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An assessment of research system and policies

Latvia

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ERAWATCH
COUNTRY REPORT 2008
An assessment of research system and policies
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Latvian Academy of Sciences

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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. The report aims at supporting the mutual learning process and the monitoring of Member States efforts. The main objective is to characterise and assess the performance of the national research system of Latvia 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 report is based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

Latvia is a small and catching-up country with a population of 2.3m and R&D funding making up 0.7% of GDP (2006). The current system of public research is primarily based on five universities, research institutes thereof and 12 state research institutes. A key turn in the development of the national R&D system was marked in 2005 by the adoption of the new Law on Research Activity stipulating an annual increase in the government R&D funding at least by 0.15% of GDP until it reaches 1%. However, there are certain concerns over the implementation of this norm given the governmental plans pursued in the light of combating the high inflation levels of the recent years. A considerable weakness of the current research system of Latvia is the lack of S&T graduates along with an accompanying insufficient supply of human resources for R&D, which has occurred largely due to a considerable predominance of brain drain over brain gain observed in Latvia.

Recent national strategic policy documents are increasingly aiming to pinpoint the main strengths and weaknesses of the Latvian research system with the latter being addressed by a range of policy measures. The main measures are currently related to the execution of nine targeted state research programmes, a radical reform of the research evaluation system, measures aimed at increasing the excellence of research results and the number of patents along with ones supporting research-industry co-operation. The main challenge, however, still remains in respect to the integration of the private business sector in the national R&D system by means of facilitating the linkages between business enterprises, universities and public research organisations, the application of research results and the involvement of private companies in both funding and executing research.

While there are selected institutes performing high level research and demonstrating excellence in terms of their research output, the overall level of research capacity is not competitive enough on an international scale. Though an evaluation system of individual project applications based on the principle of peer-review has been developed and applied, for the time being the introduction of an overall system of an additional comprehensive evaluation of institutes, universities and programmes has been lagging behind. The evaluations in the field of R&D so far having been carried

out are mainly implemented without an involvement of foreign researchers, though an external expertise of this kind would be critical for such a small country as Latvia.

Individual strengths and weaknesses of the Latvian national research system identified in the analysis provided by this report are summarised below, organised by the four main domains and the related policy challenges.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	• Growing public awareness of the role of R&D for socio-economic development
	Securing long term investment in research	• Mechanisms are in place to ensure an increase in the government R&D funding
	Dealing with barriers to private R&D investment	• Limited private R&D funding of the business sector
	Providing qualified human resources	• Increased attractiveness of research careers • Insufficient supply of human resources for R&D • Lack of policies for researchers' mobility
Knowledge demand	Identifying the drivers of knowledge demand	• Low private demand for R&D
	Co-ordination and channelling knowledge demands	• Preparation of multi-annual research programmes in the priority research fields
	Monitoring of demand fulfilment	• Underdeveloped evaluation culture and tools
Knowledge production	Ensuring quality and excellence of knowledge production	• Internationally competitive fundamental research in several fields of science • Poor performance in terms of publications, citations and patents
	Ensuring exploitability of knowledge	• High quality applied research with patentable results in at least some fields of science • Limited exploitability of produced knowledge in the framework of the current set-up of national economy
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	• A strengthening policy response for promoting knowledge and technology transfer between academia and industry
	Profiting from international knowledge	• Predominance of brain drain over brain gain • Increasing support for and intensity of trans-border cooperation in R&D
	Enhancing absorptive capacity of knowledge users	• Limited absorptive capacity of R&D results by the enterprise sector • Shortage of skilled science and engineering labour force in the business sector

While recent policies address many of the weaknesses of the Latvian research system, there are still several policy-related opportunities and risks as enlisted in the table with two particular ones standing out in terms of their relevance for the further development of the national R&D system. The first one is related to the limited participation of the business sector in undertaking and funding R&D activities. The inertness of business enterprises observable so far along with the presence of many business structures in the form of branch offices of foreign companies, the long-standing unwillingness of the government to make use of tax policy as an efficient policy instrument and the weak administrative capacity of the involved ministries all point to an actual risk of not observing any tangible progress in this field. Secondly, an important opportunity is related to increasing and strengthening the quantitative and qualitative output of research performance. A recent trend of the Latvian R&D policy (2007-2008) is related to booting the research output in terms of the number

of scientific publications and patents with an emphasis on the quality thereof (publications in highly cited journals and EPO patents) that would promote an overall competitiveness of the Latvian science. Yet, to some extent this can be impeded by the relative decrease in the level of research funding under the conditions of measures for countering the high inflation levels (in 2007, GERD decreased according to national statistics to 0.63% of GDP after reaching almost 0.7% in 2006) thereby exerting a negative influence on the overall R&D structure (e.g. in terms of human resources, etc.).

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• New support measures aimed at academia-business co-operation serving as a catalyst for business R&D investment • Necessary reforms of R&D system fostered by the availa-bility of the EU Structural Funds	• New support measures aimed at academia-business co-operation utilised without mobilising new business R&D investment • Too high reliance on funding R&D from the EU Structural Funds
Knowledge demand	• Establishment of the Research Council headed by the prime minister	• Insufficient incentives for considerably boosting the innovative activity of companies • Continued support for too many R&D fields thereby not ensuring a pronounced support for excellent disciplines and researchers
Knowledge production	• Orientation towards high quality research results with increased productivity levels	• Insufficiently effective measures for co-operative research between universities and research institutes, on the one hand, and industry and other organisations, on the other
Knowledge circulation	• Efficient implementation of new policy measures aimed at knowledge and technology transfer	• Insufficient incentives for enhancing absorptive capacity of companies and promoting mobility of human resources between public and private sectors • Undetermined policy actions in facilitating a balanced inward and outward mobility of R&D staff

In terms of international knowledge circulation, the accession to the EU and ERA in 2004 served as a signal for the Latvian government and parliament to alter the national research policy with the EU 3% Action Plan chosen as a point of reference. The following elaboration of the National Reform Programme along with the Framework Programmes (FPs), EU Structural Funds (SFs) and programmes such as COST, EUREKA have turned into essential instruments for the development of science in Latvia. Contacts with scientists from the EU countries provided an opportunity to directly adopt solutions for research management along with gaining experience in conducting research at research centres of the European countries. The participation in the EU FPs has been and continues to be a good exercise for conducting quality research, orientation towards generation of internationally comparable results and development of research collaboration. Yet, in terms of the openness of research organisations and national programmes to European and international researchers there are for the time being rather limited mechanisms contributing to that. The ERA has also contributed to the development of a new system of R&D evaluation in Latvia and through the Bologna process exerts a positive influence on the assessment of scientific research at universities and the respective promotion of excellence.

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1 - Introduction and overview of analytical framework

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

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in 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 research and development (R&D), with a particular focus on the private sector. One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts.

The main objective is to analyse the performance of national research systems and related policies in a comparable manner. The desired result is an evidence-based and horizontally comparable assessment of strength and weaknesses and policy-related opportunities and risks. A particular consideration in the analysis is given to elements of Europeanisation in the governance of national research systems in the framework of the European Research Area, relaunched with the ERA Green Paper of the Commission in April 2007.

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

- Resource mobilisation: the actors and institutions of 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.
- Knowledge demand: needs for knowledge have to be identified and governance mechanisms have to determine how these requirements can be met, setting priorities for the use of resources.
- Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
- Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in 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.

Figure 1: Domains and generic challenges of research systems

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
• Justifying resource provision • Long term research investment • Barriers to private R&D funding • Qualified human resources	• Identification of knowledge demand drivers • Co-ordination of knowledge demands • Monitoring of demand fulfilment	• Quality and excellence of knowledge production • Exploitability of knowledge production	• Knowledge circulation between university, PRO and business sectors • International knowledge access • Absorptive capacity

On the *second* level, the analysis within each domain is guided by a set of generic "challenges" common to all research systems that reflect conceptions of possible bottlenecks, system failures and market failures (see figure 1). 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, helps to deal with the considerable institutional diversity observed, 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 system performance in the four domains.

Based on this framework, analysis in each domain proceeds in the following five steps. The first step is to analyse the current situation of the research system with regard to the challenges. The second step in the analysis aims at an evidence-based assessment of the strengths and weaknesses with regard to the challenges. The third step is to analyse recent changes in policy and governance in perspective of the results of the strengths and weaknesses part of the analysis. The fourth step focuses on an evidence-based assessment of policy-related risks and opportunities with respect to the analysis under 3) and in the light of Integrated Guideline 7; and finally the fifth step aims at a brief analysis of the role of the ERA dimension.

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. 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.

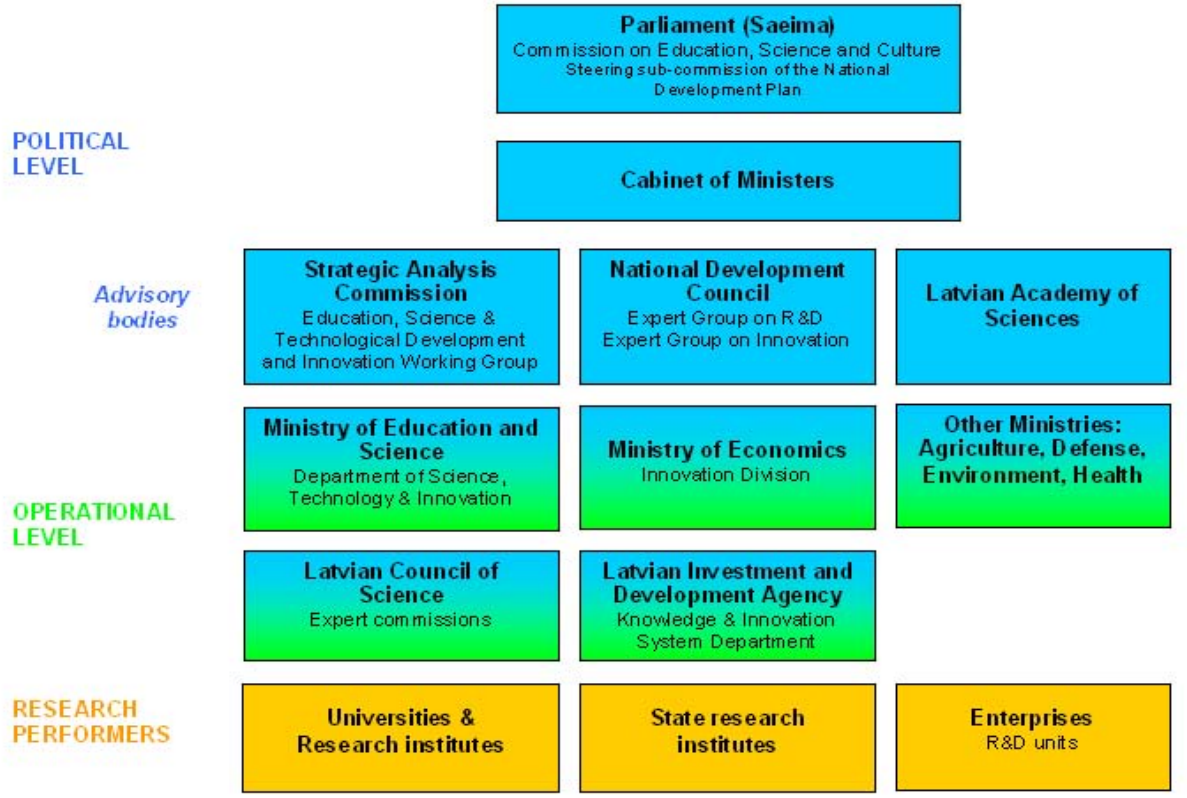
After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and chapter 5 deals with knowledge circulation. Each of these chapters contains five main subsections in correspondence with the five steps of the analysis. The report concludes in chapter 6 with an overall assessment of strengths and weaknesses of the research system and governance and policy dynamics, opportunities and risks 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 of the national research system and its governance

Latvia is a small and catching-up country with 2.3 million inhabitants. Latvia's gross domestic product (GDP) per capita in purchasing power standards (PPS) in 2007 was 58.2% of the EU27 average.[2] Given the provision of the Law on Research Activity[3], since 2005 Latvia has witnessed an overall increase in its gross domestic expenditure on research and development (GERD), which, according to Eurostat, constituted 0.7% of GDP in 2006 after stagnating around 0.4% from 1996-2004. This increase is considerable taking into account that annual GDP growth rate in 2005 and 2006 was above 10%. Increase has taken place largely due to the increased funding from the national budget as well as from the EU Structural Funds (SFs).Yet, these figures are still very low compared to the EU27 average of 1.84%, which for the time being position Latvia among the EU countries with the lowest GERD.

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



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

The main research and development (R&D) policy-maker is the Ministry of Education and Science (see Figure 2), which also coordinates and manages key research programmes, and is the central financing institution of public R&D. An important role

[2] If not referenced otherwise, all quantitative indicators are based on Eurostat data available at: http://epp.eurostat.ec.europa.eu

[3] The Law on Research Activity adopted in 2005 envisages an annual increase in public R&D funding of at least 0.15% of GDP until it reaches 1% of GDP.

is played by the Latvian Council of Science, which provides advice for policy-making, manages research programmes and the evaluation of projects, drafts proposals for the development of science and technology policy and the state budget for research financing. The Ministry of Economics holding prime responsibility for innovation policy exerts certain influence on the research sphere mainly through selected innovation policy measures. Several other ministries also allocate funds for research in their respective policy areas. Policy advice is provided also by the Latvian Academy of Sciences, the Strategic Analysis Commission under the auspices of the President of Latvia and the National Development Council. Task forces and expert groups of these advisory bodies serve as a ground for initiating and discussing the main research policy documents and governance issues. At the operational level, most of the funding for R&D and innovation is managed by the Ministry of Education and Science, the Latvian Council of Science, and the Latvian Investment and Development Agency. It is deemed that policy coordination in this area has to be strengthened therefore a proposal on the establishment of a Research council headed by the prime minister has been accepted on a governmental level.

The R&D system governance is in an almost permanent state of flux in Latvia with several recent changes, for instance, in the system of research performers implemented in 2005. Currently the main research performers in the country are represented by five universities with their research institutes and 12 state research institutes. As of May 2008, the Register of scientific institutions[4] developed by the Ministry of Education and Science comprises data on 91 additional institutions including three higher education establishments (HEEs), 14 universities' research institutes (formerly independent institutes under the former system of the Academy of Sciences or under the jurisdiction of the Ministry of Health or the Ministry of Agriculture), 41 structural units of HEEs, five societies, 15 business companies, and six foundations.

Research policy in Latvia is developed, funded and implemented only at the national level. Existent planning regions have neither the level of responsibility nor the funding capacity to develop their own research policy. However, note has to be taken of the current growth of HEEs and their related research activities in these regions.

Table 1: Funding flows in R&D in 2006

Performers / *Funders*	Higher education sector	Government research institutes	Business enterprises	Total	Share of GERD
Government	45.3%	18.0%	36.7%	100% (**€65.4m**)	58.2%
Business	14.1%	4.6%	81.3%	100% (**€36.8m**)	32.7%
Abroad	27.1%	40.0%	32.9%	100% (**€8.5m**)	7.6%
Higher education sector	100.0%	0.0%	0.0%	100% (**€1.7m**)	1.5%
Share of total R&D expenditures	34.6%	15.0%	50.4%	100% (**€112.3m**)	100%

Source: Eurostat (http://epp.eurostat.ec.europa.eu).
Note: The share of the Private non-profit sector is not provided by the available statistics.

Table 1 shows the funding flows in R&D in 2006, when GERD was €112.3m. As can be seen from these data, the share of the public sector is significant both in terms of

[4] http://izm03.izm.lv/liis/org/pases.nsf/zinnos?OpenView (in Latvian)

performance and funding, while the business sector is being less active in making investments in R&D in comparison to its overall spending on R&D. Due to an increase in national funding, the share of R&D funding from abroad, which for the last 10 years (1996-2005) has been rather high at around 20% and higher, has decreased to 7.6% in 2006.

2 - Resource mobilisation

The purpose of this chapter is to analyse and assess how challenges related to 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, with the Barcelona EU overall objective of a R&D investment of 3% of GDP and an appropriate public/private split as orientation, but also highlighting the need for a sufficient supply of qualified researchers.

Four different challenges in the domain of resource mobilisation for research which need to be addressed appropriately by the research system can be distinguished:

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

2.1 Analysis of system characteristics

2.1.1 Justifying resource provision for research activities

Resource provision for research activities in Latvia is largely motivated by their potential contribution to the development of a knowledge-based economy and national competitiveness. The main official documents of the Latvian government (the Declaration of the Intended Activities of the Cabinet of Ministers (2007), the National Lisbon Programme of Latvia for 2005-2008 and the National Development Plan for 2007-2013) emphasise the need to modernise the economic structure, which is currently still characterised by taking advantage of cheap labour and available natural resources, and manufacturing products with low value added. The stimulation of research is seen as an essential tool for promoting structural changes in the national economy in order to sustain economic growth and achieve higher prosperity levels in the future.

Moreover, for several years the government declarations and official documents have been justifying investments in R&D also by referring to the Lisbon strategy and its Barcelona 3% target. Since the adoption of the new Law on Research Activity, increased resources from the government budget as well as from the EU SFs have been invested in research activities. Moreover, cross-national comparisons of R&D indicators (e.g. European Innovation Scoreboard (EIS)) have played an important

role in public debates on the need for increased support to research, as the results for Latvia in these comparative studies have been well below the EU average.

In 2008, support for research has also been mentioned in the context of the government Action Plan for Stabilisation of Macroeconomic Situation in 2008-2009. The need to stabilise the economy has become urgent due to the potential threat of stagflation, as the high growth rates of national economy are showing signs of slowing down (according to the Eurostat forecast, the GDP growth rate in 2008 might be 3.8% after growing at the rate above 10% in the last three years) but the inflation rate was 10.1% in 2007. In the Action Plan, the building of a knowledge-intensive economy (by means of supporting academia-business co-operation, development of clusters and commercialisation of research results) is presented as a guarantee for a balanced economic development in the future.

Although since 2005 the public funding for R&D has increased in absolute terms (due to the new support measures launched by the government), the government budget appropriations or outlays on research and development (GBAORD) in 2006 made up only 0.29%, which is well below the EU average of 0.7%. In the period from 1996-2005 this percentage has not considerably increased, which might be also due to the high growth rate of the national GDP and consequently an expansion of national budget.

The role of research activities for the future of long-term socio-economic development of Latvia has also been discussed in public debates, e.g. in the context of drafting the National Development Plan for 2007-2013 as well as the long-term Sustainable Development Strategy 'Latvia 2030'. Moreover, in recent years a number of new science communication and awareness raising activities have been introduced including Café Scientifique, the Researchers' night, popular science media, etc. Many of these are motivated by the need to increase public understanding of science and eventually also tax-payer support for research activities. In addition, government agencies and business organisations have also organised informative activities to improve understanding and raise awareness of research and innovation in the business sector.

2.1.2 Securing long term investment in research

The legal basis for the long-term investment in research is provided by the Law on Research Activity and the respective provision on the annual increase of the government R&D funding. In 2005, publicly funded GERD was 0.26% of GDP, which is well below the EU average of 0.64%[5]. Provided that the planned increase is implemented as stipulated in the law, the public R&D expenditures would reach 1% of GDP by 2010. Since the adoption of this Law the increase has so far been implemented and public R&D expenditures have increased. However, in 2008 the increase is sustained mainly due to the contribution from the EU SF co-funding, which constitutes approximately 75% of the planned increase (Rivza, 2007). In 2008, in the Progress Report on Implementation of the National Development Plan, experts have concluded based on estimated increase in 2007, 2008 and 2009 that the 1% target would only be reached by 2013 and reset the target accordingly (Progress Report, 2008). They emphasised the need of providing the envisaged annual

[5] DG Research Regional Key Figures Database.

increase of 0.15% of GDP from the national budget and relying less on the funding from the EU SFs.

The Law on Research Activity also defines main types of research funding, which include base funding for research establishments, funding for multi-annual state research programmes in priority research areas (currently nine programmes have been launched for the period of 2005-2008 or 2006-2009), funding for basic and applied research projects as well as funding for market-oriented research projects. The main role in public R&D funding is played by the Ministry of Education and Science, which is responsible for all levels of education as well as science, state language and sports. Thus, investment in research is only one of the priorities of the Ministry, for which in a situation of limited resources the main priority has been an increase in teachers' salaries.

Recently, there have been several attempts to introduce medium-term planning in research funding. In 2007, the Cabinet of Ministers adopted the framework for the first medium-term budget for 2008-2010. The development of a knowledge society has been declared to be one of the medium-term budget priorities. However, because of the need to restrict budget expenditures due to the high inflation the implementation of the medium-term budget is uncertain. Difficulties in introducing the medium-term planning are also exemplified by the attempts to adopt the Guidelines of Science and Technology Development for 2008-2013 drafted by the Ministry of Education and Science that have already lasted for two years but so far have not been successful.[6]

Since 2004, when Latvia joined the EU, the EU SFs have become an important source of R&D funding supporting development and upgrading of research infrastructure, doctoral studies and post-doctoral research, etc. In the new SF programming period 2007-2013, €238m are budgeted in for R&D and additional €202m - for innovation.[7] Support is envisaged for applied research, international cooperation in R&D, development of human resources in R&D, academia-business co-operation, etc. Since 1990s an important source of funding of excellent research teams has been the EU Framework Programmes (FPs) (see more in section 5.1.2.).

In summary, in recent years several important mechanisms for securing long-term investment in research have been established. If until 2004, all public R&D funding was mainly project-based, then since the adoption of the Law on Research Activity longer term investments such as base funding and multi-annual state research programmes as well as an annual increase in R&D funding have been envisaged and implemented. Moreover, since 2004 an important long-term investment instrument is the EU SF co-funding.

2.1.3 Dealing with uncertain returns and other barriers to business R&D investment

In Latvia, for the time being business R&D investment plays a limited role in the research system. In 2005, the GERD financed by business sector were 0.19% of GDP, which is five times lower than the EU average of 1%.[8] In 2004, €11m out of

[6] The draft has been discussed at the Committee of the Cabinet of Ministers three times (5 June 2006, 22 October 2007 and 21 April 2008) but has not been accepted yet.
[7] www.esfondi.lv
[8] DG Research Regional Key Figures Database.

€21m BERD were spent in the service sector, while €9m - in manufacturing (Eurostat, 2008:36). In 2006, the share of total R&D financed by industry was 32.7%, which is an increase compared to the respective level of 17.6% in 1996. The low interest of the business sector is also demonstrated by the Community Innovation Survey (CIS) (2002-2004), which reveals that only 18% of Latvian enterprises are innovative. Moreover, 64% of innovation expenditures are invested in the acquisition of machinery and equipment, while only 12% are allocated to R&D (CSB, 2006). More than half of innovative enterprises (53.6%) are large companies with more than 250 employees. According to the 2007 EU Industrial R&D Investment Scoreboard (EC, 2007) the only Latvian company among the top 1000 EU R&D investors is the pharmaceutical company Grindeks ranked 974th with its €3.48m R&D investment.

Contribution of bank and venture capital financing to R&D is also rather negligible in Latvia. Guarantee and investment funds are not yet sufficiently developed and access to seed and venture capital is limited (MoE, 2007a). In order to address the problem of limited access to funding by companies, since 2004 the government has launched and envisaged several schemes co-funded by the EU SFs to provide loans and venture capital financing, in particular to new technology-based firms. At the moment several new measures are under development, e.g. aimed at the establishment of an investment fund to provide micro-loans to start-ups and the creation of networks of business angels.

In recent years, the need to foster private R&D has been widely recognised in the government policy documents. In line with this goal, the government has established or prepared a number of measures to foster partnerships between research organisations and businesses (e.g. support to technology transfer, establishment of competence centres, market-oriented research projects), to support development of new technology-based firms (e.g. support to business incubators) as well as to facilitate private R&D activities directly (e.g. funds for development of new products and technologies). The share of BERD financed by government in 2005 was 12.7%, which is above the EU average of 7.7%.[9]

2.1.4 Providing qualified human resources

An insufficient provision of qualified human resources is one of the main problems in the Latvian research system, which has recently experienced a decrease in the number of researchers and ageing of R&D staff (MoES, 2008a:13). During 2000-2005, the annual growth rate of researchers in full-time equivalent (FTE) was negative in all sectors (-3) and in the business sector in particular (-14) (Eurostat, 2008:52). In 2004, the age of most scientists working at universities and PROs was above 55 years and the age of 28% of these scientists was above 65 years, while only 7% of scientists working at research institutes were aged 25-34 (MoF, 2007b). Moreover, it is estimated that around one third of Latvian scientists work abroad (ibid). Until recently the main reasons for the insufficient and declining number of researchers in Latvia were low salaries, obsolete research infrastructure and limited work opportunities outside academia. The salaries of researchers in Latvia have been among the lowest in the EU. In 2006, the average yearly salary of researchers in Latvia was €10,488, which is well below the EU average of €37,947 and makes only half of the EU average even when calculated by PPS (EC, 2008:22).

[9] DG Research Regional Key Figures Database. However, reliability of these data for Latvia is questionable, as they also show very high fluctuations from 20.2% in 2002 to 3.5% in 2004.

In recent years remuneration and research infrastructure in Latvia has considerably improved. This might have contributed to the sharp increase in the number of researchers (FTE) from 3282 in 2005 to 4024 in 2006. The increased R&D funding has served as an incentive for return to research careers in Latvia for those researchers who left Latvian R&D sector during the 1990s and went to other sectors or to research institutions abroad. Yet, according to the estimates of the Ministry of Education and Science (2008:13), this number is still insufficient and should reach at least 5000 in 2013.

Improvements in career opportunities in academia also account for an increased number of PhDs awarded. If in 2001 only 37 PhDs were awarded in Latvia, then since then the situation has gradually improved with 106 PhD thesis defended in 2006 (MoES, 2008a:10). In the academic year 2006/2007, there were 1797 PhD students in Latvia, out of which 32% studied social sciences, while 14% - natural sciences, mathematics and information technology (IT), and 16% - engineering sciences. However, according to the estimates of the Ministry of Education and Science, the number of PhDs awarded is still insufficient and in the future it should reach at least 500 new PhDs awarded annually.

In order to improve the attractiveness of research careers, the government has launched several support measures financed from the national budget and EU SFs. In 2005-2008, support has been granted for doctoral studies and postdoctoral research and considerable funds have been invested in the modernisation of research infrastructure. To address the problem of the limited number of researchers working in the business sector (only 777 in 2006) in 2008, the government has launched a new support measure for the attraction of highly qualified workforce in the business enterprise sector. Moreover, efforts are made to facilitate re-emigration and re-integration of Latvian scientists currently working abroad.

In 2006, the share of non-national human resources in S&T in Latvia was only 1.2% in comparison to the EU average of 5.7% (Andersons, 2008). However, the interest in attracting foreign researchers is increasing. Due to the lack of S&T human resources, the strongest research institutes are exploring opportunities to attract foreign researchers offering them competitive salaries and attractive working environment. In 2007, the Law on Research Activity has been amended defining conditions for participation of foreign researchers in research projects implemented by Latvian research institutions.

The informative support on mobility issues is provided by the Latvian Researcher's Mobility Portal and Centre, which informs both Latvian researchers interested in job opportunities abroad and foreign researchers interested in working in Latvia.10 In 2005-2008, 80% of enquiries received by the Centre came from young Latvian researchers interested in finding funding (scholarships, internships, etc.) abroad, while few requests for information have come from foreign researchers (Kokarevics, 2008). The latter mainly come to work with the already established local collaboration partners in Latvia. So far, neither the government nor research organisations themselves have elaborated specific policies toward researchers' mobility, leaving these issues to individual researchers or research groups. The representatives of organisations hosting foreign researchers emphasise that important obstacles are

[10] http://www.eracareers.lv/index.php

presented by the procedures to obtain visa and to solve taxation issues (e.g. double taxation).

2.2 Assessment of strengths and weaknesses

The main strengths in the Latvian research system arise from an increased R&D funding and growing awareness of the role of R&D, which have been facilitated by recent changes in the legislation and policy, broad public debates and influence of the EU level processes (e.g. the Lisbon process, the 3% objective and SFs). This has lead to initial positive results such as a considerable increase in the number of researchers in 2006. However, there is still a need to attract more human resources to R&D both from Latvia and abroad. One of the major challenges for the Latvian research system is to increase interest of the business sector to invest in R&D.

Main strengths	Main weaknesses
• Mechanisms are in place to ensure an increase in the government R&D funding • Growing public awareness of the role of R&D for socio-economic development • Increased attractiveness of research careers	• Limited private R&D funding of the business sector • Insufficient supply of human resources for R&D • Lack of policies for researchers' mobility

2.3 Analysis of recent policy changes

Major policy changes in Latvia took place in 2004/2005, when the EU SFs became available, the new Law on Research Activity was adopted and new support measures (base funding and state research programmes) envisaged by the law were launched. Moreover, after the adoption of the new Law the government funding for R&D has been increased and it reached €62.5m in 2008 (with GERD reaching 0.63% in 2007[11]). According to the National Lisbon Programme of Latvia, the targets set for R&D funding are 1.1% of GDP in 2008 and in 1.5% in 2010. Yet, the more recent expert calculations and assessments cast some doubt over the feasibility of reaching the defined levels of public R&D funding in due time in the light of the upcoming economic crisis and its subsequent implications for a range of budgetary positions.

In 2007/2008, the main priority has been the preparation of new support measures to be financed from the EU SFs for the planning period 2007-2013. These measures are designed to address major bottlenecks of the national research system: to increase interest of the business sector in R&D, to renew research infrastructure and to attract additional human resources in S&T. As the first measures were launched only in spring 2008, the Progress report on the implementation of the National Development Plan (June 2008) recommends speeding up preparation of new schemes considerably as the process of launching them have already been delayed at least by a year and a half due to administrative reasons.

[11] http://data.csb.gov.lv/DATABASEEN/zin/Annual%20statistical%20data/Science/Science.asp

Challenges	Main policy changes
Justifying resource provision for research activities	• Reinforced emphasis on the importance of R&D investments and promotion in a range of strategic policy documents
Securing long term investment in research	• Prioritisation of R&D in the SF planning period for 2007-2013
Dealing with uncertain returns and other barriers to private R&D investment	• Continued support for the development of new products and technologies by companies • Envisaged support for the establishment of competence centres
Providing qualified human resources	• Introduction of support schemes for the attraction of human resources to research

2.4 Assessment of policy opportunities and risks

At the moment, all the main policy opportunities and risks are related to the use of the SFs during the period 2007-2013 for co-funding measures to support research. The developed schemes address all the major challenges with respect to raising business R&D investment and improving supply of qualified human resources in S&T. Thus, the main challenges are related to the efficient utilisation of SFs, which largely depends on the administrative capacities to manage and monitor the implementation of new measures as well as on the absorptive capacities of the enterprise sector. One of the main risks for the long-term development of R&D policies might be an over-reliance of the government on funding coming from SFs, since according to the available government documents, all new research support measures to be launched in 2008/2009 are to be financed with SF co-funding.

Main policy opportunities	Main policy-related risks
• New support measures aimed at academia-business co-operation serving as a catalyst for business R&D investment • Necessary reforms of R&D system fostered by the availability of the EU SFs	• New support measures aimed at academia-business co-operation utilised without mobilising new business R&D investment • Too high reliance on funding R&D from the EU SF

2.5 Summary of the role of the ERA dimension

Access to the funding made available through the EU FPs provides the Latvian research community with an important additional resource for carrying out their scientific activities alongside the ones being supported nationally. Altogether 1027 RTD project applications involving participants from Latvia were submitted under the FP6. 217 projects (21%) subsequently have been granted funding by the European Commission (MoES, 2008b). These results have placed Latvia among the most successful countries among the new EU MSs, though still featuring a lag behind the performance level of the old MSs.

One of the medium-term tasks of the Latvian research policy is to foster integration in the ERA, in particular by supporting participation in technological platforms and other international initiatives as well as developing research infrastructure, which might be of interest also for European and international research community (MoES, 2008a:22). It has been stated in policy documents that Latvia can participate in the

ERA with its unique research infrastructure objects such as the Ventspils International Radio Astronomy Centre and the Liquid Metal Laboratory of the Institute of Physics of the University of Latvia including the pilot equipment for studies of the Earth's magnetic field (MoF, 2007b). Yet, considerable efforts still have to be made in respect to the openness of national research organisations and programmes to foreign researchers as an incentive for providing an additional input in terms of human resources for advancing research activities in Latvia.

3 - Knowledge demand

The purpose of this chapter is to analyse and assess how research related knowledge demand contributes to the performance of the national research system. It is concerned with the mechanisms to determine the most appropriate use of and targets for resource inputs.

The setting and implementation of priorities can lead to co-ordination problems. Monitoring processes identifying the extent to which demand requirements are met are necessary but difficult to effectively implement due to the characteristics of knowledge outputs. Main challenges in this domain are therefore:

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

Responses to these challenges are of key importance for the more effective and efficient public expenditure on R&D targeted in IG7 of the Lisbon Strategy.

3.1 Analysis of system characteristics

3.1.1 Identifying the drivers of knowledge demand

A broad picture of the knowledge demand structure can be sketched out by the share of R&D spending of the private vs. public sector[12] (see Table 1 in Chapter 1). GERD and BERD in Latvia are considerably lower than the level of EU27 average.13 In 2006, the sources of GERD were as follows: business enterprise sector contributed 32.7%, which is considerably lower than EU27 average level of 54.6%, government sector – 58.2%, which is higher than EU27 average level of 34.2%, abroad – 7.5%, while higher education sector – 1.5%. Thus, the public sector has a dominant role in both R&D funding and performance. According to the statistical data (Eurostat, 2008) BERD has considerably increased from €29.6m in 2005 to €56.6m in 2006 (33% in manufacturing sectors, 67% in service sectors), and this has happened mainly due to the inflow of the EU SFs. The government sector accounts for 60% of this increase, while the business sector itself accounts for 30% of the increase.

[12] Latvia is a country with little information available regarding its technological and scientific specialisation, and this restriction on the availability of data creates difficulties in presenting a coherent profile of the country (ERAWATCH Network, 2006). Information in this report is mainly based on Eurostat data on Latvia in 2005 and 2006.

[13] According to Eurostat, the statistics for Latvia in 2006 are as follows: BERD=0.3527% of GDP (EU27=1.17%); GOVERD=0.1056% (EU27=0.25%), HERD=0.2417% (EU27=0.4%)

According to the information available, in terms of GBAORD specialisation (2006) Latvia is specialised in a large number of socio-economic objectives such as the development of agriculture, industrial production and technology, and protection and improvement of human health (ERAWATCH Network, 2006). Large part of public demand as expressed in government appropriations is non-oriented, while 58.9% (2006) is directed towards specific socio-economic objectives. A shift towards targeted research took place in 2006 when the government launched state research programmes in priority research fields.

The main manufacturing sectors in Latvia are manufacturing of wood (50% of the whole manufacturing sector) and chemicals and chemical products (23%). Contribution of agriculture, hunting, forestry and fishing is 13%. In general, the current structure of the Latvian economy has considerably shifted in favour of service sectors with the share of the latter in added value having shifted from 38.6% in 1990 to 74.8% in 2006 (MoE, 2007a). In its turn, the share of the value added by the manufacturing industry in national economy in 2005 was only 12.7% in comparison to the EU15 average of 17.3%. In 2007, the structure of commodity exports was dominated by wood and wood products (22.4%) followed by metals and metal articles (14.9%), agricultural and food products (14.5%), machinery (10.5%) and products of chemical industry (10.4%) (MoE, 2007b:22). There is a certain correlation between these figures and the research priorities approved by the government with agricultural sciences and forestry and wood sciences present in the list.

From the processes for identifying the drivers of knowledge demand (e.g. foresight and planning exercises, expert groups and technology assessments) the most widespread method in Latvia is the use of advisory expert groups. So far, the foresight instruments in Latvia have been weakly developed. In 2007, elaboration of the Sustainable Development Strategy “Latvia 2030”, which is a long-term policy planning document, was started, however, within this framework the use of foresight exercises has not been envisaged yet.

Main permanent expert working groups dealing with the analysis of R&D are the Education, Science and Technological Development and Innovation Working Group at the Strategic Analysis Commission under the auspices of the President of Latvia; the expert working groups of the National Development Plan for 2007-2013; the Latvian Council of Science and its working groups; and the Latvian Academy of Sciences and its working groups. In Latvia as a small country many experts simultaneously participate in several working groups. The analysis provided by the working groups is used by the Ministry of Education and Science and the Ministry of Economics for the elaboration of the relevant policy documents, e.g. the Operational Programmes of the National Strategic Reference Framework for 2007-2013.

From all the above-mentioned groups the most prominent one is the Working Group of the Strategic Analysis Commission, which has done the most. This group developed proposals for the draft Guidelines of Science and Technology Development for 2008-2013, which the Ministry of Education and Science has submitted to the Cabinet of Ministers and the adoption of which at the moment is in its final stages. This group also analysed proposals for priority research fields along with the respective state research programmes (see more in Section 3.1.2).

Representatives of the business sector are involved in the processes for identifying the drivers of knowledge demand; however, their involvement is weak because the interest of the business sector in R&D of innovative products and technologies at the

moment is limited. On the parliamentary level a sub-commission for the Steering of the National Development Plan for 2007-2013 has been formed to monitor these processes. Recently, this sub-commission has held several meetings devoted to the issues of research demand.

3.1.2 Co-ordinating and channelling knowledge demands

The Latvian research system has gradually gone through several phases in the development of coordination and funding thereof. Until 1990, most of the research projects were formally linked to the all-USSR programmes (top-down principle). In its turn, from 1990-1995, all funding was allocated to projects proposed by scientists themselves (bottom-up principle). Finally, since 1996, the first targeted collaborative projects emerged, which were jointly proposed by several research organisations (reinforcement of the bottom-up principle).

Joining the EU in 2004 and the adoption of the new Law on Research Activity in 2005 (one of its articles envisage that the R&D funding level declared in the Lisbon Strategy has to be reached) both served as an incentive to develop targeted research programmes. These programmes were developed by the Ministry of Education and Science jointly with experts. In 2005, the government adopted a special decision on the need to boost science competitiveness. Firstly, the priority research fields were defined (here again top-down principle can be seen), which were approved by the government. Afterwards, a respective call for programme proposals was launched. Priority setting and launching of relevant calls took place twice – in 2005 and 2006. Among the priorities approved in 2005 there were research fields in which the achievements of Latvian scientists are excellent at international level: IT, biomedicine and pharmacy as well as material sciences. At the same time, these research fields also have a strong applied research tradition. Applied research results of the Latvian research organisations in IT, biomedicine and pharmacy are mainly utilised by the foreign companies. Other research fields defined as priorities are agro-biotechnology, energy, Latvian studies, forestry and wood sciences, medical science and environmental research. Since not all branches of the Latvian science are equally efficient, the definition of these 9 priorities has marked a certain differentiation thereof.

Tasks for the implementation of these research programmes are defined in a specific and precise way in order to promote the development of these research fields and to facilitate applied research. Funding allocated to these programmes has increased each year. The time for the implementation of a research programme is set for four years. The current programmes have to be finished in 2008/2009, therefore discussions on potential future developments have been initiated among the stakeholders. It is assumed that sufficient experience has been obtained to decide on the number and definition of future priorities as well as on the content of the future programmes taking into account realistic opportunities of a small country. The existing priorities are based on the historical heritage and arguments on the need and prospects of undertaking research in the respective fields of science. The definition of the current nine priorities has also largely come as a result of interest expressed by the sectoral ministries to develop research in their respective areas. Although the debates and preparation of decisions took place within the ministerial working groups, the final decision was made at the meeting of the Cabinet of Ministers.

At the moment, the link between the state research programmes and private sector knowledge demand is weak; however, considerable efforts are directed towards improving it. In the Steering Council of state research programmes formed by the Ministry of Education and Science and in the commissions formed to evaluate the results of the state research programmes representatives of the respective ministries and private sector work together. Moreover, the representatives of private sector take part in the events, where the results of the state research programmes are presented.

The European influence is an important factor in defining priorities thereby the priority fields defined in Latvia in most cases correspond to the EU priorities. EU FPs have a considerable influence on the research development in Latvia. Common programmes for the Baltic Sea Region countries are also important, e.g. in the field of energy research.

3.1.3 Monitoring demand fulfilment

So far, no structured monitoring of knowledge demand fulfilment has been undertaken in Latvia. The monitoring of demand fulfilment is related to the general research evaluation culture in Latvia. Some experience has been obtained, especially at the Council of Science, in the evaluation of research project proposals. In 2008, the Council of Science launched a call for project proposals for the next three years considerably raising the assessment criteria in respect to the results of research previously undertaken by the applicants. However, experience in evaluating research policy and programmes is considerably more limited. A comprehensive monitoring system and a systematic approach to policy and programme evaluation have not been developed yet. The Law on Research Activity envisage an international institutional evaluation of research organisations once every six years. Policy analysis has been undertaken in order to prepare policy documents, e.g. draft Guidelines of Science and Technology Development for 2008-2013. The self-evaluation has been undertaken within the reports on Progress in Implementation of the National Lisbon Programme of Latvia for 2005–2008. Beside a system of the monitoring system of the Latvian innovation policy commissioned by the Ministry of Economics is planned to be developed in the coming years.

The Law on Research Activity envisages that evaluation and approval of priority research fields has to be undertaken once every four years. The identified priorities have to be supported by relevant state research programmes. After launching these programmes procedures and criteria for their evaluation were set. State research programmes in priority research areas are evaluated by the Supervisory Council, which adopts the report on implementation of these programmes. Based on the progress review, the Council develops recommendations for implementation of the programmes in the future. These evaluations are made publicly available on the website of the Ministry of Education and Science. It is expected that in 2009, before launching the new four-year period of priorities and research programmes, the whole priority setting and programme system will be evaluated.

3.2 Assessment of strengths and weaknesses

The key strength of the Latvian R&D system in the field of knowledge demand is embodied in the research programmes elaborated and implemented in the priority research fields defined on a national level. While knowledge demand is also

positively affected by the presence of research excellence in several research fields, the weaknesses in terms of knowledge demand in Latvia are first and foremost related to the low private R&D demand and the weak evaluation culture.

Main strengths	Main weaknesses
• Preparation of multi-annual research programmes in the priority research fields	• Low private demand for R&D • Underdeveloped evaluation culture and tools

3.3 Analysis of recent policy changes

The main policy changes in respect to knowledge demand are related to the definition of research priorities in 2005-2006 and subsequent elaboration of respective state research programmes in the identified fields of science, which are fully funded from the state budget. This largely came as a result of the adoption of the Law on Research Activity, though the need for defining national research priorities in the context of a small country has been discussed practically all along since the establishment of the research system of the independent Latvia in 1990. This priority-setting principle is reinforced also by the draft Guidelines of Science and Technology Development for 2008-2013.

The regulations on the elaboration and implementation of the state research programmes set out the principles of the organisation of programme tenders, formation of the groups of performers along with those on the reporting system and the special steering council. Although these regulations also envisage programme evaluation, the latter cannot yet be seen as a well-developed system – there are no provisions in respect to the necessity of mid-term and ex-post evaluation undertaken on the basis of peer-review.

Challenges	Main policy changes
Identification of knowledge demand drivers	• Launch of the new state research programmes • Elaboration of the draft Guidelines of Science and Technology Development for 2008-2013
Co-ordination and channelling knowledge demands	• Setting of priority research fields • Mechanisms for better coordination of priority setting and allocation funding for R&D activities provided by the Law on Research Activity
Monitoring of demand fulfilment	• Evaluation procedures for the research centres set out by the Law on Research Activity • Introduction of a steering procedure of state research programmes

In terms of timing, the introduction of the nine state research programmes coincided with the overall increase in science funding and a certain stabilisation of the institutional system (with research mainly carried out by 5 public universities and 12 state research institutes). Of course, the implementation process of all these measures also highlights certain gaps that are expected to be eliminated in the next round of programmes starting in 2009-2010.

3.4 Assessment of policy opportunities and risks

The draft Guidelines of Science and Technology Development for 2008-2013 envisage an establishment of a Research Council headed by the prime minister,

which can currently be seen as the main policy opportunity for Latvia. Provided that full advantage is taken of it, rather good progress in terms of knowledge demand could be achieved. A closely related issue concerns an increased efficiency of inter-ministerial coordination, which so far has not been well-developed. In its turn, the main policy-related risk derives from the limited interest of private business companies in engaging themselves in innovative activities. Another risk is related to the defined scope of research priorities since it can turn out that the current number of 9 priority fields is too high for such a small country as Latvia given the resulting dispersion of the available funding, which limits the support for selected truly excellent disciplines and researchers.

Main policy opportunities	Main policy-related risks
• Establishment of the Research Council headed by the prime minister	• Insufficient incentives for considerably boosting the innovative activity of companies • Continued support for too many R&D fields thereby not ensuring a pronounced support for excellent disciplines and researchers

3.5 Summary of the role of the ERA dimension

Participation of Latvia in the ERA largely influences the R&D policy making in Latvia. The Latvian research policy-makers adopt many elements from other European countries and gradually try to introduce norms common there. First of all this applies to the system of research organisation. The system of research funding currently established in Latvia can be seen as similar to the one long present in many European countries. One of the main elements characteristic of this system is now represented by the introduction of targeted funding along specific research priorities and the respective nine state research programmes. It has to be noted that the identification of the specific national priorities has largely coincided with the priorities set in the framework of ERA.

4 - Knowledge production

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

- On the one hand, ensuring knowledge quality and excellence is the basis for scientific and technological advance. 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. Quality assurance processes are here mainly the task of scientific actors due to the expertise required, but subject to corresponding institutional rigidities.
- On the other hand there is a high interest in producing new knowledge which is useful for economic and other problem solving purposes. Spillovers which are non-appropriable for economic knowledge producers as well as the lack of possibilities and incentives for scientific actors to link to societal demands lead to a corresponding exploitability challenge.

Both challenges are addressed in the research-related Integrated Guideline and in the ERA green paper.

4.1 Analysis of system characteristics

4.1.1 Improving quality and excellence of knowledge production

After 1990, Latvia undertook a radical change of its knowledge production system in comparison to what was in place before 1990, when Latvian science was part of the large science system of the USSR (Kristapsons et al., 2003). The key change took place in respect to the research institutes as the main knowledge producers formerly affiliated to the Latvian Academy of Sciences, since they were either incorporated into universities or granted the status of a state research institute. Currently, the main knowledge producers in the Latvian research system are represented by five universities with their research institutes and 12 state research institutes. More than half of the total number of national scientific publications is produced by researchers of universities and their institutes with a certain share produced also by the small number of R&D units of business enterprises.

In order to assess the output and quality of a national research system, data from the Web of Science (and its former versions) are usually used for international comparisons.[14] In the case of the Baltic countries, a mutual benchmarking between the three is being frequently used. While in 1990 all the three Baltic countries were rather equal in terms of their quantitative performance (250 publications per country a year), in 2007 Lithuania produced 1000, Estonia – 800, and Latvia only 350 publications. The annual output figure for Latvia that makes 150 SCI publications per million population (with the EU average being 650) has remained largely unchanged since 2001, while it has been gradually increasing for both Estonia and Lithuania.

This negligible output of Latvia can be to some extent explained by the following two factors. Firstly, Latvia has a considerably lower level of science funding than its Baltic counterparts. Secondly, in 1999, an alternative list of journals[15] (much more inclusive than the one used by the Web of Science), publications in which are being equalled to publications in recognized journals was introduced by the Latvian Council of Science and was subsequently applied as a criterion at the defence of doctoral thesis and reporting by research units. This, in turn, implied a strong disincentive for pursuing publications at the internationally prestigious journals enlisted by the Web of Science. This list included practically all local editions, which further implied a disincentive for the national journals to pursue a determined policy aimed at securing their own place in the above-mentioned list of the Web of Science.

Until 1990, publication traditions aimed at internationally prestigious journals were developed in physics, organic chemistry, and molecular biology. Over the recent years engineering sciences and clinical medicine have added themselves to the list (Erawatch network, 2006, Figures 9 and 10). The given specialisation is also illustrated by the fact that there are several institutes in Latvia having received an

[14] Recently an opportunity to use data provided by a system developed by *Elsevier* covering a broader number of scientific journals than the Web of Science has emerged (www.scopus.com, www.scimagojr.com), however, it is not yet widely used in the international practice.

[15] List of scientific journals of the Latvian Council of Science. Available at: http://www.lzp.lv/latv/journ.htm (in Latvian).

international recognition of their excellence. Thus, for example, under the FP5 the Institute of Solid State Physics of the University of Latvia won a tough competition for the name of an EU Excellence centre in the field of material sciences with another success of the same kind being the Institute of Atomic Physics and Spectroscopy in Latvia. In its turn, the Biomedical Research and Study Centre received special recognition from the UNESCO. High international prestige has been always enjoyed also by the Institute of Organic Synthesis. The specialisation in these research fields can also be traced in terms of scientific citations (ERAWATCH Network, 2006, Figure 11), though it has to be emphasised that in the case of Latvia one is dealing with extremely small absolute numbers of scientific publications that hardly reach 0.05% of the respective numbers for the whole world.

The Law on Research Activity (2005) and the accompanying legislative documents marked an orientation towards and a demand for high quality research results. Until then the allocation of funding was rather loosely connected with the quality of scientific publications, yet a certain turn in defining a more categorical demand for quality occurred in 2007. The regulations on the allocation of institutional funding adopted in August 2008 already envisage a much more explicit link of funding with the quality of publications (with publications in the journals enlisted in the Web of Science being given greater value). In its turn, the draft Law on Higher Education (2008) provides a more rigorous classification of scientific publications depending on their publishing type.

At the moment an attempt is being made in Latvia to implement peer-reviewed competitive funding mechanisms in regard to science branches, yet for the time being the whole process is only at its initial stage. Peer-review evaluation is currently being carried out on a systematic basis only in respect to individual project application. Nevertheless, an introduction of an international assessment of scientific activities to be undertaken by universities or public research organisations (PROs) once every six years is provided for both by the Law on Research Activity and the draft Law on Higher Education.

4.1.2 Improving exploitability of knowledge production

As of 1992, a gradual formation of the national system of intellectual property rights (IPR) of Latvia has taken place with the system now being fully in line with the EU standards. However, statistical data demonstrate a significantly lower patenting activity in comparison to both the former level of performance and the current EU27 rates. Each year around 100 patents of Latvia for inventions with national priority are being registered with up to 10 European Patent Office (EPO) applications filed annually, this making 40 and four items per million population, respectively. The main reason for the currently low patenting activity in Latvia is the limited demand by the local industry, which is still very weak and is largely taking advantage of the innovative solutions developed by their foreign partners (often parent companies).

As for the number of EPO patents it is not feasible to speak about the patenting dynamics and specialisation given the low absolute levels. Yet some conclusions can be drawn from the analysis of these patents that, for instance, show a clear specialisation pattern for pharmacology and chemicals that make up a considerable share of these patents. Rather than being an individual case, it, first and foremost, represents the work undertaken by the Institute of Organic Synthesis in the field of medical chemistry. It also demonstrates that the pharmaceutical industry as a

particular industrial branch in Latvia has survived and adapted successfully to the principles of market economy and is competitive on an international scale. Likewise, a comparatively large number of EPO patents pertain to molecular biology with the case being alike also in respect to magnetic hydrodynamics until 2000. There is small number of patents of foodstuffs, yet these are not linked to particular Latvian companies or research institutes.

Beyond doubt, the EIS methodology featuring data on EPO, US PTO and Triad patents has to be used for international comparisons in respect to patenting trends. Yet, given the small number of these patents some additional insight can be provided by the analysis of the national patents of Latvia (with national priority). There are approximately 90-100 patents of this kind granted per year. What is typical is the fact that the inventors of a considerable share of these patents come from universities and PROs. There has been an increase in the number of patents that are filed and owned by a company, a PRO or a university: in 2000, the share of these patents in the given group (with national priority) of the national patents of Latvia made up 5%, while in 2006 it had risen to 30%. This is a considerable positive trend characterising the drive of the respective institutions towards application and commercialisation of research results.

If one looks more generally at the linkage of knowledge production with the economic needs of the country it firstly has to be emphasised that a crucial role in this aspect is played by the small size of Latvia, which means that, on the one hand, scientists have to face the subsequent limited possibilities for fully exploiting their R&D results domestically, while local entrepreneurs have difficulties in finding researchers for practically undertaking modernisation of their production, on the other hand. The most successful and accordingly the most experienced scientists frequently enter into agreements with foreign companies (with this trend largely facilitated by patents) that are also stronger than the Latvian companies, and undertake contract work for those. There are also some trends towards forming clusters of research institutes and local companies along with competence centres in the fields with historically developed R&D resources and an economic potential.

4.2 Assessment of strengths and weaknesses

The following table summarises the main strengths and weaknesses of the Latvian research system in terms of knowledge production.

Main strengths	Main weaknesses
• Internationally competitive fundamental research in several fields of science • High quality applied research with patentable results in at least some fields of science	• Poor performance in terms of publications, citations and patents • Limited exploitability of produced knowledge in the framework of the current set-up of national economy

While the Latvian research system features selected fields of science characterised by high quality fundamental and applied research, there is a generally low performance on such traditional output indicators as publications, citations and patents as well as comparatively limited exploitability of the produced knowledge under the current set-up of national economy.

4.3 Analysis of recent policy changes

The amendments made to the national research policy over the last two years have been largely geared towards ensuring the quality and excellence of knowledge production and exploitability thereof. In the second half of 2007 and the first half of 2008, intense discussions took place on the level of the Latvian Council of Science in the light of trying to find solutions for increasing the number of Latvian publications included in the Web of Science and their citation rate. As a result, amendments to the evaluation criteria of applications for fundamental and applied research projects and their output were made with the main emphasis put on the excellence of the former performance of applicants along with the planned intention in respect to the particular way of publication of the results-to-be. It is expected that this decision of the Council will serve as a signal for all the Latvian scientists to pay regard to the excellence of their research output and substantiation thereof.

An essential novelty in the innovation policy of Latvia is associated with a set of innovation support measures primarily aimed at commercialisation of research results by means of technology transfer centres and points (see section 5.1.1 for more details) and competence centres. Along with an aid scheme for promoting the attraction of researchers to business enterprises, these measures are also intended to serve as an incentive for initiating and strengthening the cooperation between academic researchers and industrial actors. In its turn, one of the measures – state aid programme for the development of new products and technologies and securing industrial property rights thereof - is directly targeted at increasing the number of patent applications. The total sum earmarked for securing these rights makes up €1.4m to be granted to micro, small and medium enterprises.

Challenges	Main policy changes
Ensuring quality and excellence of knowledge production	• Elaboration and initial implementation (2008) of changes to the former system of research evaluation in order to orient it towards provision of support to those achieving excellence in research performance • Emphasis on the quality of scientific research in the draft Law on Higher Education • Emphasis placed in policy documents on the necessity of international expertise in evaluating both individual projects and research institutions
Ensuring exploitability of knowledge production	• Targeted support for cooperation between academic researchers and industrial actors • State support for the development of new products and technologies and securing industrial property rights

4.4 Assessment of policy opportunities and risks

Main policy opportunities and policy-related risks in terms of knowledge production are summarised in the table below. The recent measures that have been mainly developed within the overall complex approach to the improvement of the research system taken by policy-makers have the potential of stimulating an increase in the quality of knowledge production especially in the light of the orientation of the R&D policy toward high quality research results (publications in respectable journals) with increased productivity levels (both in terms of publications and patents). However, at the same time there is a risk of not building sufficiently strong cooperation and

linkages between individual researchers, universities and research institutes, on the one hand, and industry, on the other, which, in turn, would considerably slow down the process of the quality increase of the knowledge production given the lack of demand by the domestic industry.

Main policy opportunities	Main policy-related risks
• Orientation towards high quality research results with increased productivity levels	• Insufficiently effective measures for co-operative research between universities and research institutes, on the one hand, and industry and other organisations, on the other

4.5 Summary of the role of the ERA dimension

Participation of the Latvian scientists in the EU FPs has been and continues to be a good exercise for conducting quality research, orientation towards generation of internationally comparable results and development of research collaboration. The right to take part in the EU FPs can be seen as a high estimation of a particular group of Latvian scientists. The ERA has also contributed to the development of a new system of R&D evaluation in Latvia and through the Bologna process exerts a positive influence on the assessment of scientific research at universities and the respective promotion of excellence. Likewise, the ERA has stimulated the development of an improved system of IPR protection and a subsequent increase of patent production.

5 - Knowledge circulation

The purpose of this chapter is to analyse and assess how the research system ensures appropriate flows and sharing of the knowledge produced. This is vital for its further use in 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 continue working in industry, and the comparatively low cost of the reproduction of knowledge once it is codified. However, there remain three challenges related to specific barriers to this circulation which need to be addressed by the research system in this domain:

- Facilitating knowledge circulation between university, PRO and business sectors to overcome institutional barriers;
- Profiting from access to international knowledge by reducing barriers and increasing openness; and
- Enhancing absorptive capacity of knowledge users to mediate limited firm expertise and learning capabilities.

Effective knowledge sharing is one of the main axes of the ERA green paper and significant elements of IGL 7 relate to knowledge circulation. To be effectively addressed, these require a good knowledge of the system responses to these challenges.

5.1 Analysis of system characteristics

5.1.1 Facilitating knowledge circulation between university, PRO and business sectors

The challenge to overcome institutional barriers between universities, PROs and business to knowledge circulation and knowledge sharing and related interaction failures is high on the agenda in Latvia. Available studies repeatedly point to weak cooperation between companies and R&D organisations, development of which is hindered by the lack of former encouraging experience, motivation and knowledge of the needs and capacities of the potential partner on both sides (Adamsone-Fiskovica et al, 2009). According to CIS, in 2004 the expenditure for external knowledge acquisition by Latvian companies made up only 13% of their total innovation expenditure with the largest bulk of funding (76%) instead being allocated for machinery and equipment acquisition (CSB, 2006:13). The CIS survey also revealed that almost one third (28.8%) of innovation active enterprises (17.5% of all companies) identify difficulties in finding cooperation partners for innovation (ibid:18).

A recent study on the innovation needs of SMEs showed that over half of the surveyed companies (57.5%) spend less than 1% from their total R&D expenditures for external services (additional 26% of companies spend 1-5% and 13% of companies - 6-10%) (LTC, 2007:67). It also revealed that Latvian universities or research institutes have served as a source for innovation in only 3 out of 306 surveyed companies (ibid:47). While Latvia along with six other EU countries (Turkey, Romania, Slovenia, Hungary, Belgium and the Netherlands) has been enlisted in the group with the largest shares of public (higher education and government) sector R&D financed by business enterprise[16] (EC, 2007b:84), which would suggest a strong linkage of the private sector with HEEs and PROs, these figures have to be viewed in relation to the overall level of funding, which has been comparatively small for quite some time thereby giving significantly less weight to this seemingly considerable contribution made by companies.[17]

In terms of R&D personnel circulation, for the time being it mainly takes place in a rather fragmented way and on an ad hoc basis rather than as part of an elaborated framework. While there are cases of academic people taking posts in both academia and industry, these come as exceptions rather than a rule. However, the need of facilitating linkages between academia and industry has been increasingly recognised in the national policy documents and debates. The necessity to specifically address policies to stimulate partnerships between research and education institutions and businesses in Latvia has also been noted by the European Commission (2007a).

In terms of specific policy measures, collaboration between research institutions and industry so far has been promoted by means of support for market-oriented research available since 1993 that requires attraction of an industrial partner. Yet, having been

[16] According to data provided by IPTS, based on Eurostat, the overall HERD financed by business in Latvia has decreased from 23.04% in 2004 to 13.29% in 2006 (in comparison to 6.27% for EU27 in 2005). The same pattern applies to GOVERD financed by business, which has decreased from 20.36% to 10.17% respectively (in comparison to 8.26% for EU27 in 2005).

[17] There have been discussions on the reliability of these data so the figure should be treated with caution.

a single though highly-demanded instrument in this domain for more than a decade it has not served as a sufficient policy response to the demanding challenge. A more recent explicit policy response to this challenge is exhibited by the scheme of technology transfer (2005) whereby special liaison offices were established at several HEEs. Given the relevance of such mechanisms further support for technology transfer is planned to be provided also in the coming years in the framework of the EU SFs. Another recent development is demonstrated by the new state aid programme (2008) providing support for temporary placements of engineers and scientists in companies for finding solutions to specific technological problems or development of new products. Last but not least, cooperation between research institutions and the enterprise sector is also planned to be promoted via competence centres with a respective state aid programme to be launched in the end of 2008.

5.1.2 Profiting from access to international knowledge

Access to international knowledge has been crucial for the Latvian researchers also before 1990ties, but it was after the regaining of independence of Latvia in 1991 that more accessible means became available for free trans-border cooperation. The Association Agreement between Latvia and the European Communities enabled researchers from Latvia to participate in the EU FPs already prior to the accession to the EU in 2004. While regular cooperation started in 1992, when FP3 was into effect, in 1999 Latvia became fully associated with both FP5 and the Euratom programme. There have been growing participation rates with each subsequent FP demonstrated by the number of submitted project proposals which, for instance, during the first two years of FP6 was equal to the total submitted for FP5 (MoES, 2005). There are also expectations of continued efforts to be made by Latvian research institutions under FP7 with the current rate of success for Latvian participants being 20.2% (MoES, 2008b). At the same time, it has to be noted that there is no state support provided for drafting the project proposals.

Since FP6, Latvia has also taken part in seven ERA-net scheme projects as well as in such European initiatives as the COST programme promoting cooperation in the field of scientific and technological research (since 1997) and international R&D programme EUREKA (since 2000). Access to the international pool of knowledge have also been facilitated by the activities carried out in 2004-2008 by the Innovation Relay Centre (IRC) acting as a promoter of transnational technology transfer within the EU IRC Network. The four years of its operation in promoting commercialization of research and innovation has contributed to knowledge transfer both inwards and outwards of Latvia.

As noted above, the percentage of GERD financed by abroad has been decreasing over the recent years, yet, given the overall increase in the R&D expenditure in Latvia this decrease in the share of foreign funding has not meant an equal decrease in absolute figures, which have remained more or less on the same level (CSB, 2006:28). As for the role of private foreign direct investment (FDI), it is hard to assess to what extent does it contribute to local access to international knowledge since R&D activities of foreign-owned companies located in Latvia are mainly undertaken in their base country with no major spill-over occurring in Latvia. The overall level of FDI per capita is rather low in Latvia (1938 USD in 2004 in comparison to 7138 in Estonia) and the structure of FDI is dominated by service sectors with a relatively small share invested in industrial sectors.

A more established mechanism for accessing international knowledge is embodied in various bilateral and multilateral cooperation agreements as well as joint research projects with foreign companies or PROs located abroad. Additionally there are also a range of intergovernmental agreements on cooperation in S&T between Latvia and many European and non-EU countries concluded over the last decade.[18] Yet, in terms of the openness of national research organisations to foreign researchers there are for the time being rather limited mechanisms contributing to that. While research organisations per se are beginning to provide work places for qualified research staff on both short and long-term basis, this is not yet a common practice especially given the still rather uncompetitive remuneration level and infrastructure. So far a more common practice is that of brain-drain with many Latvian researchers moving permanently to work in different research facilities abroad or going for study visits or short-term placements in other countries.

The national programmes are predominantly designed for local researchers and research teams with a common condition set in the terms of reference for beneficiaries to be registered in the national register of scientific institutions that automatically excludes foreign institutional and individual participants not residing in Latvia. The Law on Research Activity also specifies that state budget funding for research activities can be allocated only to those institutions listed in the register. While the participation of individual researchers from the EU countries in the scientific research projects executed by national research institutions in Latvia is governed by the common framework of free movement of labour force within the EU, recent amendments (2007) to the above-mentioned law also include a new article on the participation of foreign researchers coming from non-EU countries. Yet, this does not imply opening up the programmes for foreign institutional participation.

5.1.3 Absorptive capacity of knowledge users

The absorptive capacity of knowledge users in Latvia is rather weak for the time being especially in respect to the business sector given the comparatively small share of innovative companies. The latter aspect is being related to the predominance of short-term development strategies of business enterprises determining limited investments in R&D-intensive activities as well as the lack of personnel with an adequate qualification characterised also by the limited number of researchers employed in the business enterprise sector (14%)[19] (CSB, 2006). The availability of qualified labour force on a long-term basis is becoming a pressing issue in Latvia in the light of an intensifying outflow of skilled workers in the Latvian economy as a whole. Likewise, there is still an insufficient pool of human resources in terms of the number of S&E students and graduates in Latvia despite the high overall youth education attainment level in Latvia[20] and the steady increase in the number of tertiary graduates in S&T (from 6.1 per 1 000 of population aged 20-29 years in 1998 to 9.8 in 2005) which is still considerably below the EU27 average (12.9 in 2005). In its turn, the number of PhD students in S&T fields as a percentage

[18] See http://izm.izm.gov.lv/starptautiska-sadarbiba.html (in Latvian)

[19] While, according to Eurostat, there has been an increase in both absolute figures (777 out of 4024) and the percentage share (19%) of researchers being employed in the business enterprise sector in 2006 reaching the so far highest level in Latvia, this is still rather negligible in comparison to the EU27 (49%).

[20] In 2007, 80.2% of the population aged 20 to 24 had completed at least upper secondary education, which is slightly above the EU average of 78.1%.

of the population aged 20-29 has remained almost unchanged at the level of 0.13 over the period of 1998-2005. According to CIS data, additional key factors hampering innovative activity of companies include the lack of information on technology and markets (CSB, 2006:17-18).

Currently it is being recognised that in order to facilitate the commercial application of R&D results, there is a need both to boost the innovative capacities of established companies of various profiles and to facilitate establishment of new innovative start-ups including academic spin-offs. As noted above, in the foreseeable future the absorptive capacity of companies is expected to be boosted by the new state aid programme launched in 2008 for the attraction of highly qualified workforce to companies for finding solutions to specific technological problems or development of new products that would boost innovative capacity of business enterprises, tackle the problem of qualified personnel and facilitate the much needed knowledge transfer. Other measures for enhancing participation of small and medium-sized companies (SMEs) in R&D aside from the ones directly aimed at facilitation of academia-industry linkages (see section 5.1.1.) include, for instance, state support for the development of new products and technologies available since 2004 with a new scheme to be launched under the new SF planning period as well as export promotion planned to be intensified in 2008 that both require a more strategic and long-term perspective on business development and knowledge-intensive activities.

More generic recent measures that that would strengthen the financial capacity of companies that has been listed among the hampering factors for innovative activities include an increased availability of venture capital, guarantees and loans with an additional reconsideration of the prospective tax incentives. Finally, one can also mention those measures related to upgrading the capabilities of employees in terms of their qualifications and skills and the planned state aid programme for enhancing motivation for innovation and business start-up (see also Adamsone-Fiskovica et al, 2008). Additional activities in terms of advancing human resources are also planned in the field of life-long learning with new guidelines in this policy area adopted in 2008 and EU SF funding earmarked for several policy measures.

5.2 Assessment of strengths and weaknesses

While the main weaknesses in the domain of knowledge circulation in Latvia are related to the predominance of brain drain over brain gain in the whole economy and the shortage of skilled S&E labour force in the business sector in particular contributing to the limited absorptive capacity of R&D results by the latter, the current strengths of the system can be associated with a recently strengthening policy response for promoting knowledge and technology transfer between academia and industry along with an increasing support for and intensity of trans-border cooperation in R&D. Yet, for the time being the limited domestic knowledge circulation between academic and business sectors is seen as more critical in the political and public discourse thereby also the policy response is more focused on this domain though there is still room also for an increased openness of local institutions and programmes to foreign individual and institutional participants in order to facilitate a more active international knowledge circulation in Latvia.

Main strengths	Main weaknesses
• A strengthening policy response for promoting knowledge and technology transfer between academia and industry • Increasing support for and intensity of trans-border cooperation in R&D	• Predominance of brain drain over brain gain • Limited absorptive capacity of R&D results by the enterprise sector • Shortage of skilled S&E labour force in the business sector

5.3 Analysis of recent policy changes

An overall assessment of the policy process demonstrates an expanding policy response to the challenges in respect to knowledge circulation in Latvia with emerging initiatives and measures for strengthening involvement of the private sector in cooperative schemes with universities and PROs as well as boosting the absorptive capacities of companies. While there hasn't been any recent major change in the policy goals in respect to the above-mentioned challenges, in 2007/2008, priorities have been reinforced in the light of the new programming period of the EU SFs and a range of new strategic policy documents (e.g. the Programme for Promotion of Business Competitiveness and Innovation for 2007-2013). Accordingly, in 2008, several new policy measures have been launched including the state aid programmes for the establishment of technology transfer contact points and attraction of highly skilled workforce (see section 5.1.1). Yet, so far the national policy documents have paid more attention to the facilitation of knowledge circulation between university, PRO and business sectors and improving the related absorptive capacity of knowledge users than addressing additional means for both contributing to and profiting from international knowledge exchange that is seen as a less problematic field at the moment.

Challenges	Main policy changes
Facilitating circulation between university, PRO and business sectors	• Adoption of the Programme for Promotion of Business Competitiveness and Innovation for 2007-2013 • Launch of several new policy measures (e.g., technology transfer contact points, attraction of highly skilled workforce)
Profiting from international knowledge	• Amendments made to the Law on Research Activity defining conditions for participation of foreign researchers in research projects implemented by national research institutions
Enhancing absorptive capacity of knowledge users	• Continuation of the strategic orientation towards boosting the generation and application of R&D results by companies

5.4 Assessment of policy opportunities and risks

The main policy opportunities in terms of promoting intersectoral collaboration are currently related to the set of recent and new policy measures that are targeted at knowledge and technology transfer (e.g. technology transfer points, placements of engineers and scientists, competence centres) and are expected to contribute to an intensified knowledge circulation between academia and industry. Since so far there were hardly any similar targeted measures, they now bear the potential of serving as a considerable catalyst in advancing developments in this area both due to their complementary nature and financial backing. At the same time there is a risk of

current policies not being able to sufficiently enhance the absorptive capacity of companies and promote horizontal mobility of human resources between public and private sector required for long-term productive synergies. While there are still many untapped resources for taking advantage of international knowledge exchange on the level of individual researchers and PROs, in the light of the current misbalance between inward and outward flow of researchers in Latvia a certain policy-related risk is presented by a lack of targeted policy measures facilitating reciprocal mobility of R&D personnel. There is a risk that insufficient incentive structures and framework conditions for the attraction of foreign researchers might considerably restrict the national competitive advantages in the field of R&D.

Main policy opportunities	Main policy-related risks
• Efficient implementation of new policy measures aimed at knowledge and technology transfer	• Insufficient incentives for enhancing absorptive capacity of companies and promoting mobility of human resources between public and private sectors • Undetermined policy actions in facilitating a balanced inward and outward mobility of R&D staff

5.5 Summary of the role of the ERA dimension

The context of the ERA plays its role for reducing barriers to knowledge circulation especially in respect to facilitating a more extensive participation in European R&D collaboration of both universities and PROs and companies. Access to European research resources is especially crucial for Latvia given its small size and the respectively limited national capacities in sufficiently addressing different specific research topics. At the same time, the current state-of-the-art for Latvia is characterised by mainly taking advantage of the European resources as a beneficiary rather than contributing to strengthening the ERA as a donor, for instance, by means of opening its national programmes to external actors and balancing out the researcher flow. Thereby there is still a certain mismatch between supply and demand factors presented by Latvia in respect to the ERA concept, yet it is likely to change in the future in the light of continuous improvements being made to the national research infrastructure and adjustments of related regulations.

6 - Overall assessment and conclusions

6.1 Strengths and weaknesses of research system and governance

A certain turning point in the research policy of Latvia was marked by the adoption of the Law on Research Activity, the radical nature of which was stimulated by the accession of Latvia to the EU in 2004. While until 2004, Latvia ranked among the last ones in Europe in terms of science funding and was operating in a mere survival mode, the Law brought about an important change by stipulating a fixed annual increase in the government R&D funding. In conjunction with the accompanying legislative documents as well as given the presence of the Programme for Promotion of Business Competitiveness and Innovation (2007), Operational programme, National Lisbon Programme of Latvia, draft Guidelines of Science and Technology

Development (2008) and a new draft law on higher education (2008) science policy oriented towards ensuring the future competitiveness of Latvian science and its innovation system in Europe has been developed in Latvia. At the same time one has to note the presence of certain concerns over the implementation of some of the provisions (especially regarding the increase in GOVERD) given the governmental plans pursued in the light of combating the high inflation levels of the recent years.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	• Growing public awareness of the role of R&D for socio-economic development
	Securing long term investment in research	• Mechanisms are in place to ensure an increase in the government R&D funding
	Dealing with barriers to private R&D investment	• Limited private R&D funding of the business sector
	Providing qualified human resources	• Increased attractiveness of research careers • Insufficient supply of human resources for R&D • Lack of policies for researchers' mobility
Knowledge demand	Identifying the drivers of knowledge demand	• Low private demand for R&D
	Co-ordination and channelling knowledge demands	• Preparation of multi-annual research programmes in the priority research fields
	Monitoring of demand fulfilment	• Underdeveloped evaluation culture and tools
Knowledge production	Ensuring quality and excellence of knowledge production	• Internationally competitive fundamental research in several fields of science • Poor performance in terms of publications, citations and patents
	Ensuring exploitability of knowledge	• High quality applied research with patentable results in at least some fields of science • Limited exploitability of produced knowledge in the framework of the current set-up of national economy
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	• A strengthening policy response for promoting knowledge and technology transfer between academia and industry
	Profiting from international knowledge	• Predominance of brain drain over brain gain • Increasing support for and intensity of trans-border cooperation in R&D
	Enhancing absorptive capacity of knowledge users	• Limited absorptive capacity of R&D results by the enterprise sector • Shortage of skilled S&E labour force in the business sector

The recent governmental documents provide a rather good overview of the main strengths and weaknesses of the Latvian research system. A large part of measures envisaged in these documents are currently being implemented with the main ones related to the execution of nine targeted state research programmes, a radical reform of the research evaluation system, measures aimed at increasing the excellence of research results and the number of patents along with ones supporting research-industry co-operation. The main problem, however, still has to do with the involvement and integration of the business sector in the national R&D system. Besides, while there are selected institutes performing high level research and

demonstrating excellence in terms of their research output, the overall level of national research capacity is not competitive enough on an international scale. An additional considerable weakness of the current research system of Latvia is the lack of S&T graduates along with an accompanying insufficient supply of human resources for R&D. Last but not least, the evaluations in the field of R&D so far carried out have mainly been implemented without an involvement of foreign researchers, though an external expertise of this kind would be critical for such a small country as Latvia.

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

Although recent policies address many of the weaknesses of the Latvian research system, there are still several risks as enlisted in the table with two particular ones that should be first and foremost taken account of. The first one is related to the limited participation of the business sector in undertaking and funding R&D activities. The inertness of business enterprises observable so far along with the presence of many business structures in the form of branch offices of foreign companies, the long-standing unwillingness of the government to make use of tax policy as an efficient policy instrument and the weak administrative capacity of the involved ministries all point to an actual risk of not observing any tangible progress in this field. Secondly, one has to highlight the weak quantitative and qualitative output of research performance demonstrated by the number of scientific publications and patents. There is a shortage of human resources for R&D, on the one hand, and potential budget restrictions caused by anti-inflation measures giving a discouraging message to the research community, on the other. These two then represent the key problems that have to be continuously given appropriate consideration in order to ensure positive policy dynamics and an unhindered implementation of the policy goals.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• New support measures aimed at academia-business co-operation serving as a catalyst for business R&D investment • Necessary reforms of R&D system fostered by the availability of the EU SFs	• New support measures aimed at academia-business co-operation utilised without mobilising new business R&D investment • Too high reliance on funding R&D from the EU SFs
Knowledge demand	• Establishment of the Research Council headed by the prime minister	• Insufficient incentives for considerably boosting the innovative activity of companies • Continued support for too many R&D fields thereby not ensuring a pronounced support for excellent disciplines and researchers
Knowledge production	• Orientation towards high quality research results with increased productivity levels	• Insufficiently effective measures for co-operative research between universities and research institutes, on the one hand, and industry and other organisations, on the other
Knowledge circulation	• Efficient implementation of new policy measures aimed at knowledge and technology transfer	• Insufficient incentives for enhancing absorptive capacity of companies and promoting mobility of human resources between public and private sectors • Undetermined policy actions in facilitating a balanced inward and outward mobility of R&D staff

6.3 System and policy dynamics from the perspective of the ERA

The integration of the Latvian research into the ERA is one of the priorities of international cooperation and as such is actively supported by the Ministry of Education and Science.

Participation of Latvia in the ERA largely influences the R&D policy making in Latvia. The Latvian research policy-makers adopt many elements from other European countries and gradually try to introduce norms common there. First of all this applies to the system of research organisation. The system of research funding currently established in Latvia can be seen as similar to the one long present in many European countries. Accession to the EU and ERA in 2004 served as a signal for the Latvian government and parliament to alter the national research policy with the EU 3% Action Plan chosen as a point of reference. The following elaboration of the National Reform Programme along with the FPs, EU SFs and programmes such as COST, EUREKA have turned into essential instruments for the development of research in Latvia.

Participation of the Latvian scientists in the EU FPs has been and continues to be a good exercise for conducting quality research, orientation towards generation of internationally comparable results and development of research collaboration. The context of the ERA plays its role for reducing barriers to knowledge circulation especially in respect to facilitating a more extensive participation in European R&D collaboration of both universities and PROs and companies, though in terms of the openness of research organisations and national programmes to European and international researchers the is not yet equally developed in Latvia.

Access to European research resources is especially crucial for Latvia given its small size and the respectively limited national capacities in sufficiently addressing different specific research topics. The ERA has also contributed to the development of a new system of R&D evaluation in Latvia and through the Bologna process exerts a positive influence on the assessment of scientific research at universities and the respective promotion of excellence.

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List of Abbreviations

BERD	Business expenditure on research and development
CIS	Community Innovation Survey
COST	European Cooperation in the field of Scientific and Technical Research
CSB	Central Statistical Bureau of Latvia
EC	European Commission
EIS	European Innovation Scoreboard
EPO	European Patent Office
ERA	European Research Area
EU FP	European Union Framework Programme
EU MSs	European Union Member States
EU SFs	European Union Structural Funds
FDI	Foreign direct investment
FTE	Full-time equivalent
GBAORD	Government budget appropriations on research and development
GDP	Gross domestic product
GERD	Gross domestic expenditure on research and development

HEE	Higher education establishments
IPR	Intellectual property rights
IRC	Innovation Relay Centre
IT	Information technology
MoE	Ministry of Economics
MoES	Ministry of Education and Science
MoF	Ministry of Finance
MoRDLG	Ministry of Regional Development and Local Government
NDP	National Development Plan
NRP	National Reform Programme
NUTS	Nomenclature of Territorial Units for Statistics
PhD	Post Honoured Degree
PPS	Purchasing Power Standards
PRO	Public research organisation
R&D	Research and development
SMEs	Small and medium-sized companies
S&E	Science and engineering
S&T	Science and technology
US PTO	United States Patent and Trademark Office
USSR	Union of Soviet Socialist Republics

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Abstract

The main objective of ERAWATCH country reports 2008 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 are produced for each EU Member State to support the mutual learning process and the monitoring of Member States' efforts by DG Research in the context of the Lisbon Strategy and the European Research Area. 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. The reports are based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.
This report encompasses an analysis of the research system and policies in Latvia.

The mission of the Joint Research Centre is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of European Union policies. As a service of the European Commission, the Joint Research Centre functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

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