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ERAWATCH Analytical Country Report 2007: Poland

Jan Nill

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Contact information
Address: Edificio Expo. c/ Inca Garcilaso, s/n. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

IPTS website: http://ipts.jrc.ec.europa.eu
JRC website: http://www.jrc.ec.europa.eu
DG RTD website: http://ec.europa.eu/research/

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Executive summary

Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs, which aims to increase and improve investment in research and development, in particular in the private sector.
One task of JRC-IPTS within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts. The main objective of the reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. This analytical approach has been tested in 2007 by applying it to a number of countries, one of which is Poland. This report is based on a synthesis of information from the ERAWATCH Research Inventory and other important publicly available information sources.

Poland's society and economy have undergone a profound transformation over the last 15 years. In this context, Poland has recently started to adjust and reformulate the role of its research system. Poland has a number of existing strengths on which it can build, as the summary assessment given in the table below indicates.

Domain	Challenge	Assessment of system strengths and weaknesses
Resource mobilisation	Securing long-term investment in research	Resources for long-term investments are provided steadily by the government, but level and growth dynamics are lower than in other Central and Eastern European Countries
	Dealing with barriers to private R&D investment	Limited private R&D funding in comparison with the EU average and other new Member States
	Providing qualified human resources	Mechanisms in place to ensure the provision of a qualified human resource base for R&D
	Justifying resource provision for research activities	Little pressure from society and the economy to provide more resources for R&D
Knowledge demand	Identifying the drivers of knowledge demand	Lack of sophisticated private R&D demand due to low-tech orientation of the economy
	Channelling knowledge demands	Until recently weak co-ordination of knowledge demands by policy actors
	Monitoring demand fulfilment	Evaluation culture and systematic monitoring mechanisms not strongly developed
Knowledge production	Ensuring quality and excellence of knowledge production	Solid system to enhance basic research underpinned by quality criteria
	Ensuring exploitability of knowledge	Weak mechanisms to gear knowledge production towards commercial applications
Knowledge circulation	Facilitating circulation between universities, public research organi-sations and business	Lack of robust mechanisms to facilitate knowledge circulation between research sectors due to not settled role of the state-owned R&D units (JBRs) in this respect and few well established technology transfer institutions
	Profiting from international knowledge	Participation in Framework Programmes as important mechanism, but full benefits increasingly challenging to reap
	Enhancing the absorptive capacity of knowledge users	Low absorptive capacity of knowledge users and in particular SMEs

Mechanisms are in place to ensure the provision of a well qualified human resource base for R&D and there is a solid system to enhance basic research underpinned by quality criteria. Yet some of the key elements for a smooth-running research system are not yet in place, e.g. there is still little sophisticated demand for R&D from the private sector due to the dominant medium- and low-tech orientation of the economy. However, R&D demand from foreign-based companies recently seems to have started growing significantly. The mechanisms to gear knowledge production towards commercial applications and absorptive capacity of knowledge users, in particular SMEs, are still weak. The challenge of ensuring the circulation of knowledge between science and industry also remains to be resolved.
The lack of linkages between knowledge production and knowledge use is mirrored in the governance structure of the Polish research system, with separate ministries having responsibilities for science and for innovation. However, the improvement of policy co-ordination mechanisms by the establishment of a high level innovation council is under preparation.

The table below summarises the main opportunities and threats relating to recent policy dynamics, and it shows that recent policies address many of the weaknesses of the Polish research system.

Domain	Main policy-related opportunities	Main policy-related threats
Resource mobilisation	- increased public resource mobilisation for research due to significant budget increases in response to the Lisbon Strategy and the availability of European Structural Funds - enhanced private R&D investment due to a range of new support measures, which may also contribute to further foreign R&D investment	- leverage effects from public towards private resource mobilisation might not be achieved to the extent expected
Knowledge demand	- new instruments preparing research policy priority setting including major scientific and private stakeholders, e.g. through the "Poland 2020" National Foresight Programme - more effective public demand through the joint Operational Programme for an Innovative Economy and improved implementation mechanisms for multi-annual strategic programmes	- possible improvement of effectiveness of public expenditure by increased involvement of the regions through regional operational programmes threatened by a lack of adequate regional governance capacities
Knowledge production	- new agency (national R&D centre) for programme implementation as an improved mechanism to enhance excellence as well as effectiveness of public expenditure	- reinforced sectoral governance structure of JBRs might hamper further institutional reforms aiming to improve both the excellence and exploitability of knowledge production
Knowledge circulation	- implementation of the "Innovative Economy" Operational Programme for the period 2007 to 2013 will enhance cooperation and transfer between universities, public research organisations and private enterprises - support for international activities in the Framework Programmes and beyond might produce leverage effects	- modest scope of reform of institutional setting for facilitating knowledge circulation may limit effectiveness of measures - the policy measures implemented are not yet sufficient to significantly enhance absorptive capacity of private actors

The Lisbon Strategy's policy coordination and monitoring process has helped in setting more explicit targets and in giving higher priority to research and innovation. Opportunities emerge from the joint implementation of: (i) increased mobilisation of public resources for R&D; (ii) structural reform to improve the channelling of knowledge demands, strengthen centres of excellence in knowledge production and improve the economic exploitability of knowledge through the new National R&D centre and the reform of the state-owned R&D units (JBR), and; (iii) an improvement of absorptive capacity through the new Operational Programme "Innovative Economy" jointly designed by the ministries for science and for economics and supported by Structural Funds.
However, the table also shows that despite recent policy responses, a few threats remain, which endanger the effectiveness of a range of the planned measures.

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Chapter 1. Introduction

1.1 Scope and methodology of the report in the context of the European Research Area and the Lisbon Strategy

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in research and development (R&D), innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This aims to increase and improve investment in R&D, with a particular focus on the private sector. One task of the JRC-IPTS within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts. The main objective of the reports is to characterise and assess the performance of national research systems and related policies in a comparable manner.

To ensure comparability across countries, a dual level analytical framework has been developed and applied. On the first level, the analysis focuses on key processes relevant to system performance in four policy-relevant domains of the research system:

1. Resource mobilisation: the actors and institutions in the research system have to ensure and justify that adequate public and private financial and human resources are most appropriately mobilised for the operation of the system.
2. Knowledge demand: the research system has to identify knowledge needs and how they can be met, thus determining priorities for the use of resources.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of any research system.
4. Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in the economy and society or as the basis for subsequent advances in knowledge production.

These four domains differ in terms of the scope they offer for governance and policy intervention. Governance issues are therefore treated not as a separate domain but as an integral part of each domain analysis.

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
• Long-term research investment • Barriers to private R&D • Qualified human resources • Justifying resource provision	• Identification of knowledge demand drivers • Channelling of demand • Monitoring and evaluation	• Quality and excellence of knowledge • Exploitability of knowledge	• Inter-sectoral knowledge circulation • International knowledge access • Absorptive capacity

On the second level, the analysis within each domain is guided by a set of "challenges", common to all research systems, which reflect conceptions of possible bottlenecks, system failures and market failures (see list above).

The way in which a specific research system responds to these generic challenges is an important guide for government action. The analytical focus on processes instead of structures is conducive to a dynamic perspective and eases the transition from analysis to assessment. Actors, institutions – and the interplay between them – enter the analysis in terms of how they contribute to performance in the four domains.

Based on the above framework, the analysis here proceeds in three steps. The first step is to analyse the characteristics of the current research system; the second step is to analyse recent changes in policy and governance. The third step in the analysis aims at an evidence-based assessment of the system's strengths and weaknesses and its policy-related threats and opportunities in the light of the Lisbon process ("SWOT" analysis).

The national research system is defined in functional terms as an open system comprising actors, institutions and the processes by which they interact to contribute to the production and circulation of scientific, technical and related knowledge, as well as to the mobilisation of resources and articulation of demand for R&D. Thus, the research system also includes research policy actors, together with actors and institutions at the interface with the wider innovation system. The national dimension remains important, but it has to be seen in the broader context of an increasingly open system. The report focuses here on the European context of the national research system. Many of the challenges analysed also reflect important concerns of the European Research Area (ERA). Where interactions with the EU level are relevant in addressing domain challenges they are explicitly included in the system characteristics and trend analysis – insofar as the information is readily available. In addition, the jointly agreed research-related EU Lisbon Strategy goals serve as a key reference for assessing recent trends and policy developments.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory[1] and other important publicly available information sources as of autumn 2007. In order to enable a proper understanding of the research system, the approach taken is mainly qualitative. Quantitative information and indicators are used, where appropriate, to support the analysis. After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and chapter 5 deals with knowledge circulation. Each of these four main chapters contains a subsection on relevant recent policies in the domain. The report concludes in chapter 6 with an overall assessment of the strengths and weaknesses of the research system and governance and policy dynamics, opportunities and threats across all four domains in the light of the Lisbon Strategy's goals.

[1] ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home. Other sources are explicitly referenced.

1.2 Overview of the structure and governance of the research system

Figure 2 below shows the current governance structure of the Polish research system. It has undergone considerable changes in the last three years. In 2004, for the first time a ministry responsible for the definition of R&D policy (instead of the scientific community itself) was established. Since the end of 2005 it has taken the form of the Ministry of Science and Higher Education (MNiSW) and is the central financing institution of public non-military R&D (see Figure 1 below).

Figure 1: Ministry of Science and Higher Education 2007 budget plan (in € millions)

Research projects and goal-oriented projects	304.94	31.76%
Statutory activity and investments	606.47	63.16%
Research support activity	15.84	1.65%
Foreign cooperation	29.22	3.04%
Remaining activity	3.72	0.39%
Total	960.19	100%

Source: Ministry of Science and Higher Education; this figures do not include EU Structural Funds

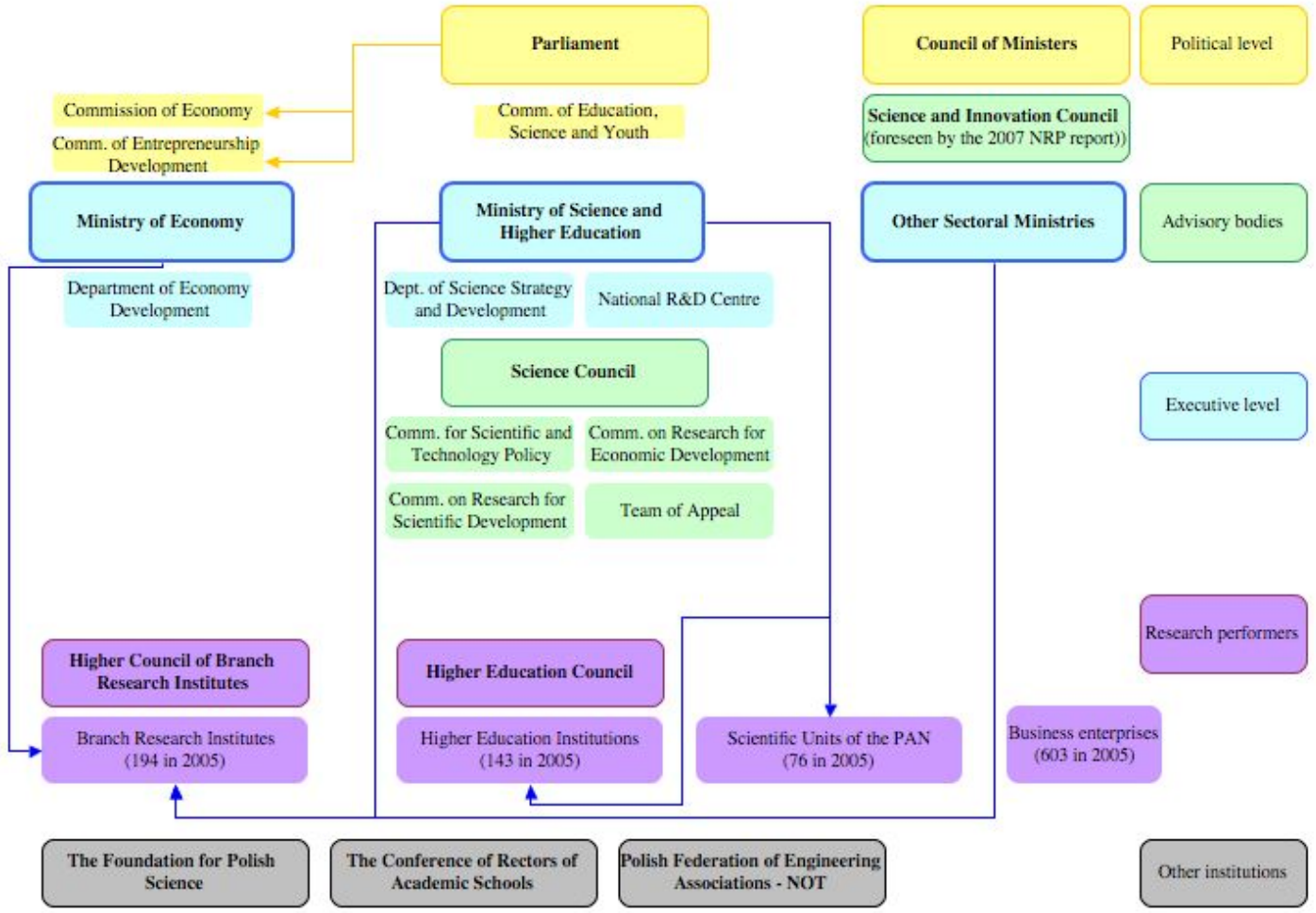
Advice to the MNiSW is provided by the Science Council, the successor of the State Committee for Scientific Research formerly responsible for research policy. The Science Council comprises a science and technology committee and research commissions for the needs of science and of industry. The opinions and recommendations issued by the Science Council have a significant impact on the final decisions of the MNiSW. Further changes in the governance structure are currently ongoing, such as the creation of the National R&D Centre, a national agency for research programme implementation.

The Ministry of Economic Affairs (MG) is responsible for innovation policy. It governs the majority of the so-called state-owned R&D units (JBRs), one of the main groups of public R&D performers, although some JBRs are also governed by other sectoral ministries. It is also the co-ordinator of the Lisbon Strategy for Poland and in charge of the corresponding National Reform Programme. Of other ministries, the Ministry of Regional Development is worth mentioning. It is the main responsible for the national development strategy which includes the supervision of the management of EU Structural Funds and responsibility for the regional operational programmes.

The Council for Science and Technology Development is a co-ordinating body established by a Prime-Ministerial Decree in January 2005. The Council is headed by the Prime Minister and consists of ministers in charge of science, economy, public finance, labour and education. The tasks of the Council include drafting opinions and assessments on a range of mechanisms supporting the use of scientific research and development, measures for increasing the innovativeness of the economy and the quality of life, or mechanisms of cooperation between public administration bodies, and submitting them to the Council of Ministers and the Prime Minister. The council may be replaced by a new Science and Innovation Council with similar functions.

Parliament plays a fairly strong role in research policy making as initiatives in this area are usually introduced in the form of laws which need to be approved by Parliament, e.g. the Act on the Principles of Financing Science. Moreover, it significantly shapes and finally decides the annual public budget for R&D as well as the structure of taxation.

Figure 2: Overview of the governance structure of the Polish research system



Source: ERAWATCH Research Inventory (2008), http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=PL&parentID=34

The role of the 16 Polish regions in research policy making is still limited. Nevertheless, regional governments have significant resources from European Structural Funds with which to implement innovation activities and develop regional human resources and now all the regions have regional innovation strategies. Their role will increase in the 2007-2013 Structural Funds period, as each region will have its own regional operational programme for the first time.

There are four major groups of R&D performers. These are the currently 143 research-performing universities, the nearly 200 state-owned Research and Development Units (JBRs), the nearly 80 institutes of the Polish Academy of Science (PAN), and the R&D centres of private enterprises, the latter performing only around 30% of total Polish R&D.

Chapter 2. Resource mobilisation

The purpose of this chapter is to analyse and assess how challenges affecting the provision of inputs for research activities are addressed by the national research system: its actors have to ensure and justify that adequate financial and human resources are most appropriately mobilised for the operation of the system. A central issue in this domain is the long time horizon required until the effects of the mobilisation become visible. Increasing system performance in this domain is a focal point of the Lisbon Strategy, guided by the Barcelona objective of a R&D investment of 3% of the Gross Domestic Product (GDP) in the EU as a whole and an appropriate public/private split.
Four different challenges in the domain of resource mobilisation for research can be distinguished which need to be addressed appropriately by the research system and research policies:

- Securing long-term investment in research
- Dealing with uncertain returns and other barriers to private R&D investment
- Providing qualified human resources
- Justifying resource provision for research activities

2.1 Analysis of system characteristics

Poland is the largest new EU Member State and one of the six largest EU countries in terms of population. With R&D expenditures of €1,386 million (2005)[2] it ranks 14th in the EU, contributing around 0.7% of total EU27 R&D expenditures. At 0.57% (R&D expenditure as a percentage of GDP in 2005) Polish R&D intensity is significantly lower than the EU 27 average of 1.84% and also lower than ten years ago. At 5.7% (2005) the share of R&D expenditures financed from abroad is still not very significant and remains below EU average, but has increased rapidly since 2000.

2.1.1 Securing long-term investment in research

In Poland, government – and in particular the Ministry of Science and Higher Education - plays the main role in securing long-term investment in research. The legal framework was last updated in the Act on the Principles of Financing Science

[2] If not stated otherwise, all quantitative indicators are based on Eurostat data.

and there is as yet no long-term budget programming for research in Poland. For the first time, the 2004 Act on the Principles of Financing Science introduced a basis for multi-annual research programmes. The Act also requires that government expenditures on R&D should be set at a level sufficient to achieve the Lisbon Strategy goals.
The Polish system is heavily reliant on publicly-owned research organisations for long-term investments in research. A significant, although slowly diminishing share (around 51% in 2005) of publicly financed research is conducted in public or semi-public research institutes, while more than 40% (with a slowly rising trend) is performed in higher education and less than 10% in the business sector. The main funding instrument is statutory (block) funding of research activities and infrastructure, which according to the 2007 budget is estimated at 2.33 billion PLN (€606.5 million), equal to about 63.16% of the entire public budget allocated to science and research (see also Figure 1 above). Since the beginning of the 1990s universities' research spending (apart from staff costs) is financed by this type of funding from the national budget. In relative terms, basic research has benefited from this funding structure, as between 1994 and 2003 its share rose from 32% to nearly 40% (ERAWATCH Network, 2006).

Since Poland joined the European Union in 2004, European funding has started to play a significant role in R&D resource mobilisation. This has resulted in a considerable increase in the amount of financial support allocated to research, technological development and innovation through the EU Structural Funds. The Polish progress report gives a total allocation from the national development plan 2004 to 2006 of €800m for innovation and R&D support (Republic of Poland, 2006). Planned resources for this period under the measure "Strengthening cooperation between the R&D sector and the economy" amount to €137 million, of which €100m come from the EU (Dabrowa-Szefler and Jablecka-Pryslopska, 2006).
In addition, Polish research units currently receive about €50 million a year from the EU Framework Programme (FP) (IPTS, 2006). For some research units this represents a considerable share. Poland has joined many European infrastructure initiatives, and was for instance, the first Central and Eastern European country to become a member of the European Organization for Nuclear Research (CERN). Co-operation with the European Space Agency (ESA) has also recently begun.

In conclusion, basic resources for long-term investment in research are mainly and steadily provided by the government. Comparing with Europe as a whole, however, resource mobilisation is low. Government appropriations for R&D as a share of GDP is 0.31% (2004), which is significantly below the EU25 average of 0.74% (2005) as well as below the share in other Central and Eastern European Countries and has been in continual decline since the early 1990s (Dabrowa-Szefler and Jablecka-Pryslopska, 2006). At 1.1%, the annual rate of growth in R&D expenditure in real terms between 2001 and 2005 was also low, although this seems to have changed recently. In a recent OECD assessment, the capacity for long-term planning was highlighted as one of the areas where there is scope for improvement (OECD, 2007).

2.1.2 Dealing with uncertain returns and other barriers to private R&D investment

The framework for private resource mobilisation for R&D changed completely with the transition from a centrally planned economy to a market economy. In 2004 587 enterprises were involved in R&D activity (GUS, 2005). Today, the share of total

Polish R&D financed by the business sector is around 30% (2005), which has even dropped since 1995. This comparatively low share is also due to the lack of large R&D intensive firms. According to the 2006 EU Industrial R&D Investment Scoreboard (European Commission, 2007), the only Polish company among the European top 500 R&D investors is Telekomunikacja Polska (€14.3 million in 2005). Also in comparison with other Central and Eastern European Countries, multinational firms still play a minor, albeit expanding role. Nearly 40% of BERD is performed by small and medium-sized firms (SMEs) with less than 250 employees, a significantly higher share than the EU average.

External private financing mechanisms for business R&D by banks and venture capital firms are also rather weak, although a range of guarantee and local loan funds have recently emerged. The government has partially attempted to address the problem. The share of business R&D financed by the government appears to be one of the highest shares in the EU, with 13.7% (2005), although it is decreasing. This figure has to be interpreted with caution, however, because it includes those state-owned R&D units (JBRs) whose R&D is over 50% funded from market sources. So-called goal oriented projects are one instrument financed by the Ministry of Science and Higher Education, which supports collaborative research for SMEs and industry. In principle, they require a 50% contribution from business. Recently, they have been renamed as "Technology Initiatives" (Inicjatywa technologiczna) and are now implemented in form of specific calls (see section 5.2.2).
With the Act on some forms of supporting innovation activities (2005), the government has introduced additional mechanisms to support research in the private sector. The status of private R&D centres has been created (for details see section 2.2.2). For the first time, the Act also allows R&D expenditure to be classed as an expense for tax purposes, regardless of the final R&D results, and to shorten the depreciation period from 36 to 12 months. Further incentives provided focus less on R&D as such and more on the acquisition of technologies, e.g. the creation of a Technology Loan Fund and a 50% deduction of the cost of acquiring new technology from taxable income (see section 5.2.2). In addition, general income tax exemptions are available for new foreign direct investment in special economic zones, and these also apply to R&D investments.

Summing up, private actors in Poland seem to still have difficulties coping with the risks of R&D investment. At 0.17% (2005) business-financed R&D as a share of GDP is significantly lower than the EU average of 1.01% (2004). While the EU average is not the appropriate benchmark for comparison given the socio-economic situation of Poland, the intensity of private R&D funding is also lower than in other Central European Countries such as the Czech Republic, Hungary and Slovenia. Increasing business R&D is one of the challenges repeatedly highlighted, but given the low absorptive capacity and a lack of private knowledge demand an adequate response has to go beyond the domain of resource mobilisation (see also sections 3 and 5.1.3).

2.1.3 Providing qualified human resources

Postgraduate education is offered by universities, which have a fairly autonomous status. The availability of qualified researchers is relatively high. Currently 30,000 students are undertaking PhD training, and 5,000 of them graduate each year. The number of doctoral students has increased 12-fold since 1990 (Dabrowa-Szefler and

Jablecka-Pryslopska, 2006). Also the number of science and technology graduates has risen significantly over the last few years (see also section 5.1.3).
With the economic and social transformation, other fields such as economics, business and social sciences have become increasingly attractive and career prospects for researchers have to compete with other economic opportunities. Pursuing an academic career requires a PhD, "Habilitated Doctor" status, and subsequently the academic title of Professor, with specific criteria and procedures at each of the three levels. The majority of the research community, in particular young researchers, are calling for the abolition of the second degree, while its defenders support the present system as a quality assurance mechanism (Dabrowa-Szefler and Jablecka-Pryslopska, 2006). Moreover, limited post-doc and faculty positions in universities compared with the number of PhDs, particular in the social sciences, and low demand for researchers in business are disincentives for starting a researcher career (OECD, 2007).
The government is trying to enhance quality and perspectives of postgraduate education with the provision of competitive grants (supervised by the Science Council) for

- supervised projects aimed at preparing a doctoral dissertation and
- specific projects, including projects relating to the post-doctoral academic degree, on subject matter specified by the applicant.

Attracting foreign researchers, as additional mechanism to provide qualified human resources, is hampered by comparatively low salaries and partly also by the language barrier. The Polish government has created a programme to recruit expatriate researchers, but most of the applicants were actually recruited from within Poland (OECD, 2007). Grants to researchers returning from abroad are also provided by the Foundation for Polish Science's "Homing" programme (Rybicki, 2007).

2.1.4 Justifying resource provision for research activities

Resource mobilisation for research has not traditionally been high on the general policy agenda, although there is evidence suggesting that this is changing. Until 2005, there was clear competition between research and innovation policy, which in practice meant a lack of horizontal coordination between the ministries concerned. The changing context after EU accession in 2004 has contributed to greater recognition of R&D as a driver of innovation, e.g. Poland initially even embraced the Barcelona objective of attaining a level of 3% of GDP devoted to R&D by 2010.
Correspondingly, the enhancement of public understanding of science is not a priority topic, but there are initiatives in Poland promoting science among the general public, and particularly children and young people, e.g. Science Days or Science Picnics (European Trend Chart on Innovation, 2006). There are also flourishing science festivals at the local level, which are co-funded by the government.

To sum up, societal pressure for resource mobilisation for research is still low which is also reflected in the share of R&D outlays in total government expenditures, which at 0.73% (2004) is significantly lower than the EU25 average of 1.56% (2004) as well as lower than in other Central and Eastern European Countries and has decreased since 2000.

2.2 Analysis of recent changes and policies

2.2.1 Relevant recent trends

While foreign multinational firms present in Poland have typically conducted little R&D in Poland, this has been changing in recent years. Around 30 multinationals have now established R&D centres in Poland, mainly in information technology (OECD, 2007).

Another trend relevant for securing long-term investment in R&D is that of the increasing budgets for R&D and innovation in the new programming period for the EU Structural Funds (2007-2013). The total Community allocation for Poland foreseen is €66.5 billion of which 63.9% are scheduled to be Lisbon goal-relevant expenses. This is around three times the respective amount for the period 2004-2006 (Republic of Poland, 2007).

2.2.2 Role and expected impact of recent policies

The National Reform Programme (2005-2008) of December 2005 assumed that a level of 1.65% Gross Expenditures on R&D (GERD) per GDP will be reached by 2008. On 8 June 2006, the Council of Ministers adopted the Implementing Document of the National Reform Programme, setting clear targets for R&D policy. The document confirmed the 1.65% policy target for GERD, and introduced the additional target of increasing private funding of R&D from 0.17% of GDP in 2004 to 0.55% of GDP by 2008. The progress report of 2007 expects and commits to a much more modest rise of GERD per GDP to 0.81% in 2008 and 0.92% in 2010 (Republic of Poland, 2007). Given existing funding levels which are still well below, the latter percentages are more realistic.
In 2007, the planned public science budget (excluding military R&D and EU Structural Funds) is 3.7 billion PLN (€960m). According to the implementing document of the NRP (2005-2008) the budget should increase to 4.91 billion PLN (€1,165.4m) by 2008.

Early in 2006 the various R&D relevant fiscal measures contained in the Act on Some Forms of Supporting Innovation Activities (2005) came into force (see also section 5.2.2). It is expected that these incentives will also help attract R&D investments by foreign companies. An impact assessment forecasted an increase of intramural business R&D expenditure of more than €220m, although this seems to be an overestimate (Walendowski, 2007). A business granted the status of a private R&D centre will be exempted from various taxes (e.g. agricultural tax, forestry tax and property tax). Such businesses will also be able to establish an internal innovation fund from which to finance R&D activities. An R&D Centre is allowed to pay up to 20% of its monthly income into this fund. The advantage is that the financial resources allocated to this fund are not treated as income, thus reducing tax liability. Among the conditions to be met is that 50% of annual revenues (of at least €800,000) should be generated by the company's own research and development activities. Participation by firms has thus far been low, however (OECD, 2007).
One important measure to stimulate R&D investments by innovative SMEs shortly due to become operational is the new revolving "National Capital Fund", capitalised with €180m from the EU Structural Funds. Key issues are attracting capable managers and investors and the independence of the fund (OECD, 2007).

Recent policy initiatives have to a large extent concentrated on preparing the Structural Fund interventions for the financial horizon 2007-2013, which is not surprising given the importance of financial allocations. According to the National Strategy Reference Framework (NSRO) adopted by the Council of Ministers on 1 August 2006, there have been 40 events and 3,500 people have been consulted about the priorities. One result is the single OP Innovative Economy 2007-2013, which includes research-related issues. The total public allocations for the implementation of the programme amount to €9,711.6 million, including EU funding of €8,245.9 million. Among the priorities are research and development of modern technologies as well as R&D infrastructure, for which an EU contribution of €2,234 million is foreseen (Ministry of Regional Development, 2007). According to the Ministry of Science and Higher Education, in 2007 at least €46 million will be added to the national science budget. In addition there will be 16 regional operational programmes with an overall EU contribution of €16.55 billion, including technological research and development, and innovation and enterprise as one action line. In particular the implementation at the regional level, which up to now had a limited role, still constitutes a considerable research policy challenge (Walendowski, 2007). The new operational programmes "Human Capital 2007-2013" (see section 5.2.2) and "Development of Eastern Poland" contain important R&D-related elements, too.
A new programme has been set up by the Ministry of Science and Higher Education to support the career development of young post-doctoral researchers. It provides financing for participation in projects carried out at a body other than that which awarded the researcher's qualification (OECD, 2007).

2.3 Assessment of resource mobilisation

The main strengths and weaknesses of the Polish research system in terms of resource mobilisation for R&D can be summarised as follows:

STRENGTHS:	WEAKNESSES:
- Mechanisms are in place to ensure the provision of an adequate and well qualified human resource base for R&D.	- limited private R&D funding in comparison with the EU average and other new Member States - little pressure from society and the economy to provide more resources for R&D

The main opportunities and threats for resource mobilisation in Poland arising from recent policy responses and in the light of the Lisbon Strategy can be summarised as follows:

OPPORTUNITIES:	THREATS:
- Increased public resource mobilisation for research due to significant budget increases in response to the Lisbon Strategy and the availability of European Structural Funds - enhanced private R&D investment due to a range of new support measures, which may also contribute to further foreign R&D investment	- leverage effects from public towards private resource mobilisation might not be achieved to the extent expected

Chapter 3. Knowledge demand

The purpose of this chapter is to analyse and assess how knowledge demand contributes to the national research system's performance. It is concerned with the mechanisms used to determine the most appropriate use of, and targets for, resource inputs. Main challenges in this domain relate to governance problems stemming from specific features of knowledge and the need for priority setting. These include:

- Identifying the drivers of knowledge demand
- Co-ordinating and channelling knowledge demands
- Monitoring and evaluating demand fulfilment

Responses to these challenges are of key importance for the more effective and efficient public expenditure on R&D aimed at in the Lisbon Strategy Integrated Guideline 7.

3.1 Analysis of system characteristics

Private demand for R&D is constrained by the sectoral structure of the Polish economy, which primarily focuses on low- and medium-low-tech activities. The share of medium-low and low tech in manufacturing business expenditures on R&D (BERD) is 20% (2002), which is double the EU average, while the share of high tech is 34%, which is significantly below the EU average of over 41%. Polish business R&D is strongly specialised in mining, metals and agriculture. Furthermore there are a range of sectors in which Poland specialises in terms of value added but not BERD and where a similar pattern exists for patents compared with BERD, e.g. non-metallic minerals, food, timber, and publishing. The share of BERD performed in services was among the lowest in the EU but has increased in 2004 to 24.7%. According to data for the period between 2001 and 2003, it is specialised in community services, telecoms and construction, while IT services have been at the bottom end of the R&D specialisation (ERAWATCH Network, 2006). Recently, knowledge demand of multinational enterprises has increased, e.g. in the motor vehicle and the IT sectors.
Public R&D demand is comparatively unspecific. Around two thirds of government appropriations and outlays for R&D are attributed to non-oriented research and general university funds. Among the oriented socio-economic objectives of R&D, in a European perspective compared with the EU 15, Poland is only specialised in industrial production, although it is difficult to draw robust conclusions (ERAWATCH Network, 2006).

3.1.1 Identifying the drivers of knowledge demand

Systematic instruments to identify drivers of knowledge demand have only been introduced in recent years. The main instruments involved in identifying research priorities are:

- The National Foresight Programme, which is supposed to provide strategic orientations (for details see section 3.2.2). A pilot foresight was conducted in the "health and life" area between 2003 and June 2006, with financing from the EU Structural Funds.
- The Strategic Research Agendas prepared by the Polish Technology Platforms. These were initiated in 2004 in response to the EU's FP6 activities on technology platforms. Today, there are 25 Polish Technology Platforms which attempt - with a varying level of activity - to integrate the most dynamic and competitive companies as well as research units.

"Europeanisation" seems to be the single most important driver (Kozlowski, 2006).

Consultation mechanisms are occasionally used (e.g. during preparation of the National Framework Programme and recently during preparation of the Operational Programmes of the National Strategic Reference Framework 2007-2013). Think tanks, such as the Gdansk Institute for the Market Economy, the Polish Academy of Sciences, the Main Council of the R&D Units or the Conference of Rectors of Academic Schools in Poland, usually take part in debate on the planned research policy measures (IPTS, 2006).

The business sector's ability to articulate its demands to political actors is not very strong, with the partial exception of the National Chamber of Economy. This is in large part due to the economic profile resulting from the transformation of the economy and the resulting low absorptive capacity for R&D (see also section 5.1.3). Only since February 2005 the Minister of Science and Higher Education is able to appoint industry representatives as members of the Committee on Research for the Development of the Economy, part of the Science Council. Currently, in the transitional period, only two members of this Committee have been drawn from industry, although after 2008 their number is expected to rise (IPTS, 2006). The three main sectors driving private knowledge demand are transport equipment (15.4% of the total amount of BERD), machinery (10.3%) and pharmaceutical products (9.4%; GUS, 2005). The state-owned R&D units (JBRs) partly act as intermediaries between traditional industries and science (OECD, 2007).

An overall appraisal of innovation governance ranked the Polish system's performance as satisfactory with regard to the openness of the process of designing innovation policy (measures) and the involvement and consultation of key stakeholders. However, it highlighted weaknesses in the appraisal of the impact on innovation of developments and regulations in other policy fields (European Trend Chart on Innovation, 2006).

3.1.2 Co-ordinating and channelling knowledge demands

Until recently, research policy had a relatively passive role and all research areas were supported without prioritisation, as was also indicated by the large share of non-oriented Government appropriations for R&D. Only since 2004 has the minister responsible for science and higher education, and not the scientific community itself, had the final say on funding R&D projects. As a result of several years' of attempts by experts and government to agree upon national research and development priorities, including a public consultation with over 1600 responses, the National Framework Programme (KPR) was created in 2005. As major system defining strategic research areas for the first time, it has been composed of three hierarchical stages:

1. The strategic research areas include projects covering a wide range of issues, corresponding to the country's long-term scientific and technological policy.
2. The priority directions (characterised by a medium-term period for attainment) narrow down the thematic scopes within the strategic research areas.
3. The so-called "ordered projects" are defined by detailed priorities of the KPR. Priorities are based on proposals from different stakeholders (such as ministries, regional governments, universities, research organisations or companies). The ordered projects established under the KPR were intended to be large, interdisciplinary and area-related and include basic research, applied research and experimental development.

The expenditure on the KPR should contain a major part of the public funds for R&D. The planned budget for 2006 was €68.7 million, which is 8% of the total science budget in 2006. The following nine main strategic research areas were defined:

- Health
- Environment
- Agriculture and food
- State and society
- Security
- New materials and technologies
- Information technologies
- Energy and its resources
- Transportation infrastructure.

In each of these areas, the main priorities have been divided into a number of groups. The minister has called an interdisciplinary group to elaborate the proposed themes and the conditions under which projects are to be conducted. Public competitions for projects to be implemented were foreseen at least once a year.
Within this overall framework, the programme has been relatively open to changes in priorities and it was envisaged that priorities will be updated annually.
However, implementation of the KPR has recently been superseded by new developments in the context of the establishment of the National Research and Development Centre (see section 3.2.2).

Also, other ministries can initiate multi-annual thematic programmes, either within or beyond the KPR framework. Programmes have been established which support specific national policies in energy, health, agriculture and the environment. However, with the exception of health, which represents a 3.4% share of GBAORD in 2003, all these socio-economic objectives receive well below of 2% of GBAORD. Agreements on multiannual programmes are negotiated with the respective Ministries, e.g. the Ministry of Agriculture and Rural Development. Beyond that, sectoral ministries can also use those R&D units (JBRs) which they govern to channel demand for thematic R&D. This is also one mechanism with which to channel the 16% of GBAORD which is oriented towards industrial production and technology. Another comparatively large field is defence-related research, accounting for more than 7% of GBAORD. Military R&D projects are financed through direct transfers from the Ministry of Finance to the Ministry of Defence.

The similarity of the nine strategic research areas of the KPR with the thematic areas of the European Framework Programme indicates that the European Union at least has an indirect influence on priority setting and programme design in general. Moreover, European activities on Technology Platforms and the preparation towards FP7 resulted in the setting up of a system of Polish Technology Platforms mentioned above. Also, the observable increase in consultations of stakeholders over the last years, which began prior to the preparation of the EU Structural Fund's financial perspective 2004-2006, is characterised as being inspired by EU experience.
Polish co-operation with the European Space Agency will produce further European interaction, the next step in which will require, among other things, committing at least €1 million a year over five years to strengthening the space industry. Currently, R&D related to the exploration and exploitation of space is negligible (0.1% of GBAORD), if the statistics are comprehensive.

The European influence on the system's performance with regard to knowledge demand has been evaluated positively (Kozlowski, 2006). By contrast, assessments of co-operation and co-ordination between different Polish government actors have found this area to still be rather weak. Improving overall co-ordination with a special emphasis on enhancing horizontal policy cooperation and the quality of partnerships is considered to be of the key challenges in the Polish context (European Trend Chart on Innovation, 2006). This challenge has been repeatedly mentioned in reports or studies addressing the problems of the Polish innovation system (e.g. Goldberg, 2004; Wintjes, 2004).

3.1.3 Monitoring and evaluating demand fulfilment

Officially, the Science Council may carry out evaluations, but in practical terms no evaluations of national research policy measures and programmes have yet been conducted. However, the problem has been mentioned in the 2004 *Guidelines for the government's science, science and technology and innovation policy until 2020*. Also, participation of industry stakeholders in the various forms of research evaluation has been recommended. Representatives of the business community are expected to participate in the peer review of funding applications in the field of applied research.
So far assessments have only been performed in order to define programmes supported by Structural Funds. Recently, three evaluations have been completed regarding the implementation of the Operational Programme Increasing Competitiveness of Economy 2004-2006. The evaluations were conducted by independent experts and the results are publicly available. However, these assessments do not include specific analysis of R&D related results and impacts.

System evaluations so far have been largely conducted with the assistance of international organisations such as the World Bank (Goldberg, 2004). More recently, a peer review of the Polish policy mix for innovation has been conducted by the OECD which was requested by Polish government (OECD, 2007). Recent developments suggest that policy makers also make use of international assessments. For example, the project Phare SCI-TECH led to the updating of the Act on the Research and Development Units (JBR) with a view to speeding up the process of reorganising the public R&D sector. An innovation governance assessment financed by the Dutch Government (Wintjes, 2004) stimulated debate, which ultimately led to the adoption of the Act on some forms of supporting innovation activities.

An overall appraisal of evaluation practice in innovation policy ranked the Polish system's performance on a range of aspects as being unsatisfactory (with room for improvement), e.g. with regard to the regularity and transparency of policy monitoring and review processes, the existence of an "evaluation culture" and the use of evaluation results in policy making (European Trend Chart on Innovation, 2006).

3.2 Analysis of recent changes and policies

3.2.1 Relevant recent trends

One recent trend already mentioned, which is also relevant for knowledge demand, is the increase in European Structural Funds. This corresponds to an increasing role and responsibility of regions with regard to the channelling of demand. While around €6.3 billion Lisbon goal-relevant expenditure is allocated via the national "Innovative

Economy" Operational Programme, nearly €7 billion of expenditure of this type is now allocated via regional operational programmes (Republic of Poland, 2006).

3.2.2 Role and expected impact of recent policies

The National Framework Programme (KPR) as one of the few recent policy initiatives adopted is an example of a tool that is clear and transparent. Built jointly with stakeholders, it aimed to overcome a key gap of the Polish research system and is geared towards the Lisbon targets (IPTS, 2006). However, implementation has progressed more slowly than expected. It has been superseded by changes in the government and the development of a new implementation structure for research support. The establishment act of the new National Research and Development Centre (NCBR), as a state agency financing strategic R&D activities, has entered into force mid July after several delays. The NCBR is due to manage strategic R&D projects with a budget of more than €25m. Several ministries as well as representatives from the private sector and the scientific community will be represented on its council. In total, 10% of the MNiSW budget is planned to be allocated to the NCBR, using also resources from the "Innovative Economy" Operational Programme based on EU Structural Funds.

Since 2006, on the initiative of the Ministry of Science and Higher Education, a consortium co-ordinated by the Institute of Fundamental Technological Research of the Polish Academy of Sciences has been running the "Poland 2020" National Foresight Programme. The three main areas covered are sustainable development, ICT and security. The impact of this initiative remains to be seen.

The new programming period for the European Structural Funds was prepared in 2006. A national strategic reference framework was adopted. Research- and innovation-related measures were integrated into the Operational Programme Innovative Economy 2007-2013, which was jointly prepared by the ministries for science and for the economy and adopted in May 2006. A draft version of this programme was circulated among representatives of various interest groups for consultation. Governance of the implementation is divided between the two ministries according to the focus of the priorities. In September 2006, the Minister responsible for science and higher education organised a collection of ideas for the themes of key R&D projects which should receive financing in the framework of the Operational Programme. One example of a project of this kind is the so-called DolBioMat project, for which the Wrocław research community is due to be granted €120 million. This will form one element of the EIT plus initiative which aims to establish one of the Knowledge and Innovation Communities of the envisaged European Institute for Technology in Wroclaw (EIT PLUS, 2007). Another Operational Programme focuses on human capital development, including developing human capital for R&D.
For the 16 regional operational programmes the regional governors (*voivodes*) appointed by the government and the regional self-governments (headed by an elected *voivodeship* marshal) are both responsible, which complicates implementation. Given the fact that experience of some regions in designing and managing R&D projects is low, there is a danger that some regions will seek to develop research-oriented policies without a thorough analysis of different investment options and taking different research and technological specialisations and global trends insufficiently into account. A recent attempt by the government to regulate responsibilities between central and regional level has met with resistance from regional representatives (Walendowski, 2007).

An update of the Act on the Principles of Financing Science was adopted mid June 2007 and entered into force 1 July. The main aim is to streamline the application procedure for R&D grants and to take account of institutional changes such as the creation of the NCBR.

The policy coordination challenge with regard to public knowledge demand has been recognised by the Polish government and is mentioned in strategic policy documents. The two options discussed are to strengthen the existing Council for Science and Technology and to create a new Innovation Council, linked directly to the Prime Minister's office and responsible for the horizontal and vertical coordination of research and innovation policy. Recently the latter option, which had been proposed by the Ministry for the Economy, is favoured and an implementation as replacement of the existing Council is envisaged for 2007 (OECD, 2007).

3.3 Assessment of knowledge demand

The main strengths and weaknesses of the Polish research system in terms of knowledge demand can be summarised as follows:

STRENGTHS:	WEAKNESSES:
- (no main strengths in this domain)	- lack of sophisticated private R&D demand due to low-tech orientation of the economy - until recently, weak co-ordination of knowledge demands by policy actors - evaluation culture and systematic monitoring mechanisms not strongly developed

The main opportunities and threats for knowledge demand in Poland arising from recent policy responses and in the light of the Lisbon Strategy can be summarised as follows:

OPPORTUNITIES:	THREATS:
- new instruments preparing research policy priority setting including major scientific and private stakeholders, e.g. through the "Poland 2020" National Foresight Programme - more effective public demand through the joint Operational Programme for an Innovative Economy and improved implementation mechanisms for multi-annual strategic programmes	- possible improvement of effectiveness of public expenditure by increased involvement of the regions through regional operational programmes threatened by a lack of adequate regional governance capacities

Chapter 4. Knowledge production

The purpose of this chapter is to analyse and assess how the research system fulfils its fundamental role of creating and developing excellent and useful scientific and technological knowledge. Any response to knowledge demand has to balance two main challenges:

- On the one hand, ensuring knowledge quality and excellence is the basis of scientific and technological advances. It requires considerable prior knowledge accumulation and specialisation as well as openness to new scientific opportunities, which often emerge at the frontiers of scientific disciplines. Due to the expertise required, quality assurance processes are here mainly the responsibility of scientific actors, but may be subject to corresponding institutional rigidities.
- On the other hand, there is considerable interest in producing new knowledge which is useful for economic and other problem solving purposes. Spillovers which are non-appropriable by economic producers as well as the lack of possibilities and incentives for scientific actors to link to societal demands lead to an exploitability challenge.

Both challenges are addressed in the research-related Lisbon Strategy Integrated Guideline.

4.1 Analysis of system characteristics

4.1.1 Ensuring quality and excellence of knowledge production

The institutional setting for ensuring continuity and quality in the production of knowledge in Poland is marked by a variety of historical influences. One is the tradition of autonomous universities which combine a research and education function and ensure research quality, mainly through academic career mechanisms. This tradition was kept alive during the communist era but lost importance in the transformation to a liberal market economy that began in the 1990s. Although it was formally reinforced in the new education law, it was superseded by the rise of new, often private, institutions focusing on higher education and the changed funding mechanisms. The research performing universities now account for now more than 30% of Polish R&D (Dabrowa-Szefler and Jablecka-Pryslopska, 2006). The best known universities are Warsaw University, Technical University of Warsaw, and Jagiellonian University in Cracow. The Warsaw School of Economics has also gained an important international position and reputation.

The second influence is the 40 years of integration of research in a centrally planned economy lasting until 1989, which led to two additional and distinct institutional forms of performing basic and applied research. One the one hand there is the important role of the Polish Academy of Science as the central umbrella over a range of public research institutes. It is still quite influential due to its historical role in research governance, although it performs less than 15% of R&D. And on the other hand, there are the nearly 200 state-owned Research and Development Units (JBRs), which in communist times collaborated closely with industry and were even seen as substitutes for companies' in-house R&D (see also Goldberg, 2004). They lost some of their role with the economic transformation (see below) but still perform more than a third of Polish R&D.

Since the early 1990s research excellence and quality have been the formal main priorities of research policy and key criteria for public research funding. No priorities for socio-economic development were set, however (Dabrowa-Szefler and Jablecka-Pryslopska, 2006). Until recently, when competitive project-oriented grants gained importance, the main instrument was selective statutory or block funding. This was based on a parametric assessment whereby various indicators were applied, including (up until 2005) factors such as peer-reviewed publications, monographs, academic degrees obtained, patents, quality management of laboratories, etc. over the three previous years. Research units were benchmarked on this basis against other units conducting research of a similar nature in a similar discipline and graded into five categories, leading to different levels of block funding. In 2005, 60% of PAN R&D units, 19% of university research units and 15% of JBRs were graded in the highest category. A new assessment system was proposed in 2005 but met with criticism from the research community (Dabrowa-Szefler and Jablecka-Pryslopska, 2006). So far it seems only to have been implemented for funding research in universities, but the amount of the additional premium funding is insufficient to significantly raise overall levels of university research (OECD, 2007). Given the low level of funding and the tradition of the research community's distributing funding bottom up according to scientific disciplines that prevailed until 2004, in practice the envisaged selective effects have barely materialised (OECD, 2007). Nor was openness to inter- and multidisciplinary projects promoted by these practices. The lack of selective effects is one key reason for the increase in competitive project-oriented funding mechanisms and the planned creation of the NCBR as a new agency for its management (see also section 3.2.2).

Against this backdrop, starting with FP 5, competitive European funding mechanisms played an important role in the establishment of networks of centres of excellence and competence centres. For example, 85 centres of excellence were selected in 2001 which received an additional budget of €26m, representing a considerable share of funding at the research unit level. In 2005, Poland was ranked in 9th position in the EU 25 with 456 FP contracts signed (Siemaszko and Supel, 2006). Overall, however, the volume of funding awarded to successful Polish contracts is well below the estimated Polish contribution to FP funding. EU initiatives were followed in 2004 by a competitive call run by the Polish research ministry for the establishment, selection and co-financing of finally 100 Centres of Advanced Technologies in Poland. This activity was part of the implementation of the European Structural Funds, aiming at increasing the role of science and research as a factor in enhancing the competitiveness of the Polish economy. However, funding does not cover the cost of research, but only co-ordination and infrastructure costs.

While the natural sciences and engineering together remain the dominant scientific fields in Poland, accounting for 60% of HERD and two thirds of GOVERD, the share of engineering has decreased in universities and increased in public research organisations. Over the period 2001 to 2003, compared with the EU15, Polish scientific publications showed a strong specialisation in chemistry, physics and also in materials sciences, plants and animals, and, albeit decreasing in importance, mathematics. Compared with 1993/1995, Polish publications lost their (low) specialisation in engineering and space sciences. Citations show a roughly similar picture, but engineering here remains a field of specialisation. The social sciences have increased their share, particularly in universities, but are still an area with strong negative specialisation compared to the EU15 (ERAWATCH Network, 2006).

The Polish government assesses the persistent fragmentation of the R&D system, the development and modernisation of the R&D infrastructure, which has not been favoured by the dominant funding mechanisms, and the strengthening of the system of centres of excellence as important challenges in order to ensure the quality of knowledge production. Room for quality improvement is also indicated by the number of peer-reviewed scientific publications per million inhabitants, which is, at around 300, only half of the EU average, and also lower than in many other Central and Eastern European Countries, although growing faster than the average between 2001 and 2004.

4.1.2 Ensuring exploitability of knowledge

The process of adjusting intellectual property rights to international standards started with the Association Agreement with the EU in 1991. A separate law on Industrial Property Rights was finally adopted in 2000 (Dabrowa-Szefler and Jablecka-Pryslopska, 2006).

The traditional mechanisms linking knowledge production to possible economic or other societal needs largely collapsed during the transition to a market economy. With the establishment of the branch R&D units (JBRs) in the communist era, production of applied knowledge was in fact institutionally separated from both firms and universities. The decline in public funding and decreasing demand for R&D from industry as it began to be privatised meant JBRs had to compete on small-scale projects. They adjusted during the transformation by downsizing and realising assets to generate income with which to survive. In more than half of the branch R&D units, the main source of income has been generated by non R&D activities. This had a negative impact on their subsequent ability to perform their previous role. An attempt in 2003 to introduce reforms produced only limited results. A new reform has been finalised in 2007 (see section 4.2.2 for details).
Incentives for academic researchers to co-operate with industry were limited and the fact that statutory funding distribution mechanisms were the main source of R&D funds was a disincentive (Dabrowa-Szefler and Jablecka-Pryslopska, 2006). This is reflected in the comparatively high and even increasing share (nearly 40%) of basic research in Polish R&D (see also ERAWATCH Network, 2006).
The problematic status of the exploitability of knowledge is also reflected in the low correlation between sectoral business R&D and patent applications. Moreover, patent specialisation only partly corresponds to value added specialisation (each compared with the EU15 specialisation profile), with significant discrepancies in some areas, for instance, in the chemicals, pharmaceuticals and petroleum sectors (ERAWATCH Network, 2006).

The Act on the Principles of Financing Science (8 October 2004) tried to respond to these challenges by introducing or strengthening two types of competitive R&D projects:

- development projects aimed at carrying out a research task intended for practical application, and
- goal-oriented projects, now including projects concerning the implementation of sectoral operational programmes or regional development programmes including R&D, which can be submitted by sectoral ministries, regional authorities or entities able to implement results in practice (Dabrowa-Szefler and Jablecka-Pryslopska, 2006).

The goal-oriented projects targeted at business, and in particular SMEs, are managed by the Polish Federation of Engineering Associations (NOT), which is a non-governmental network of around 50 branch institutions. The Act also added a new evaluation criterion for research funding applications, namely that the possibility of co-financing R&D from non-budgetary sources should be taken into account. This means that applications involving financial engagement from industry will be treated on a preferential basis (IPTS, 2006).
So far there is no cluster policy in Poland, but there is growing recognition of the importance of the issue expressed by the number of expert reports and conferences.

The improvement of co-operation with industry in knowledge production as one means to increase the exploitability of knowledge has repeatedly been highlighted in assessments as one of the main challenges facing the Polish research system (e.g. OECD, 2007; European Trend Chart on Innovation, 2006). A recent OECD review found that only a few of the Centres for Advanced Technology are performing well and that, to date, they have had little effect on seeding regional or interregional clusters (OECD, 2007). The system's weak performance in terms of exploitability of knowledge is also reflected in the low number (less than 5) of EPO patent applications per million inhabitants (2003) compared with an EU 27 average of 128, although this indicator should be interpreted with care in the case of the new EU Member States. However, patent applications have increased four fold since 1996, leading to one of the fastest growth dynamics in the EU 1999 to 2002.

4.2 Analysis of recent changes and policies

The policy document on "Preliminary Assumptions for Change in the Research and Development System" produced by the Polish Ministry for Science and Higher Education (3 March 2006) presents an outline of a proposed major reform aiming at improving the quality of public knowledge production. In the context of the creation of the national R&D Centre (NCBR) (see section 3.2.2), the JBRs are to be re-arranged (mostly by mergers) and integrated in a network of centres of excellence. The implementation document of the National Reform Programme underpins this with the target of reducing the number of JBRs from 187 in 2004 to 130 in 2008. A part of the restructuring will be achieved by privatisation of some of the JBRs.

The NCBR's legal framework was only completed in mid 2007, which has also delayed the implementation of the revision of the Act on R&D entities. Its intention was to change the principles of financing to eliminate barriers to restructuring and enable a stronger concentration of resources, e.g. by introducing the possibility of bankruptcy. The revision has been passed by parliament in July 2007. One remaining issue which makes further changes difficult is the discrepancy between funding (by the Ministry or Science and Higher Education) and governance. Here, the role of sectoral ministries is strengthened. Another perceived problem is the close link between the institutional form of the JBRs and the communist era, which leads to political resistance to a stronger role for them.

Another agency, the Agency for Basic Research (ABP) is to be created to deal with projects aimed at the support of the development of science. This agency is partly transferring the model of the German Research Foundation (DFG) and the European Research Council (ERC) to the Polish context.

4.3 Assessment of knowledge production

The main strengths and weaknesses of the Polish research system in terms of knowledge production can be summarised as follows:

STRENGTHS:	WEAKNESSES:
- solid system to enhance basic research underpinned by quality criteria	- weak mechanisms to gear knowledge production towards commercial applications

The main opportunities and threats for knowledge production in Poland arising from recent policy responses and in the light of the Lisbon Strategy can be summarised as follows:

OPPORTUNITIES:	THREATS
- new agency for programme implementation (NCBR) as an improved mechanism to enhance excellence as well as effectiveness of public expenditure	- reinforced sectoral governance structure of JBRs might hamper further institutional reforms to improve both the excellence and exploitability of knowledge production

Chapter 5. Knowledge circulation

The purpose of this chapter is to analyse and assess how the research system ensures appropriate knowledge flows and sharing between actors. This is vital for its further use in the economy and society or as the basis for subsequent advances in knowledge production. Knowledge circulation is expected to happen naturally to some extent, due to the mobility of knowledge holders, e.g. university graduates who go on to work in industry, and the comparatively low cost of reproducing knowledge once it is codified. However, there remain three challenges related to specific barriers to knowledge circulation which need to be addressed by the research system in this domain:

- Facilitating knowledge circulation between university, PRO and business sectors
- Profiting from access to international knowledge
- Enhancing the absorptive capacity of knowledge users

Significant elements of Integrated Guideline 7 relate to knowledge circulation. To address them effectively requires a good knowledge of the system's responses to these challenges.

5.1 Analysis of system characteristics

5.1.1 Facilitating inter-sectoral knowledge circulation

The state-owned Research and Development Units (JBRs) had traditionally been the main public research institutions to facilitate inter-sectoral knowledge circulation. With the changing of the role of the JBRs during the transition (see section 4.1.2), these institutions had difficulties to preserve this role when adapting to the new environment. Many have tended either to specialise in knowledge production or to take on other commercial activities. Nevertheless, these public research organisations are still an important actor in the research system and the main actor in terms of links with business. This is also reflected in the overall share of government

R&D expenditures financed by industry, which according to recently revised Eurostat data at 14.7% (2004) is significantly higher than the EU 27 average of 6.1% (2004).
Another important bridging institution is the Polish Agency for Enterprise Development, which was established in 2000. Among other activities, it supports collaboration between SMEs and public research entities, promotes the commercialisation of R&D results and supports academic entrepreneurship (European Trend Chart on Innovation, 2006). A range of science and technology parks have also been established.

Incentives for inter-sectoral R&D collaboration and the circulation of personnel between universities and industry seem to be low from both sides. Despite the limited public funding of Higher Education expenditures on R&D (HERD), the share of HERD financed by business is, at 5.5% (2004), lower than the EU average of 6.7% (2004) and has declined since the end of the 1990s.
The revised law on higher education passed in July 2005 attempts to facilitate inter-sectoral collaboration. Article 4.4 provides that higher education institutions should cooperate with industry by providing their R&D results – on a commercial basis, or free of charge – to enterprises and should raise awareness of entrepreneurship within the academic community by conducting economic activities. Article 86.1 builds on this and allows higher education institutions to set up academic incubators of entrepreneurship and technology transfer centres.

Recently, other mechanisms to enhance inter-sectoral knowledge-circulation have grown in importance. One such mechanism is the creation (since 2005) of Polish Technology Platforms for cooperation between industry and research (see section 3.1.1). Other mechanisms enhancing co-operation between academia and industry were launched within the framework of the Sectoral Operational Programme "Improvement of the competitiveness of enterprises 2004-2006" to implement the EU Structural Funds for that period, e.g. aid for Advanced Technology Centres and technology transfer activities at the regional level. Currently, there are 29 technology transfer centres of which 13 are situated in universities. Universities also run 38 regional patent information centres (Dabrowa-Szefler and Jablecka-Pryslopska, 2006). Also a new law regulating Public-Private Partnerships was passed in 2005 (for more details see section 5.2.2).

The bolstering of links and knowledge flows between public and private R&D actors is frequently highlighted as one of the main challenges facing the Polish research system (e.g. OECD, 2007; European Trend Chart on Innovation, 2006). Responses to this challenge also call for improvements in the exploitability of knowledge (section 4.1.2) and the absorptive capacity of knowledge users (section 5.1.3).

5.1.2 Profiting from access to international knowledge

Even before it joined the European Union, Poland took part in European Framework Programmes since FP5. As discussed in section 4.1.1, access to international knowledge via this mechanism has contributed to enhancing research excellence. However, benefiting from the FPs has become more of a challenge for Polish research actors with the shift towards larger integrated projects in FP6 and FP7.
The Act of 8 October 2004 on the Principles of Financing Science has introduced grants for "special projects" pursued under international programmes not subject to co-financing with foreign funds. There are also measures to foster international mobility of researchers, which are mainly run by the Polish Academy of Science.

National research programmes are, in principle, open to foreign researchers, but this often requires a special agreement with the Science Ministry. Funding of participants from abroad by Polish funds is excluded.

5.1.3 Enhancing the absorptive capacity of knowledge users

Polish knowledge users have limited absorptive capacity. According to the Community Innovation Survey 2004, the share of innovative enterprises is, at 26.6% in industry and 22% in services, still much lower than the EU 27 averages of 41.5% and 37% respectively. A report on the innovation potential of Polish SMEs reveals that 91.1% of SMEs surveyed do not co-operate with JBRs, universities, and technology transfer centres (Zolnierski, 2005). While total private innovation expenditures increased between 2000 and 2004, BERD decreased over this period. Companies have started to upgrade their outdated technology but not increased their R&D capabilities (European Trend Chart on Innovation, 2006). Nevertheless, recent data of the Polish Statistical Office suggests that the co-operation agreements of firms with research institutions or other firms on innovation activities are rapidly growing from 8% 2001-03 to 24% 2003-05.

A shortage of highly qualified labour does not constitute the main bottleneck, although there are some problematic recent trends. The share of scientists and engineers in the total labour force has increased steadily since 2000 and in 2006 it reached a level of 5.9%, which is above the EU 27 average of 5.4%. The number of S&T graduates has also risen significantly, although less than the huge threefold increases in total students and graduates over the last 15 years. Hence the share of S&T graduates in total graduate numbers has dropped to around 12%, a percentage which is considerably lower than the EU 25 average of 23% (2004). The share of students in science and engineering has fallen to 7.2% (2006) and the number of S&E students declined by almost 10,000 in the period between 2003 and 2007.

The Polish government has recognised the challenge of the low absorptive capacity for R&D of Polish companies and launched a number of initiatives to improve it. Most of the measures are part of the Structural Funds' Operational Programmes and focus on investments and purchases of technology, and partly also on the improvement of human resources for innovation (for details see European Trend Chart on Innovation, 2006). The focus on technology uptake has also driven the fiscal incentives in force since January 2006 (see section 5.2.2).

5.2 Analysis of recent changes and policies

5.2.1 Relevant recent trends

The increasing establishment of R&D centres by foreign multinational firms in recent years (OECD, 2007) is opening up new opportunities for access to international knowledge.

5.2.2 Role and expected impact of recent policies

Although a new law on Public-Private Partnerships (PPP) which could be expected to enhance inter-sectoral knowledge circulation came into force on 7 October 2005, to date there have been no regulations determining the requirements necessary for establishing PPP contracts. As reported in the ERAWATCH Research Inventory,

representatives of the business sector have been somewhat sceptical about the regulation, which was prepared by the Ministry of Finance. The main issues raised by business relate to complicated and costly procedures during the selection of private partners, but business actors have also complained that there is no distinction between large and small projects.
The measures included in the implementation programme for the 2004-2006 Structural Funds focused on the development and modernisation of R&D infrastructure and, on the human resources side, on general employee training. The contribution to knowledge circulation and transfer is therefore considered to be limited (Walendowski, 2007).
The "Innovative Economy" Operational Programme under the National Development Plan 2007-2013 announces measures aimed at increasing the synergy with world science, such as cooperation between research networks and consortia and development of the network of institutions participating in FP7. A programme by the Ministry of Science and Higher Education supporting the international mobility of researchers by financing on a competitive basis projects of researchers carried out in a research unit abroad has been launched end of 2006. Increasing absorptive capacity by human resource development is addressed by the "Human Capital 2007 – 2013" Operational Programme (HC OP). The programme is implemented on the basis of the European Union allocations from the ESF in conjunction with the national funds. The total allocation for the implementation amounts to €9,559.8 million, including the EU allocation – €8,125.9 million and national public funding of €1,433.9 million. One of the ten priorities is high quality education meeting the needs of the labour market.

The incentives introduced in the Act on some forms of supporting innovation activities for the fiscal year 2006 onwards focused strongly on boosting firms' absorptive capacity. The main elements are the creation of a Technology Loan Fund and a 50% deduction from taxable income of the cost of acquiring new technology.
The technology loan may not exceed €2 million and an entrepreneur's own share in the full investment capital must not be less than 25%. The Bank of the National Economy (BGK) evaluates the applications for technology loans. A considerable proportion of the credit may be forgiven if products based on such a new technology are sold on the market. Specific conditions apply to loan abatements, which cannot exceed €1 million. The annual budget is estimated at €25 million which might be quickly exhausted by a small number of big companies with strong market positions taking advantage of the measure (Walendowski, 2007).
The tax incentives allow small and medium sized companies to deduct up to 50% of their spending to acquire new technologies from their taxable income. The definition refers to technological knowledge which allows production or modernisation of products and services, and it must be less than 5 years old. For other companies the limit on the tax credit was initially set at 30%, but the act has since been amended to offer the same conditions to these companies. Participation by firms has thus far been limited, however (OECD, 2007).
The design of the policy measures explicitly focuses on technology adoption and embodied knowledge transfer. This, and not R&D as such, is the focus of the tax incentives, and also the design of the Technology Loan Fund does provide stronger incentives for investment in less risky new technology. While access to modern technology is an important first step on the way to develop R&D capacities, it is an established result of innovation research that beyond such capital investments, R&D investments and human resource investments are also important to create learning

capabilities and be able to benefit from new knowledge. Hence there are doubts whether, and to what extent, the measures described will be able to contribute to increasing the actual research and innovation potential of the companies supported over the long term (European Trend Chart on Innovation, 2006). There is currently an ongoing debate as to whether additional tax incentives for business R&D should be introduced. However, this would require the parallel establishment of a corresponding private R&D accounting and reporting system in order to be effective and to limit re-labelling effects (OECD, 2007).

A new form of implementation of the so-called goal oriented projects has been put in place with the Technological Initiative, for which €80 million have been earmarked. This focuses on supporting and implementing large-scale technological innovation co-financed by industry. A first call for projects by the Ministry of Science and Higher Education was opened in March 2007 and received nearly 500 proposals. Target groups for the programme include companies and institutions which act as intermediaries for the use of research findings for commercial purposes (Rybicki, 2007).

An important change in governance structures with regard to knowledge circulation is the establishment of the national R&D centre (NCBR, see also section 3.2.2). Among its tasks will be the commercialisation and other forms enabling transfer of research results to the economy as well as implementation of international programmes aimed at researcher mobility. In addition, there is a new programme on academic entrepreneurship to support innovation based on R&D activities (OECD, 2007).

5.3 Assessment of knowledge circulation

The main strengths and weaknesses of the Polish research system in terms of knowledge circulation can be summarised as follows:

STRENGTHS:	WEAKNESSES:
- (no main strengths in this domain)	- low absorptive capacity of knowledge users and in particular SMEs - lack of robust mechanisms to facilitate knowledge circulation between university, PRO and business sectors due to not settled role of JBRs in this respect and few well established technology transfer institutions

The main opportunities and threats for knowledge circulation in Poland arising from recent policy responses and in the light of the Lisbon Strategy can be summarised as follows:

OPPORTUNITIES:	THREATS:
- Implementation of the "Innovative Economy" Operational Programme for the period 2007 to 2013 will enhance cooperation and transfer between PRO , universities and private enterprises - support for international activities in the Framework Programmes and beyond might produce leverage effects.	- modest scope of reform of institutional setting for facilitating knowledge circulation may limit effectiveness of measures - the policy measures implemented are not yet sufficient to significantly enhance absorptive capacity of private actors

Chapter 6. Overall assessment and conclusion

6.1 Strengths and weaknesses of research system and governance

Poland's society and economy have undergone a profound transformation over the last 15 years. For a long time, transforming the Polish research system was not a priority for either political or private actors in this process, and this was reflected in a low and shrinking R&D intensity as well as a low societal pressure for stronger resource mobilisation for research. Nevertheless, over the last five years this situation has begun to change. Starting with the establishment of a ministry responsible for research and a series of thoroughly revised or new laws, Poland has started to adjust and reformulate the role of the research system in the economy and society. The table below summarises the ways in which Poland can build on existing strengths in this process and which weaknesses remain relevant.

Domain	Challenge	Assessment of system strengths and weaknesses
Resource mobilisation	Securing long-term investment in research	Resources for long-term investments are provided steadily by the government, but level and growth dynamics are lower than in other Central and Eastern European Countries
	Dealing with barriers to private R&D investment	Limited private R&D funding in comparison with the EU average and other new Member States
	Providing qualified human resources	Mechanisms in place to ensure the provision of a qualified human resource base for R&D
	Justifying resource provision for research activities	Little pressure from society and the economy to provide more resources for R&D
Knowledge demand	Identifying the drivers of knowledge demand	Lack of sophisticated private R&D demand due to low-tech orientation of the economy
	Channelling knowledge demands	Until recently weak co-ordination of knowledge demands by policy actors
	Monitoring demand fulfilment	Evaluation culture and systematic monitoring mechanisms not strongly developed
Knowledge production	Ensuring quality and excellence of knowledge production	Solid system to enhance basic research underpinned by quality criteria
	Ensuring exploitability of knowledge	Weak mechanisms to gear knowledge production towards commercial applications
Knowledge circulation	Facilitating circulation between universities, public research organi-sations and business	Lack of robust mechanisms to facilitate knowledge circulation between research sectors due to not settled role of the state-owned R&D units (JBRs) in this respect and few well established technology transfer institutions
	Profiting from international knowledge	Participation in Framework Programmes as important mechanism, but full benefits increasingly challenging to reap
	Enhancing the absorptive capacity of knowledge users	Low absorptive capacity of knowledge users and in particular SMEs

Mechanisms are in place to ensure the provision of sufficiently large and well qualified human resource base for R&D, and a solid quality-criteria-based system to enhance basic research in universities and the institutes of the Polish Academy of Science. Nevertheless, some of the key elements of a smooth-running research system are not yet in place. There is still little demand for sophisticated R&D from the private sector due to the dominant medium-and low-tech orientation of the economy. However, R&D demand from foreign-based companies recently seems to have started growing significantly. The mechanisms to gear knowledge production towards

commercial applications are still weak, and the same is true for public knowledge demand, and for the absorptive capacity of knowledge users, in particular SMEs. Related to this, to some extent, the challenge of ensuring knowledge circulation between universities, public research organisations and enterprises has not been resolved. Not surprisingly, the resulting mismatch between knowledge production and the requirements and needs of business as well as the need for improved co-operation between science and industry actors is perceived as one of the main outstanding policy challenges. The analysis suggests that all these factors need to be addressed if improvements are to be achieved.
The gap and lack of linkages between knowledge production and knowledge use is mirrored in the governance structure of the Polish research system, in which ministerial responsibilities for science and higher education are separate from those for innovation and the economy. Responsibilities for public research funding and political demand for applied research are also divided. However, with the establishment of the Council for Science and Technology early 2005 and the ongoing debates about a strengthening of its role or its replacement by a high level innovation council, resulting governance issues are being addressed.

6.2 Policy dynamics, opportunities and threats from the perspective of the Lisbon agenda

Recent policies address many of the weaknesses of the Polish research system. The policy coordination and monitoring process of the Lisbon Strategy has helped to develop more explicit targets and to give a higher priority to research and innovation. Opportunities emerge from the joint implementation of:

- increased public resource mobilisation for R&D, which will benefit both science and business
- structural reform to improve the channelling of knowledge demands, strengthen centres of excellence in knowledge production through the new National R&D centre, and increase the economic exploitability and circulation of knowledge through a reform of the JBRs
- an improvement of the absorptive capacity of knowledge users and strengthening of additional institutions to improve co-operation between public research organisations and industry, through the new "Innovative Economy" Operational Programme jointly designed and managed by the Ministries for Science and for Economics and supported by Structural Funds.

New instruments to support research policy priority setting including relevant stakeholders contribute to more effective policy responses, e.g. through "Poland 2020" National Foresight Programme and the Polish Technology Platforms.

However, despite recent policy responses some threats remain. Although there is a policy goal of one third of R&D funding coming from the private sector, the balance between public and private resource mobilisation seems increasingly biased towards public investments. Given the private R&D demand structure and low absorptive capacity of private actors, as well as the policy focus on technology acquisition, the effectiveness of the scheduled measures to enhance private R&D remains to be seen.
Also, the scope and effectiveness of the reform of the R&D units, which clearly emerges as the key to benefiting from the new opportunities, is still unclear. Political governance issues with this respect seem not fully resolved and might hamper further institutional reforms. A too modest scope of reform of the institutional setting

for facilitating knowledge circulation could also limit the effectiveness of the new funding measures.

The table below summarises the main opportunities and threats concerning recent policy dynamics:

Domain	Main policy-related opportunities	Main policy-related threats
Resource mobilisation	- increased public resource mobilisation for research due to significant budget increases in response to the Lisbon Strategy and the availability of European Structural Funds - enhanced private R&D investment due to a range of new support measures, which may also contribute to further foreign R&D investment	- leverage effects from public towards private resource mobilisation might not be achieved to the extent expected
Knowledge demand	- new instruments preparing research policy priority setting including major scientific and private stakeholders, e.g. through the "Poland 2020" National Foresight Programme - more effective public demand through the joint Operational Programme for an Innovative Economy and improved implementation mechanisms for multi-annual strategic programmes	- possible improvement of effectiveness of public expenditure by increased involvement of the regions through regional operational programmes threatened by a lack of adequate regional governance capacities
Knowledge production	- new agency (national R&D centre) for programme implementation as an improved mechanism to enhance excellence as well as effectiveness of public expenditure	- reinforced sectoral governance structure of JBRs might hamper further institutional reforms aiming to improve both the excellence and exploitability of knowledge production
Knowledge circulation	- implementation of the "Innovative Economy" Operational Programme for the period 2007 to 2013 will enhance cooperation and transfer between universities, public research organisations and private enterprises - support for international activities in the Framework Programmes and beyond might produce leverage effects	- modest scope of reform of institutional setting for facilitating knowledge circulation may limit effectiveness of measures - the policy measures implemented are not yet sufficient to significantly enhance absorptive capacity of private actors

Both the European Research Area, with the Framework Programmes as the main instrument until now, as well as the European Structural Funds have contributed significantly to underpinning policy opportunities for the improvement of the Polish research system. They have also had some structural effects, as is shown by the design of the National Framework Programme, the Polish Technology Platforms and the continuation of the FP5 centre of excellence initiative. However, there are limits to the possible scope of its contribution. Increased and improved R&D funding alone will not be sufficient to improve the performance of the Polish research system and governance, and FP7 will probably benefit only the strongest performers. The partial regionalisation of research and innovation measures based on the Structural Funds – with an increased Lisbon-goal orientation – might initially threaten the effectiveness of the measures, unless they are accompanied by a modernisation of regional governance structures for dealing with increasing R&D resources – which is still only partly complete. An effective implementation of the Structural Funds will therefore remain a key issue in the further development of the research policy mix.

References

Dabrowa-Szefler, M.; Jablecka-Prysłopska, J. (2006): OECD Thematic Review of Tertiary Education. Country Background Report for Poland. Warsaw, July 2006.

EIT PLUS (2007): http://www.eitplus.wroclaw.pl/main.php?p=40

ERAWATCH Network (2006): ERAWATCH Country Specialisation Report. Country: Poland. http://cordis.europa.eu/erawatch/index.cfm?fuseaction=home.downloadFile&fileID=265

ERAWATCH Research Inventory (2007/2008): Country information on Poland, http://cordis.europa.eu/erawatch (ERAWATCH Network main country correspondent: Jacek Walendowski, Technopolis)

European Commission (2007): Monitoring industrial research: Analysis of the 2006 EU Industrial R&D Investment Scoreboard. DG JRC and DG Research

European Trend Chart on Innovation (2006): Annual Innovation Policy Trends and Appraisal Report: Poland 2006. European Commission, Enterprise Directorate-General. http://trendchart.cordis.lu/reports/documents/Country_Report_Poland_2006.pdf

Goldberg, I. (2004): Poland and the knowledge economy: Enhancing Poland's competitiveness in the European Union. The World Bank, Rewasz Publishing House.

GUS – Central Statistical Office (2005): Nauka I Technika W 2004 R. Central Statistical Office, Warszawa.

IPTS (2006): ERAWATCH country related information working paper in view of the National Reform Programmes – Country: Poland. Seville: Institute for Prospective Technological Studies.

Kozlowski, J. (2006): Can Europeanisation improve the CEECs' research systems? Paper for the SPRU 40th Anniversary Conference: The Future of Science, Technology and Innovation Policy, 11th-13th September 2006. http://www.sussex.ac.uk/Units/spru/events/ocs/viewpaper.php?id=158

Ministry of Regional Development (2007): Innovative Economy Operational Programme 2007 – 2013. National Strategic Reference Framework 2007 – 2013, Warszawa, 5 February 2007.

OECD (2007): Policy Mix for Innovation in Poland – Key Issues and Recommendations. OECD, DSTI/STP/TIP(2006)13/FINAL, http://www.nauka.gov.pl/mn/_gAllery/28/81/28814/20070627_PolishPolicyMix_final.pdf

Republic of Poland (2006): National Reform Programme for 2005-2008 to implement the Lisbon Strategy. First Annual Progress Report. Adopted by the Council of Ministers on 13 October 2006. Warsaw.

Republic of Poland (2007): National Reform Programme for 2005-2008 to implement renewed Lisbon Strategy in Poland. Report 2007. Adopted by the Council of Ministers on 11 October 2007. Warsaw.

Rybicki, T. (2007): Financing Research. The Polish Science Voice, 27 June 2007. http://www.warsawvoice.pl/view/15173

Siemaszko, A., Supel, J. (2006): TEZY DO DYSKUSJI na konferencję „Uczestnictwo w Programach Ramowych UE". Analiza uczestnictwa w 6.PR – przygotowania do 7.PR. Uczestnictwo polskich zespołów w Programach Ramowych. Badań, Rozwoju Technologii i Wdrożeń UE. Krajowy Punkt Kontaktowy Programów Badawczych UE, Warszawa, kwiecień 2006; http://www.6pr.pl/pliki/4143/6i7PRanaliza_kwie06.pdf

Walendowski, J. (2007): Monitoring and analysis of policies and public financing instruments conducive to higher levels of R&D investments. The "POLICY MIX" Project. Country Review Poland. Technopolis Belgium, January 2007. http://ec.europa.eu/invest-in-research/pdf/download_en/poland.pdf

Wintjes, R. (2004): Priority issues for the innovation system of Poland. System analysis and recommended directions for change. Position Paper. MERIT, University of Maastricht and ECORYS.
Żołnierski, A. (2005): POTENCJAŁ INNOWACYJNY POLSKICH MAŁYCH I ŚREDNIEJ WIELKOŚCI PRZEDSIĘBIORSTW. Polska Agencja Rozwoju Przedsiębiorczości, Warszawa

Abbreviations

ABP: Agencja Badan Poznawczych (Agency for Basic Research)
BERD: Business Expenditures on R&D
BGK: Bank Gospodarstwa Krajowego (Bank of the National Economy)
CERN: Conseil Européen pour la Recherche Nucléaire (European Organization for Nuclear Research)
DFG: Deutsche Forschungsgemeinschaft (German Research Foundation)
ERA: European Research Area
ERC: European Research Council
ESA: European Space Agency
FP: Framework Programme
GDP: Gross Domestic Product
GERD: Gross Expenditures on R&D
GUS: Główny Urząd Statystyczny (Central Statistical Office)
HERD: Higher Education Expenditures on R&D
JBR: Jednostki Badawczo-Rozwojowe (state-owned R&D units)
KPR: Krajowy Program Ramowy (National Framework Programme)
MG: Ministerstwo Gospodarki (Ministry of the Economy)
MNiSW: Ministerstwo Nauki i Szkolnictwa Wyższego (Ministry of Science and Higher Education)
NCBR: Narodowym Centrum Badań i Rozwoju (National Research and Development Centre)
NOT: Naczelna Organizacja Techniczna (Polish Federation of Engineering Associations)
NSRO: Narodowe Strategiczne Ramy Odniesienia (National Strategy Reference Framework)
OECD: Organisation for Economic Co-operation and Development
PAN: Polska Akademia Nauk (Polish Academy of Science)
PLN: Polski nowy (Polish zloty)
PPP: Public-Private Partnership
R&D: research and development
SMEs: small and medium-sized enterprises

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Abstract

The main objective of ERAWATCH analytical country reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. The reports support the mutual learning process and the monitoring of Member States efforts by DG Research in the context of the Lisbon Strategy. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. This analytical approach has been tested in 2007 by applying it to six countries, one of which is Poland. The report is based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.