GERD will double. There is also a certain amount of the EU Structural Funds programmed within the OPs. Even if the relative share of the Structural Funds is not as high as the other sources, their role is quite important. The projects financed from the EU funds should serve as the engine of change for thinking about R&D financing, testing of innovative policy making, as well as bring about change in the efficiency of expenditure on R&D.

[12] The Country's Development Strategy for the years 2007-2015, approved by the Council of Minister of the Republic of Poland on 29.11.2006

Chart 1. Increase of main components of GERD in Poland 2007-2015 (mln PLN).



Own elaboration on the basis of the Ministry of Science and Higher Education data

Another aspect of additional finance for the R&D and higher education sector is related to different rules of subsiding research and the universities functioning, depending on the source of finance, namely, the Structural Funds or state budget.

When taking into account the EU funds one can observe a very small dependence of present algorithms for the research activity conducted by the universities and the algorithms for didactics and infrastructure financing, upon the scientific potential of the particular university.

The grant algorithm for the university functioning and infrastructure is based, to a very limited extent, on the scientific potential co-efficient.[13]

Moreover, grants on statutory activity of the research entities reflect only retrospective ways of calculating the subsidy, which means that the entity receives grant money based on the data from the previous years, while current necessities can be different from the past. Also participation in EC Framework Programmes had no big influence on the level of state subsidy.

Financing from additional EU Funds, which since 2007 has been flowing via the Polish budget, is quite different. It can be admitted only after the universities or research entities' project is accepted by the authorities and after signing the contract. If the project is multiannual, one may enclose its costs, financed either from the Structural Funds or from own contribution, in the state budget in advance. Nowadays, in Poland it seems extremely important to co-ordinate those two financial inflows from the country and the EU budgets and concentrate spending on developing the most promising and strongest academic centres and research entities.[14] This is also very often pointed out that only the reforms of the system of

[13] Its wage among other algorithm co-efficients is low and is 0,10 when other related to the former grant is 0,7 and to the number of academic staff, 0,35 levels. Regulation of the Minister for the Science and Higher Education, 2nd April 2007

[14] In the Strategy of Development of the Science in Poland until 2015 the processes of consolidation, commercialization and privatization of the research entities is stressed. The changes should lead to creation of

financing of the R&D and higher education sectors, combined with the institutional changes (i.e. establishing the national governmental agencies that specialize in the scientific activity coordination in the applied and basic sciences) can bring the positive effects in both spheres.[15]

2.3. Priorities of development of the R&D and higher education sectors in the Polish Operational Programmes co-financed from the Structural Funds.

The objectives of the Strategies and prognosis are also present in the Operational Programmes (OPs) financed partly from the Structural Funds. Poland is the biggest net beneficiary from the EU budget. The Structural Funds were also directed to the R&D and higher education. These sectors, treated as crucial for the growth of a contemporary economy and a knowledge-based economy, have to be taken into account in many aspects of state and regional policies. The Structural Funds projects in R&D will serve as pilot projects and hints to change the structure of financing of the research, include the innovative elements into policy-making at different administrative levels and as an answer to the diagnosed problems. The first task was to plan the financial contribution of the project beneficiaries in the R&D area (mainly contribution given by the enterprises, Chart 1). The continuous change in the way of thinking on R&D investing should bring the effects in the form of higher private spending on research and development.

In 2004-2006 (which was the previous financial perspective for the New Member States) the Structural Funds distributed by the Ministry of Science for the co-operation between the scientific area and the enterprises were spent within the Sectoral Operational Programme Improvement of the Competitiveness of Enterprises years 2004-2006. Almost 88,5 mln euro from the European Regional Development Fund (ERDF) was spent for projects. Since the start of the Programme until 2007, 677 applications were delivered, 214 contacts were signed for total amount of 121,3 mln euro. The value of the ERDF grant is equal to 13% of the state Budget—Section "Science" in 2006. [Operational Programme IE, 2006]

The applicants have the greatest interest in investment projects, yet significantly fewer submitted applications and signed contracts related to the implementation of R&D projects. This is a typical feature of undercapitalized structures, but changes in the infrastructure should result in an increased number of research projects, due to the modernized infrastructure. Furthermore, the reasons for such a structure of applications should be attributed to inflexible and complicated procedures and general construction of applied instruments when scientific entities are involved. The majority of projects are implemented

smaller amount of strong entities, which are able to conduct integrated and huge R&D projects. Their results will serve the society and economy and help gain a strong position in the international arena. Very important role plays co-operation between ministries of economy, agriculture and Heath. After JBR (research entities) restructurization one will aim at the creation of the national scientific institutes (Państwowy Instytut Nnaukowy – PIN). Also referring to the institutions of the Polish Academy of Sciences one focuses on the effectiveness of research, especially those that influence civilization and economic development of the country and use of the best practices in the entities management. When the research entities of the universities are taken into account one predicts concentration of expenditure on the functioning of the inter-universities interdisciplinary centres.

[15] The Strategy of Development of the Science in Poland until 2015 assumes changes of budgetary subsiding R&D, where the basis of the assessment of the level of efficiency of the research entities are effects of the parametric evaluation. The evaluation is pursued once per 4 years, and starting point for that are published or implemented research results of the entity. The parametric assessment is based on patents, main articles and books, copyrights and practical use of the results outside the evaluated entity. The biggest change in the evaluation will be stress put on the entity acting on the commercial market, strong dependence of the amount of subsidies on the implementation of tasks that conform the state policy as well as position in the ranking; and involvement into parametric assessment the representatives of enterprises, financial institutions and foreign experts.

by scientific entities from the public sector. Projects carried out by entrepreneurs relate mainly the areas of "computer science and related activity" and "conduct of research and development works".[The Strategy…]

In 2007 with the beginning of new financial perspective, due to the EU "n+2" rule, the projects can be implemented until 2015. In those years the actions within R&D and higher education sectors are included into:

- Operational Programme "Innovative Economy" 2007-2013 (OP IE)
- Operational Programme "Human Capital" 2007-2013 (OP HC).

In both programmes the main responsible institution is the Ministry of Science and Higher Education and the total budget for the sphere coming from the national OPs is almost 4,1 bln euro. The annual share of the Structural Funds in GERD in 2007-2015, depending on year, varies from 8% to 15%.

The objectives of both programmes are the answer to the problems defined in the Strategy of Development of the Polish Science until 2015. The programmes aim at:
1) strengthening cooperation between R&D and economy,
2) improvement of quality of research and increase in quantity of scientists,
3) improvement of efficiency of the R&D entities and institutions of the system of financing R&D,
4) development of the research infrastructure.[16]
In the OP IE the strong necessity of research infrastructure creation and modernization is underlined. Therefore, the following activities are required:
a) direct investment
b) consolidation of dispersed infrastructure
c) increased efficiency of the use of the research infrastructure.

A very important element of the strategy of R&D infrastructure development in Poland is the list of individual infrastructural projects within thePriority Axis of the OP IE, which was prepared by the Ministry of Science and Higher Education. The projects are not taking part in the call for proposals and were chosen by the Ministry because they should play a crucial role in the scientific development of the whole country. The list comprises a set of research laboratories and equipment of value higher than 100 mln PLN. Those infrastructural solutions help the Polish scientist get new experiences in conducting investment and exploitation in the area, and at the same time, improve the position of research centres at the international arena. One of main criterion of choosing the projects to be co-financed from the OP IE is co-operation with the enterprises.

Besides, modernization of existing infrastructure should be financed from the budgetary sources. In such context priority is given to the projects led by the consortia or networks of the universities or research entities.

As a supplement the "horizontal investment" i.e. in information technologies development for the R&D sphere, are prepared. Those investments are implemented according to the objectives of the "Programme of development of the ICT infrastructure 2007-2013".

Within the objective of the strengthening cooperation between R&D and the economy the instruments encouraging the entrepreneurs to undertake activities that help improve their competitiveness are programmed. Such improvement can be obtained through commissioning R&D that are potentially giving them advantage on the market and further implementation of the R&D results. The constant increase of money spent on R&D in enterprises is estimated in

[16] Those aims are conformed to the EU strategic goals as well as the COM (2005) "Common actions for growth and employment. The Community Lisbon Programme"

the budget. Also growing role of soft instruments such as strengthening the business support institutions and their networks with the particular focus on the innovative set of institutions (i.e. technology parks, incubators, centres of advanced technologies) is underlined.
The main expected results of the implementation of the priority axis in the OP IE are:
a) improvement of infrastructure and laboratory equipment of national research centres of the highest research potential,
b) improvement of the level of competitiveness of Polish research centres,
c) widening and enriching the offer of research services provided by scientific entities for enterprises,
d) increasing transfer of R&D results to the economy,
e) improvement of the quality of Polish science management through creation of efficient mechanisms for access to information

Another sectoral operational programme that aims at the improvement of the education quality at all levels and many forms, as well as the research quality and human potential increase[17], is the Operational Programme "Human Capital" financed from the European Social Fund. Within the programme there are activities concentrated on the increasing the skills of entrepreneurs and scientists in order to pursue common projects aimed at the increase of innovativeness in the economy. Those activities include intellectual property issues and the ability to commercialize the R&D results (efficient knowledge transfer).

In Poland decentralization and the involvement in the economic, social and territorial development programming by the regional authorities, has played a role. The authorities of each Polish region (voivodship) prepared their own Regional Operational Programme (ROP). In some Polish regions, according to contemporary development paradigms, the implementation of the Regional Innovation Strategies is the key point. Therefore, in some Regional Ops one can also find activities or priorities that support R&D sphere, commercialization of the results of R&D and research, ICT and social infrastructure development.

The actions complimentary to the OP "Innovation Economy" actions one can find in the 16 Regional Operational Programmes and the sectoral Operational Programme "Development of Eastern Poland." All areas referring to R&D and higher education present in all Polish Programmes are the following:

- Infrastructure: social (didactic), information technology, research
- Academic incubators
- Clustering
- Research and development projects (goal-oriented, commissioned, applied and basic)
- Education offer improvement and staff mobility
- Postgraduate studies improvement
- Expertise and analysis
- Promotion of entrepreneurship and knowledge transfer
- International co-operation.

Summing up, both projects related to R&D and higher education can be implemented within the sectoral and regional OPs.[18] (Table 3.)

[17] "While analyzing the quality of human resources potential in R&D in Poland some bibliometric data states that: In 2003, Poland's share in the world scientific publications stood at 1.45% (11,600 citations) and was the highest over the last twenty years. However, as compared to other EU countries, the number of citations of Polish scientists per one thousand inhabitants was substantially lower. The average for the EU-15 in 2002 accounted for 673, whereas for Poland it was 266." OP Innovative Economy p. 34.

Table 3. R&D and higher education in Operational Progammes (OPs)

Research and Development	Higher Education
• 2 most important sectoral OPs: – Innovative Economy – Human Capital • Development of Eastern Poland • Regional Operational Programmes	• Sectoral OPs: – Infrastructure and Environment – Innovative Economy – Human Capital – Development of Eastern Poland • Regional Operational Programmes

Own elaboration

3. Conclusions

Polish science and its economy still face continuous challenges in the light of increasing international competitiveness. Those challenges require a response in the form of formulating and pursuing active research, scientific, technological and innovative policies. The activities proposed in the "Strategy for the Development of the Science in Poland until 2015" shall enable "increase in intensity and quality of research in Poland and enhancing economic and social utility of the Polish science". The main actions, within the framework of the country research policy, should comprise:

– increase of efficiency of financing research from public resources;

– strengthening cooperation between the research entities and enterprises;

- legal, organizational and system changes that help implement research, scientific, technological and innovative policy in more effective way and increase R&D financing from non-budgetary sources;

- enhancing the international co-operation, especially in the EU area;

– promotion of science and innovativeness among the Polish society.[The Strategy…]

The majority of the above mentioned activities are included in the sectoral and/ or regional Operational Programmes, for which Structural Funds in Poland can be used.

The role of the pilot-projects co-financed from the Funds seems to be crucial when necessary reforms in the sphere of Polish R&D and higher education are concerned. Those projects will serve as a benchmark and decide to some extent on the successful changes in both areas. Those "technical" possibilities that Poland has right now, can be considered the subject of a broader universal dichotomy presented by C.P. Snow. One may pose the question which key factors are the key ones for the development of an information society: those coming from the pure science or those from humanities? The consequences of this antinomy influence the formulation of curricula in higher education. In that context, can specialisation be the "enemy" of broad knowledge and creativity?

An analysis of the European and country strategic documents let us enumerate some threats and chances deriving from discussions. As far as threats are concerned one may state that:

- priorities setting can be a possible trap for those less useful areas of education (humanities, arts) or science (i.e. basic research in different fields)

- there might be difficulties in currricula formulation due to the different solutions in the EU countries. Besides, in some countries the ministerial guidelines are very rigid in order to make some study offers more interdisciplinary.

On the other hand, chances are referred to:

- proper reading of the Operational Programmes. In order to overcome the problem of supporting only priority entities, some project examples like Universities Development Programmes where each university can benefit were prepared.
-where education offerings are concerned—despite rigorous regulation in some areas, universities can still formulate their own specialization programmes to some extent.
-Referring to research projects some possibilities of obtaining additional funding for non-priority units, are given in the Polish Legal Act on the Higher Education (2005), where consortia of different actors and problem-based projects are present. Good examples of common interdisciplinary projects are observed such as:

- use of ICT and technologies in many areas
- co-operation of artistic schools and institutes with the universities (traditional, technical, economic)
- interdisciplinary graduate and postgraduate studies offered by two or more universities
- postgraduate studies offer in culture management
- appearance of cultural industries
- promotion of notion of culture as environment for entrepreneurs
- social responsibility of business initiatives.

There are signals sent by entities involved in the processes of European integration that despite setting down preferences there are still efforts to overcome certain fragmentation made by the policy-makers. Even if in the world of scarce resources it is obligatory to chose, human development embraces different (priority and non-priority) areas in order to be complex.

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