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An assessment of research system and policies

Slovenia

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An assessment of research system and policies
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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 Slovenia 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.

According to the standard R&D indicators, Slovenian research system is developing rather successfully. The business sector investment in R&D is growing, with public expenditure remaining stable as percentage of GDP – thus also recording nominal increase. In terms of scientific output, the indicators like rate of publishing, impact factor and citations are all positive, even though still at relatively low level, which is understandable taking into account the size of the country. The potential impact of R&D and innovation on the growth of the country is recognised in all strategic documents, yet the implementation of policy objectives is slower than planned. Implementation seems to be a continuous problem in Slovenian R&D, partly because the goals are set very ambitiously, partly because current status is favoured by certain influential groups within scientific community and partly because stronger political support for the sector is lacking.

Key strengths and weaknesses of the system are summarised below:

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	The recognition of the importance of R&D and innovation for long-term growth and increased competitiveness in all strategic papers has not been translated in more dynamic allocation of public resources for R&D.
	Securing long term investment in research	Relative stability of public resources in spite of other pressures on the budget expenses is a result of medium-term contractual commitments of Slovenian Research Agency. Also, the inclusion of different R&D and innovation support measures in OP for strengthening regional development potentials 2007-2013 provides for certain stability in public investment in R&D.
	Dealing with barriers to private R&D investment	Several support measures for R&D in business sector exist, but their fragmentation and insufficient coordination can be seen as a weakness. Venture capital is lacking.
	Providing qualified human resources	A well-developed system of support for young researchers, both in public R&D as well as in business sector can be considered as a strength, while limited interest of youth to pursue S&T studies as well as inefficient higher education system in term of length of studying weaken the supply of human resources. Slow transition to Bologna system in higher education can be depicted as weakness, too.

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge demand	Identifying the drivers of knowledge demand	Several systems for identification of knowledge demand exist, but translation of identified priorities and knowledge demand to funding programmes of the public institutions is slow and not systematic. Particularly in public R&D sphere internal setting of priorities dominates, with little regard for external knowledge demand.
	Co-ordination and channelling knowledge demands	Non-existence of a system for co-ordination and channelling of identified knowledge demand into public R&D financing is a serious weakness.
	Monitoring of demand fulfilment	Development of a more systematic ex-ante and ex-post evaluation at the level of research programmes/ projects by SRA as well as the introduction of socio-economic relevance as one of the assessment criteria has improved evaluation practice. Still, this remains an internal system within publicly funded science and does not assess how the knowledge demand in society / economy at large is met.
Knowledge production	Ensuring quality and excellence of knowledge production	With increased internationalisation also improvement in publications, citations and impact factors of Slovenian science. Higher education still lacks systematic practice of independent evaluation of quality of teaching and overall output.
	Ensuring exploitability of knowledge	Increased attention to socio-economic relevance of research for obtaining further / additional financing makes cooperation with business sector more important for public R&D units, but at the same time the scientific excellence prevails as key criterion, maintaining current gap between the two sectors.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Many different bridging institutions to facilitate knowledge flow exist, but are not sufficiently specialised. Lack of systematic coordination of support measures and institutions prevents optimal functioning of the support network.
	Profiting from international knowledge	Stable and continuous support to participation in international R&D programmes, including the ERA-NETs, ETPs, JTI, EUREKA has been beneficial for the participants as well as policy makers, since Europeanization of R&D and innovation policy accounts for several improvements of the system.
	Enhancing absorptive capacity of knowledge users	Increased BERD as well as swift response to tax subsidy suggest there is significant absorptive capacity of certain knowledge users in business sector, yet low innovation activity among small enterprises may indicate both low demand and low absorption capacity for new knowledge there.

Since its independence, Slovenia has been developing its R&D and innovation system in several fields: institutional set-up, the content of the R&D programmes, the financing modes as well as other support measures and instruments. Policy learning, in particular from EU member countries has had important implications on current structure of the system. Setting up of the public agencies (Slovenian Research Agency- SRA, Technology Agency – TIA, Public Agency for Entrepreneurship and Foreign Investment – PAEFI) was a model seen in Scandinavian countries and were to help streamline the process of knowledge production and circulation. Numerous support measures such as technology parks, incubators, clusters, technology platforms, centres of excellence, etc. were established as a response to observed deficiencies of the system, most notably insufficient knowledge transfer from public R&D to business sector. Due to lack of systematic coordination and stable support of their activities, they have not yet fulfilled their tasks.

The public research sector's performance with regard to publications, citations and impact factor has been satisfactory – this has been the result of more systematic evaluation practice stressing scientific excellence as dominant criterion. On the other hand, the level of cooperation with business sector has declined in spite of recent policy attempts to integrate economic and social relevance of research in assessment criteria.

Evaluation practice as such has developed and most institutions provide regular ex-post evaluation of their activities, some also ex-ante. In this segment of research policy as in many others, more cooperation among stakeholders could lead to further system improvement in terms of higher transparency, systematics and synchronisation of criteria.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	Continued support to R&D in business sector; Higher education reform to stimulate enrolment in S&T studies.	Pressure for public budget allocation to other, non R&D related issues and consequent decline of public funds available for R&D; Insufficient measures to support human resource development.
Knowledge demand	Improved system of identification of knowledge demand in business sector.	Insufficient policy coordination; Lack of appropriate mechanisms to translate knowledge demand of business sector in public R&D priorities.
Knowledge production	Regularity and stability of evaluation procedures; Systematic development of independent evaluation body.	Powerful internal lobby groups who have strong impact on evaluation results; Difficulty in assuring objectivity in relatively small R&D and higher education community.
Knowledge circulation	Additional financial resources to support knowledge transfer; Built a transparent and sufficiently client-friendly support network.	Fragmented support network/ instruments for knowledge transfer; Low absorption capacity of SMEs, especially small enterprises.

By incorporating the objectives of improved cooperation between business sector an public R&D institutions and increased knowledge production in Operational Programme for strengthening regional development potentials for financial perspective 2007-2013, it is hoped that the financial constraint with regard to support measures will be eliminated. However, this increases the risk that non-coordinated policies and measures will discourage potential users, especially small enterprises, where absorption capacity for new knowledge is already relatively low.

The integration of Slovenian research sphere into ERA is one of the priorities in the strategic documents on R&D and in daily practice of policy-makers. The participation of researchers in different programmes is supported by providing information, advice as well as financial means. Slovenia tries to participate in most of the activities within ERA and is gradually opening up its public research programmes to foreign participation. The impact of European R&D and innovation policies on the shaping of national policies and even R&D priorities has been substantial. While up to now most of the attention was given to the promotion of participation per se, one of the challenges for the future R&D policies is going to be a selection of key thematic areas where it is important to cooperate from the viewpoint of national economic and social benefit, not only for personal gain of an individual researcher.

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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 Europeanization in the governance of national research systems in the framework of the European Research Area, re-launched 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:

1. 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.
2. 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.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
4. 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.

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.

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, public research organisations and business sectors; • International knowledge access; • Absorptive capacity.

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

The level of research and development (R&D) investment in Slovenia in recent years has been under 1.5% of Gross Domestic Product (GDP), with a slight increase in 2006 to 1.59% (Statistical Office of RS – SURS, Feb. 2008). In nominal terms this means €483.7m in 2006. The business sector share of total investment in R&D is 59.2%, followed by government sources (29.0%) and sources from abroad (5.8%). Slovenia introduced the Lisbon and Barcelona targets into its R&D policy and is hoping to achieve 3% investment in R&D by 2010, yet the current trends, particularly the inability to increase public sector financing at the rate of growth of GDP (6.1% in 2007), are not so optimistic. In fact the 2008 Report on the achievement of the Lisbon strategy goals noted that an increase in public R&D investment to 1% is to be achieved by 2012[2].

Table 1: Funding flows in R&D in 2006

Performers Funders	Higher education sector	Government research institutes	Business enterprises	Total	Share of GERD
Government	40.8%	48.5%	10.5%	100% (**€140.8m**)	29.1%
Business	2.4%	5.8%	91.5%	100% (**€287.8m**)	59.3%
Abroad	25.1%	33.0%	41.7%	100% (**€28.4**)	5.8%
Higher education sector	5.0%	86.1%	8.5%	100% (**€27.7m**)	5.7%
Share of total R&D expenditures	15.0%	24.4%	60.3%	100% (**€484.7m**)	100.0%

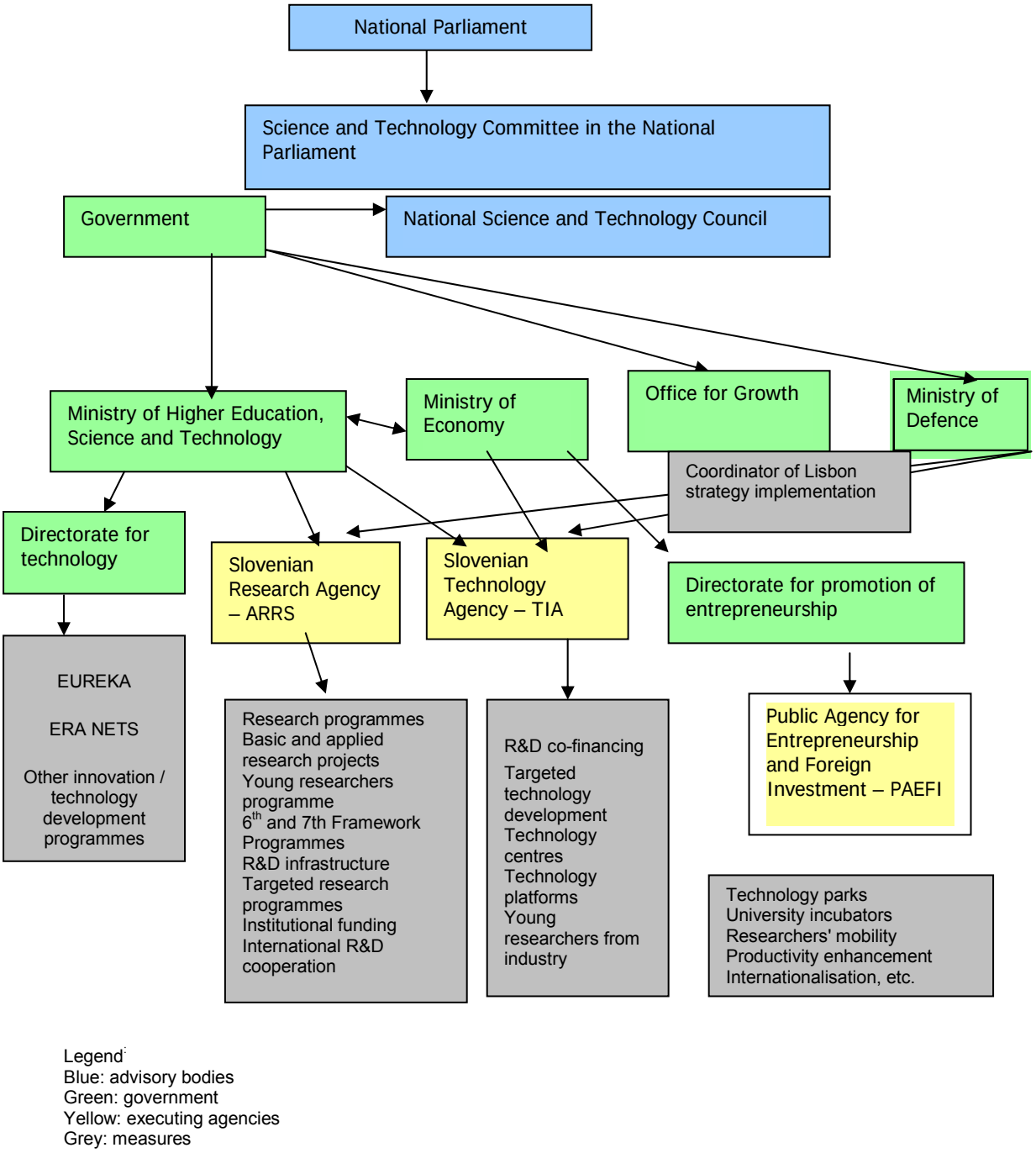
Source: Statistical Office of RS, February 28th, 2008
Note: The share of the Private non-profit sector is only 0.1%.

The Ministry of Higher Education, Science and Technology (MHEST, http://www.mvzt.gov.si/en/) is responsible for the preparation of the policy documents in the R&D area, for implementation of R&D policy (that is, implementation of the National Research and Development Programme – NRDP[3]), the public R&D budget and international cooperation in the area of R&D. An advisory body to the government in the R&D area is the National Science and Technology Council[4], with members from the research community, higher-education institutions, the business community and the government[5]. For the execution of R&D and innovation policy, two special public agencies have been established: Slovenian Research Agency (SRA[6]) and Slovenian Technology Agency (TIA[7]). The first is responsible for the execution of public research financing, for the professional and independent selection/evaluation process of R&D projects and programmes and the monitoring of

[2] Government Office for Growth, 2008, http://www.svr.gov.si/fileadmin/srs.gov.si/pageuploads/Dokumenti/SI-NRP2008-en.pdf
[3] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.documentAjax&uuid=7D87A9BB-B3F1-0959-F567E3A894EDC30B
[4] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=org.document&UUID=1686F32D-0661-2236-95DF8D150AB32B38&hwd=
[5] For details, see ERAWATCH Research Inventory Slovenia: http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=4&countryCode=SI
[6] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=org.document&UUID=7D87C86F-B1EA-8535-7A0946A6B127BC61&hwd=
[7] http://tia.si/o_agenciji,533,0.html

research implementation. The Slovenian Technology Agency is in charge of programmes promoting innovation and technology development.

Figure 2: Structure of the Slovenian research system



Source: ERAWATCH Research Inventory 2008, Structure of the Research System

The Ministry of Economy (ME: http://www.mg.gov.si/en/) is covering the programmes in which entrepreneurship and innovation policy are combined, so certain of its policy

measures are also relevant for R&D, such as the researchers' mobility scheme. Some of the programmes and measures of the ME are executed by TIA, while several measures, more focused on the entrepreneurship promotion, are entrusted for the execution to the Public Agency for Entrepreneurship and Foreign Investment (PAEFI: http://www.japti.si/home). In recent years, Ministry for Defence (MD: http://www.mors.si/?id=home&L=1) has become more engaged in financing R&D as well by running two major programmes, one with SRA (Knowledge for peace) and one with TIA (Technologies for peace). The Government Office for Growth (http://www.svr.gov.si/en/) is responsible for the implementation of the Slovenian Development Strategy[8] (IMAD, 2005) as well as the National Reform Programme for Achieving the Lisbon Strategy Goals[9] (Republic of Slovenia, 2005). The Office also coordinates the preparation of the annual National Report on the Implementation of the National reform programme – NRP for Achieving the Lisbon Strategy Goals.

The four universities and a number of public research institutes[10] constitute the main public research capability. In recent years several new higher education institutions have been established by private funds as well, including Euro- Mediterranean University[11]. During the last ten years there has been a constant growth of business investment in R&D, which in real terms increased by 63% during the period 1997-2005. At the same time, the public resources experienced only 31% growth and remain at approximately 0.4% of GDP.

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;

[8] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.document&UUID=7D87A4CA-C30B-7F76-24B2D3F6E1735FDE&hwd=

[9] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.document&UUID=FD89615B-034B-D2FD-865A648C56CA12E5&hwd=

[10] By end 2008: 15.

[11] The Euro-Mediterranean University (EMUNI University: http://www.emuni.si/en/), with its seat in Piran - Portorož, Slovenia, was inaugurated on June 9, 2008. Its objective is to be an international, post-graduate, higher-education, and research institution, fully integrated in the Euro-Mediterranean area. EMUNI University was co-founded by universities and other higher-education and research institutions.

- 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

Slovenia has committed itself to Lisbon and Barcelona objective of increasing R&D investment to 3% of GDP in all its strategic documents: Slovenian Development Strategy 2005-2010 (IMAD, 2005), National Research and Development programme 2005-2010 (NRDP, 2005) as well as in the National Reform Programme for Achieving the Lisbon Strategy Goals[12] (Republic of Slovenia, 2005).

The justification of increased investment in R&D was based also on the assessment that the economic growth during the first period of transition was based on privatisation and rationalisation of the resources, while the next phase of more qualitative growth needs to be based on increased innovation and R&D activity. The latter should provide for increased competitiveness of Slovenian industry in global markets and thus provide long-term inputs in economic development and growth.

Yet, the adoption of political documents and commitments for higher investment in R&D in Slovenia has not yet been translated into actual delivery of results. As recognised in 2007 Report on the implementation of the NRP (Republic of Slovenia, 2007), this is a long-lasting process that requires the co-ordination and participation of several policies and players. The report also acknowledges for the first time that the 3% target will take more years to achieve. In particular, the public sector expenditure as percentage of GDP has been stagnating during the recent years. Part of the explanation, offered by the government is very dynamic growth of GDP, which would require much more dynamic nominal increase of public resources than planned.

2.1.2 Securing long term investment in research

The public sector financing commitments are being implemented through the national budget, currently planned for two-year cycles. The share of R&D expenditures has not been increasing in relative terms over the years, but it has also not lowered, in spite of pressures on budget savings. Most of the funding decisions are based on two

[12]Detailed description of policy documents can be accessed at:
http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.document&UUID=FD89615B-034B-D2FD-865A648C56CA12E5&hwd=Lisbon%20Strategy%20Goals
see also related documents through the following links:
http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.document&UUID=C413FF8B-B88F-322D-7378CD97C4C12D96&hwd=Lisbon%20Strategy%20Goals
http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.document&UUID=7D87A4CA-C30B-7F76-24B2D3F6E1735FDE&hwd=Lisbon%20Strategy%20Goals
http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.document&UUID=7D87A9BB-B3F1-0959-F567E3A894EDC30B&hwd=Lisbon%20Strategy%20Goals

main lines of argument: already committed resources through various long-term existing programmes of SRA and more recently, TIA on one hand and on the other, the necessary input from the national budget for the measures and programmes to be implemented through Structural Funds co-financing. Major share of the SRA funding is taken up by so called Research programmes[13], where contract period is usually five years- this by itself secures important part of public R&D investment. The budget system has certain in-built stability, which makes it difficult to implement sudden significant increase in allocation of public funds to R&D, but at the same time avoids sudden reduction of the resources available to public R&D programmes.

More dynamic investment in research is developing in private sector. The introduction of corporate income tax subsidy on R&D expenses resulted in positive reaction from business sector, with the R&D investment growth rate of 22% from 2005 to 2006. Overall, the business sector investment in R&D has grown from €91m in 1997 to 291 m in 2006.

While participation in the EU Framework Programmes as well as other activities in the area of R&D internationalization are supported by the government, it is the private sector R&D units who seem to be able to attract more than half of the foreign investment in R&D activity. The share of R&D investment coming from abroad has been relatively stable over the years at the level of 5-8% annually (SURS, Feb. 2008).

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

While support to business R&D is high on the government's priority list in the strategic documents, the actual allocation of R&D funds shows that most of the public resources are directed to government R&D sector and higher education sector. In 2006, only 10.1% of public R&D funds went to business sector. On the other hand, the business sector has spent most of the money dedicated to R&D in-house (91.7%).

The measures designed to stimulate private R&D investment include corporate income tax subsidy, different ways of co-financing of R&D projects, subsidised loans for R&D investment, support to technology centres and technology platforms, co-financing of the services offered to business sector by technology parks, business / university incubators as well as mobility schemes. Most of the government's support measures have been included in Operational Programme (OP) for Strengthening Regional Development Potentials in the National Strategic Reference Framework[14], under the development priority »Competitiveness and research excellence«. For this priority as much as 23.5% of total resources of this OP (or €402m) have been earmarked (primarily from European Regional Development Fund). This means that from 2008 the financial resources available will increase significantly, but so will the administrative processes- the experience of the previous round of projects / calls supported with EU funds reveals that the system introduced in Slovenia is highly complex and has discouraged many potential applicants (Bucar et al., 2007).

[13] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=prog.document&UUID=7D87B479-BAD1-C57F-1B12AB4FE1C719C5&hwd

[14] http://www.svlr.gov.si/fileadmin/svlsrp.gov.si/pageuploads/KOHEZIJA/kohezija-200207/National_Strategic_Reference_Framework.pdf

What was particularly welcomed was the new tax incentive, introduced in 2006, under which investment in R&D is tax deductible in the amount of 20%. The enterprises can reduce their taxable income for corporate tax by 20% of their investment in R&D in general and by additional 10% if the investment was made in the regions up to 15% under the average development level and by 20% for the R&D investments in regions where the development gap is more than 15%. Eligible costs comprise both the purchase of equipment and new technology for the purposes of R&D, the cost of labour in R&D activities, and the purchase of licences. In all, the enterprises have claimed €72.2m in 2007 on account of R&D tax relief (IMAD, 2008).

Venture capital is still relatively underdeveloped in Slovenia. There are several smaller private venture companies, which do not necessarily finance projects in Slovenia only. The Chamber of Industry and Commerce (http://eng.gzs.si/slo/) has launched a venture capital fund in 2006 to assist enterprises in new ventures in high-tech areas[15]. The government has been planning since 2005 to form a private-public partnership to start a venture capital fund, and has in 2008 got the legal clearance, yet the Fund has not been established yet.

On the other hand, the Slovenian Enterprise Fund – SEF (http://www.podjetniskisklad.si./index.php?id=86), set up by the government, has significantly increased its resources. Their programme is aimed particularly at providing subsidised credits, but has been expanded in the area of direct subsidies to start-up companies for certain costs. In the first group of measures of SEF, we find favourable bank investment loans with a low interest rate (value for 2008: €16m), direct loans for R&D projects and supplementary guarantees for regional guarantee schemes (supplementary guarantee of the Fund – €1.25m). The direct investment subsidies for start-ups in technology parks and incubators were started in 2007 and for 2008 an amount of €2.16m was set aside for this call. Part of the financial resources is available only to new start-ups and part to the start-ups[16], which are already established within technology parks and incubators. In terms of number of applicants, quite popular measure is the co-financing (subsidies) of new technical equipment in SMEs for which €25m were available in 2008. The scheme has been expanded with special line of co-financing (subsidies) of new technical equipment in micro enterprises (up to 9 employees) in the amount of €9m[17].

2.1.4 Providing qualified human resources

The programme of young researchers[18] has been one of the most successful Slovenian instruments in stimulating young people to pursue scientific careers. Launched in 1985, it provides funds for post-graduate studies and Ph.D. work. Young researchers participate in research work during their postgraduate studies on basic research or R&D applied research projects, they have regular, fixed-term employment contracts, the Ministry of Higher Education, Science and Technology finances via the Slovenian Research Agency their salary, social contributions, as well as material and non-material costs for research and postdoctoral study. Funds for the training of junior researchers are allocated for a fixed-term, up to a maximum of four

[15] RSG Capital – venture capital management, http://www.rsg-capital.si/eng/intro .
[16] The start-up firm by definition is an enterprise less than 3 years old.
[17] http://www.podjetniskisklad.si/index.php?id=86
[18] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=prog.document&UUID=60F03F40-9287-2F04-D84A300B8F3D44A5&hwd=

years and six months for a science Ph.D. programme (doctorate). Between 200 and 250 new junior researchers complete the training programme every year, with the same number of new junior researchers being included in the programme. In cooperation with the Ministry of Economy, a new sub-programme was opened in 2001 specifically to young researchers from business sector that pursue graduate studies, attracting initially around 30 students per annual call. By 2007 the funding increased to approximately 150 young researchers from industry at a cost of €4.2m annually. In 2008, the financing had been supplemented by the European Social Fund and planned resources increased to the level of €5.96m. This should make possible to annually add 80 new young researchers to the scheme. This measure is a direct response to the lack of highly skilled researchers in business R&D and has been well received by the enterprises. It opens, however, a question of sufficient number of candidates for both schemes of Young researchers, in particular of the candidates from Science and technology (S&T) area.

Slovenia is experiencing a common EU problem of low interest among young people in pursuing S&T studies (IMAD Development Report, 2008)[19]. Even though the enrolment in higher education has increased significantly in the recent years to reach more than 50% of the generation, this increase was not equally spread: social sciences, economics and law attracted most new students. An active promotion of S&T studies started in 2006 by the Minister of Higher Education, Science and Technology in the senior high school classes, promising more scholarships and better employment possibilities for S&T students. The reforms suggested for higher education system also argue in favour of new programmes and facilities for S&T studies and more restrictive policy towards social science studies and economics (Republic of Slovenia, 2007).

One of the most serious problems of country's higher education is the question of efficiency of studies. In 2006, about 80% of students needed more than 5 years from enrolment to graduation (last available data). The introduction of "Bologna" programmes was supposed to help resolve both problems (enrolment and length of studying), yet it is particularly the science and technology programmes (faculties) where the change to new programmes has been delayed and old, not very attractive programmes are continued[20]. Most departments / universities claim that without substantial increase in resources (financial, human and space) they will not be able to implement the reforms as planned. Already the dynamic of growth of new higher education students has not been followed with adequate increase in the number of teaching staff[21]. This affects the quality of education, partly responsible for efficiency of higher education. So far, little has been done in providing additional resources to higher education institutions.

The human resource issue is addressed also by the measure, introduced by the Ministry of Economy in 2006, under which a transfer of researchers from public research institutions to business R&D units is supported. The measure is implemented via (Public Agency for Entrepreneurship and Foreign Investment –

[19] In 2006, the share of enrolment of students in S&T was 21.1% (below EU average of 24%).
[20] The MHEST allowed universities to follow different dynamics of the transition to Bologna system, so some of the Faculties opted for the latest possible date (academic year 2009/10).
[21] The student/professor ratio in Slovenia was 23.0, significantly below EU-19 (only OECD members of EU) average of 16.4 in 2005. (IMAD, 2008, p.113)

PAEFI[22] and it provides for co-financing of the salaries of the researchers who have been working in public R&D units and are to move to business sector. The success rate of the uptake of such mobility scheme in 2006 was modest, so several modifications were introduced in 2007 and 2008 to make it more attractive. One of the novelties is the encouragement of the transfer of highly-skilled personnel from large enterprises to the small ones. The specific criteria is that the researchers eligible are those with engineering or natural science background and that they should continue working in the same area of research. The goal for 2008 was to achieve at least 30 transfers from public R&D to business sector and another 30 from large corporations to small and micro firms[23].

2.2 Assessment of strengths and weaknesses

One of the strengths of resource mobilisation in Slovenia is the growth of business R&D investment. Even though the overall level of 0.95% of GDP is far from the planned Lisbon/ Barcelona target of 2% of GDP from business sector, the very fact that business has responded positively to the introduction of tax subsidy is encouraging (22.6% growth of R&D investment in 2006 in comparison to 2005 level).

Main strengths	Main weaknesses
• Continuous growth of business R&D investment; • Recognition of the potential impact of R&D and innovation on economic growth in strategic documents; • A relative stability in budget resource allocation for R&D and innovation; • Successful implementation of the two schemes under Young researchers programmes.	• Slow implementation of the strategic programs (Slovenian Development Strategy, NRP, etc.) in the area of R&D and innovation in terms of increasing resources ; • No increase in number of S&T students, which may lead to insufficient human resources for R&D, especially in business sector; • Uneven transition to Bologna system in higher education, with parallel systems allowed within same University, slowing down overall reform process in higher education.

While all of the strategic documents recognise the potential impact of R&D and innovation on economic growth, this has not been translated in increase of budget allocation for R&D and innovation. The government cites the fact that Slovenian GDP has grown significantly in recent years, making even the maintenance of the same percentage of resources available for R&D a challenge. In view of many other pressures on the budget, the relative stability of resources is already considered as strength (Republic of Slovenia, 2007). This stability is likely to be maintained throughout the 2007-2013 financial perspective, since significant number of measures for the promotion of business R&D has been incorporated in the Operational Programme for Strengthening Regional Development Potentials and thus needs to be steadily supported by the national resources as well.

Growing R&D investment in business sector may lead to a difficulty in finding sufficient human resources in R&D sector. While the Young Researchers

[22] http://www.podjetniski-portal.si/content.aspx?docid=8587&rootnodeid=9
[23] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=prog.document&UUID=F1AC7932-543A-4150-993362D290CA95F2&hwd=

Programmes have been succesfully expanded, the number of S&T students is not increasing as hoped.

2.3 Analysis of recent policy changes

The issue of dedicating resources to R&D has not attracted much attention in general public or media. Even in policy circles, the topic is receiving only occasional attention beyond the responsible institutions[24]. One of the attempts by the Slovenian Research Agency (SRA) to build the case for investing in R&D and to popularise the research is the systematic evaluation of the economic and social relevance of public research.[25]

Challenges	Main policy changes
Justifying resource provision for research activities	• All research programmes/ projects have to report on socio-economic relevance of their research at the end of the programme / project.
Securing long term investments in research	• By inserting many of R&D support measures in the Operational Programme till 2013, the Slovenian co-financing share is to a large extent also secured for this duration.
Dealing with uncertain returns and other barriers to business R&D investments	• Increased resources for innovation and R&D support measures for enterprises through Structural Funds.
Providing qualified human resources	• Expansion of the Young Researchers Schemes • Increased scholarships for S&T students.

To increase the amount of available resources for support measures for business R&D, the innovation and entrepreneurship policy has been integrated with the regional development policy. In practice this means that the National Strategic Reference Programme[26] as the basis for drawing on EU Structural Funds follows closely the priorities in Slovenian Development Strategy and NRDP in the area of strengthening national competitiveness, promotion of entrepreneurship and R&D and innovation. One of the five priorities, called *Effective generation, two-way flow and application of the knowledge needed for economic development and quality jobs* is focused on the strengthening of cooperation between the research/academic sphere and the business sector. Under this priority, different support measures for business R&D and innovation are planned. This calls for long-term national budget commitment as the national co-financing to the expected resources coming from Structural Funds, in this case primarily from European Regional Development Fund. On the other hand, the Operational Programme for Strengthening Regional

[24] An open round table to launch association of Slovenian researchers with ambition to create a pressure group for mobilisation of resources for R&D attracted less than 50 people in spite of invitations sent to all registered researchers, members of the Parliament, government representatives, political parties, etc.

[25] This is done by the introduction of a special chapter in all of the project / programme final reports required by the Slovenian Research Agency, where the recipient of the resources has to demonstrate the economic and social relevance of the undertaken research. This reporting not only includes the description of such impact but asks for the amount of additional resources the programme/project was able to raise from other sources (private of abroad).

[26] http://www.svlr.gov.si/fileadmin/svlsrp.gov.si/pageuploads/KOHEZIJA/Programski_dokumenti/NSRF_Slovenia_18_06_07_Unoff_eng_trasl.pdf

Development Potentials[27] with these measures means also that overall more resources will be available for different support measures during the period 2007-2013. This increase is already reflected in the published and announced calls for support measures during 2008.

The human resource issue in R&D is attracting a lot of policy attention as well. Not only are there additional financial resources available for the Young Researchers from Industry, also the standard programme has been opened to participants from abroad (not just EU). Also several additional scholarship opportunities have been developed by the Slovene Human Resource Development and Scholarship Fund: some for Slovenian students to study abroad, some to promote enrolment in S&T studies and some to promote enrolment of foreign students especially in S&T studies in Slovenia[28]. Some of the programmes are supported by the European Social Fund as well.

2.4 Assessment of policy opportunities and risks

Both, the strengths and the weaknesses present a policy opportunity. On one hand, the fact that business has increased its investment in R&D calls for continuation of support policies to maintain the trend. Also, the additional resources available through European Regional Development Fund and European Social Fund provide significant increase of support in some areas. On the other hand, already slow implementation of declared public budget increase for R&D along with the risk that several other interest groups (pressure to increase salaries in public sector, pension fund, social transfers due to increased prices, etc.) will be more successful in increasing their shares in the national budget, can result in declining resources for R&D. A more pro-active policy to raise public awareness of potential that R&D and innovation can have for economic and social growth in Slovenia could help prevent such development.

Main policy opportunities	Main policy-related risks
• Continued support to R&D in business sector; • EU Structural Funds available during the 2007-2013 period; • Higher education reform to stimulate enrolment in S&T studies.	• Pressure for public budget allocation to other, non R&D related issues and consequent decline of public funds available for R&D; • Insufficient measures to support human resource development in S&T area.

Attractiveness of S&T studies can be greatly enhanced if the planned reforms in higher education are successfully implemented. Along with more scholarships available for S&T students also upgrading of the premises and modernisation of curricula offer opportunity that more youngsters will find S&T studies interesting. Yet, policy changes in higher education are slow and insufficiently supported with increased allocation of resources. As already mentioned, it is the S&T departments at the universities who are most reluctant to reform their programmes in accordance with Bologna. Part of the reason for their lack of enthusiasm may be found in unclear

[27] http://www.svlr.gov.si/fileadmin/svlsrp.gov.si/pageuploads/KOHEZIJA/Programski_dokumenti/OP_Strength_regional_dev_potentials_FINAL.pdf

[28] For 2008, the Fund is planning €1.2m for approximately 50 scholarships for Slovenian S&T students abroad and €500,000 for those, studying social sciences and humanities. For foreign S&T students in Slovenia, a scholarship fund of €250,000. See details on: http://www.ad-futura.si/

financial support for the reform by the MHEST as well as in insufficiently defined guidelines by the universities on how to organise reform processes.

2.5 Summary of the role of the ERA dimension

The integration of the Slovenian research sphere into the ERA is one of the priorities in the area of international cooperation and as such actively supported by the Ministry of Higher Education, Science and Technology (MHEST). The active participation of researchers in the ERA is called for in the National Research and Development Programme, 2006–2010, as well.

The Ministry of Higher Education, Science and Technology promotes and informs the Slovenian research public about the conditions of co-operation and calls for proposals, published by the European Commission.

According to the final report of the European Commission, published by the Ministry of Higher Education, Science and Technology[29] , on the 6th Framework Programme, Slovenian institutions submitted 3898 applications and were successful in 616 cases, achieving a rate of success of 15.8%. While most applications were filed by the higher education and R&D institutions, as many as 22.5% were submitted by small and medium enterprises and industrial organisations. Out of 503 projects, where institutions from Slovenia cooperated, most projects were in IT area (20%), followed by projects in sustainable development & global change (12%), nanotechnology, materials and processes 9.7% and scientific policy support (8%). Overall, Slovenia participated in all areas of 6th FP, mostly in STREPs 28.2%, in SSA 19.3% and CA 16.3%. The total value of the resources that Slovenia had received was €76.4m, which compares well with 34.8 contribution to the 6th FP. The amounts in individual contracts vary significantly depending on the instrument or the programme.

Slovenia is actively involved in different ERA-NETs as well as several technology platforms (TPs). MHEST has a special measure through which it supports the creation of Slovenian TPs[30] as a platform for further cooperation at the EU level i.e. in the European Technology Platforms (ETPs). Part of the financial support to Slovenian TPs is directed specifically for their active participation in the respective ETPs. Also, Slovenia is a member of several EU and intergovernmental research institutions.

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

[29] http://www.rtd.si/slo/6op/gradivo/zaklj-por-07022008.asp
[30] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=prog.document&UUID=FDC89821-F688-43EF-79AF72D50A885CB3&hwd=

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

Looking at the source of R&D financing, the structure of knowledge demand has changed during the last decade in favour of business sector. Business has become the most important financier (59.3%) as well as performer (60%) of R&D activity. Most of the resources are however spent internally: as much as 91% of total business investment in R&D was spent in 2006 in business R&D units. On the other hand most of the government resources have gone to public research institutes (48%) and higher education (40.5%). Data from National Statistical Office reveal a gradual shift from non-oriented research towards industrial production and technology as well as to other civil research – corresponding figures for 2007 are 37.5%, 30.0% and 15.4% (SURS, February 2008).

On the other hand, BERD is heavily concentrated in industrial production and technology (48%). The main R&D intensive branches are pharmaceuticals, followed by radio, TV and communications equipment, machinery and equipment, electrical machinery and apparatus and other fabricated metal products. The fear that the importance of R&D investment by pharmaceutical industry will decline with the entry of FDI (one of the two major pharmaceutical companies was taken over by Novartis) has not proved justified: 36% of total intramural business enterprise R&D expenditure falls on pharmaceuticals (SURS, Dec. 2008). The R&D investment of service sector declined from 17% to 12.8% of total R&D expenditure by 2006. No major change has occurred in terms of research intensity of other sectors.

3.1.1 Identifying the drivers of knowledge demand

The most elaborate scheme for identification of knowledge demand, decisions on future orientation of Slovenian R&D policy and priority setting is the preparation of the five-year National Research and Development Programme. The Programme is important both for public R&D and business sector, since it includes key policy focus in the five year period, including the sector priorities, mechanisms (programme vs. project financing, co-financing), ratios between different scientific fields as well as between different types of research (basic, applied, development)

According to the Law on Research and Development (2002[31]) the ministry responsible for science needs to prepare the draft text of this basic policy document in the area of R&D. Various stakeholders may be involved in the preparation of the text. The *expert groups*, appointed by the ministry during the preparation of the current National Research and Development Programme (2006-2010), were

[31] http://zakonodaja.gov.si/rpsi/r07/predpis_ZAKO3387.html

composed of experts from science community, industry and government. Most of the experts were selected by the minister, not as representatives of each community, but as individuals with relevant knowledge in the area of research policy. The ministry also commissioned a series of background studies as well as a preliminary foresight exercise.

Once the draft of the National Research and Development Programme is prepared, the law requests the draft be open for *public discussion* among different stakeholders. The Slovenian Chamber of Industry and Commerce is usually asked to organise the debate on behalf of the business sector, being the forum for business to express its opinions on various government policies. This is the opportunity for business sector to specify its expectations from R&D policy as well as assess if the priorities proposed are in accordance with their knowledge demand.

The coordination of directors of research institutes (KORIS) has to present its comments and proposes changes and amendments to various policy documents. The Rectors' Conference acts on behalf of universities. All of these bodies have a consultative function, but no formal powers in the process of accepting the policy documents. The final version of the policy documents must be approved by the Council for Science and Technology[32] prior to its submission to the government. During the discussion at the government level, all ministries are invited to comment, especially the Ministry of Finance and Ministry of Economy. The Ministry of Finance needs to check the resources available and the dynamics of R&D financing. The Ministry of Economy must check the compatibility of R&D policy with the innovation policy and the policy to support entrepreneurship.

The current National Research and Development Programme follows rather closely the priorities set in the EU 6th Framework Programme (concerning information and communication technologies, advanced (new) synthetic metal and non-metal materials and nanotechnologies, complex systems and innovative technologies, technologies for sustainable development and health and life-sciences) and adds to the list of priorities research of specific importance for the Slovenian culture and history.

The basis for the selection of these priorities was a pilot project on technology foresight exercises. These priorities were to be used as a guide where the public resources for R&D should be channelled. Due to their very broad level, the second more detailed technology foresight project was carried out with results submitted to the government in the spring 2008. The methodology was partly based on Delphi, but due to the limited available resources, the consultations were limited to the smaller number of experts. Still, the working groups organised according to thematic areas provided a good forum for discussion among the business representatives and the research sphere as to what the long-term potential of each actor is. It remains to be seen how these identified priorities will be integrated in the financing mechanisms.

[32] The Council for Science and Technology is the top body for science and technology policy. According to the Law on Research and Development (2002), its composition is such that six members come from research sector, six from the business sector, one from the public research sector and one from the union representing the researchers. As a rule the automatic members are the minister of finance, the minister of higher education, science and technology, the president of the Chamber of Industry and Commerce, all three rectors of the universities and the president of the National Academy of Science and Arts. The current NRDP (2006-2010) gives specific responsibilities to the council in terms of final approval of evaluation criteria and several other policies in the R&D field.

A still rather poorly utilised possibility for knowledge demand identification are technology platforms, which have been supported by the MHEST and initially also by the Chamber of Industry and Commerce. One of the ambitions of the technology platforms[33] is to provide a forum where both the public R&D institutions and especially firms using / developing particular technology can meet and exchange knowledge and ideas of how to develop further in the future. What the technology platforms' system still lacks is a clear mechanism of transmitting identified knowledge demand to R&D policy-makers and also to knowledge suppliers: in other words, they still don't have systematic influence on shaping of funding priorities in Slovenia.

Another novelty in the identification of knowledge demand is the establishment of development groups within the Competitiveness Council by the Government's Office for Growth in spring 2008. The main objectives of the Council are[34]:

- the improvement of cooperation between the government, knowledge institutions and business sector in the area of design and implementation of the policies to promote technology development;
- stimulate technology development in Slovenia by selection of research and technology areas within the priorities defined in strategic government documents, to enable the concentration of resources and search for synergies among the selected fields;
- Through concentration of public and private resources to priority areas increase the share of resources for RTD as a share of GDP as well as increase of their efficiency.

The Competitiveness Council has 10 so called *development groups,* each with 16 members, representatives of the research – higher education and business sector. Seven groups follow the sectors (life and health, ICT, materials and nanotechnologies, environment and construction, energy and renewable energy sources, communications, transport and vehicles, process technologies), while three are meant to be horizontal (creative industries, business-finance and public research and higher education governance). The groups were expected to provide already by the fall of 2008 inputs in terms of priority research areas/themes both for basic and applied research, identify business interest and research capabilities as well as assess absorption capacity of Slovenian business and market potential at the global markets. The final reports of the groups, presented in Oct. 2008, fulfil this task to a certain extend. What remains to be developed is a systematic uptake of the identified priorities into the funding programmes for public R&D as well as in the business R&D support measures.

3.1.2 Co-ordinating and channelling knowledge demands

The National Research and Development Programme is the basis for the annual programme of work of the Ministry of Higher Education, Science and Technology (MHEST) and the budget for R&D. The budget allocation is negotiated first at the level of government and finally agreed to by the National Assembly. On the basis of its resources, the Ministry of Higher Education, Science and Technology fund various programmes, including those of the SRA and TIA. Both agencies prepare their

[33] In 2007, 16 technology platforms were supported. http://www.tia.si/shared_files/Razpisi/2007/TP07/skleptp07.pdf .
[34] http://www.svr.gov.si/si/delovna_podrocja/svet_za_konkurencnost/

annual programmes, consisting of a financial plan for their own operation as well as the funding of various research / support programmes, and present them to their respective boards of directors. Once the programmes have been approved, the MHEST presents them to the government for approval. The agencies are responsible for the implementation of the programmes and the correct use of the resources allocated to them.

The annual programmes of the two Agencies need to follow the objectives and priorities laid out in the NRDP. Yet, as already mentioned, these are relatively broad and set for the entire period of the NRDP. There is currently no mechanism in place which would ensure that identified specific knowledge demand through technology platforms, foresight exercise or from development groups is channelled to and integrated in annual programmes of SRA or TIA.

What has been identified in several evaluations as a weakness of Slovenian R&D and innovation system is the lack of clear and operational coordination mechanism. Frequent shifts in the institutional set-up (see for details annual Trendchart Country Reports 2005, 2006, 2007) and thus also changes of responsibilities allow for rather independent policy-making of different stakeholders. There are ample practical incidents which confirm lack of coordination and common policy approach: on one hand, in the spring 2008 the technology foresight exercise was completed and on the other, the Office for Growth had initiated identification of research themes of interest for business through development councils. Yet parallel to these activities, the SRA launched a call for research programmes, the single largest long-term financing scheme, which accounts for more than two thirds of public funds for research work[35]. The proposals were submitted in May 2008, the selection procedure was carried out through the summer with decisions on financing announced in Sept. The research programmes will run from 2009 to 2013, in some cases 2014. In practice this means that a large section of public R&D resources has been committed to “internal” setting of the priorities by the research community itself, while the prospective identified knowledge demand will have only limited public resources left - both in terms of finance as well as in terms of human resources[36].

This lack of coordination of knowledge demand is reflected also in high degree of internal financing of business R&D expenses (91% in 2006), which has increased in spite of declared policy of supporting cooperation between public and private R&D. On the other hand, only 11% of R&D activities in public sector were in 2006 financed by business sector, a decline from around 20% at the beginning of the century, suggesting that business sector knowledge demand is best met by the business sector’s own R&D capacities, while public research dedicates its capabilities to topics of its own interest.

[35] Research programmes have in 2006 covered more than 800 FTE (full time equivalent) while all other schemes (postdoctoral, applied and basic research projects) amounted to less than 400 FTE. (Sorcan et al.,2008)

[36] The researchers, employed in public R&D sphere (institutes and higher education) try to secure for themselves programme financing, since it means relatively stable 5-year basic research support. It is reasonable to say that a significant number of senior researchers in public sector are financially supported by programme financing to a certain extent.

3.1.3 Monitoring demand fulfilment

The evaluation practice has gradually improved in Slovenia during last decade. Still, monitoring of the R&D system has so far focused more on the overall performance than explicitly on the issue of demand fulfilment. The most comprehensive recent system evaluation was carried out during the preparation of the National Research and Development Programmes, when the Ministry of Higher Education, Science and Technology engaged several outside institutions and its own staff in analysis and benchmarking of the entire S&T system. A rather standard set of R&D indicators (EU Key Figures on R&D, European Innovation Scoreboard- EIS, OECD S&T Indicators[37]) were compared as were the trends for the years from 2000. Parallel to this, an internal evaluation of the measures in the area of R&D and innovation was performed and an assessment of the results of the first five years of research-programme financing. The outcome of the evaluations was reflected in the setting of R&D policy and funding priorities for the current NRDP.

The evaluation practice for research programmes and measures to promote R&D has been developing gradually by SRA and is becoming more systematic in the recent years. Research programme evaluations depend on the type of the programme. In general, the basic criteria employed by the ministry responsible for science and by SRA have been quantitative appraisals of bibliographic references of the members and especially the heads of the research programmes/projects. A new regulation on the evaluation of the researchers and research organisations/teams was passed in April 2006, introducing a complex point system for bibliographic references. This system is applied in the evaluation of the annual reports submitted by the research programme groups and also used to prescribe the eligibility criteria for the selection of basic, applied or developmental research projects. An important new category, introduced in 2006 is the socio-economic relevance of the research, mostly assessed by the size of external resources the programmes / projects was / is able to generate.

The evaluations are usually performed by a combination of internal staff and outside experts. SRA occasionally uses external foreign evaluators and is planning to do so systematically in the near future (pending the availability of resources). The agency now performs both ex-ante and ex-post evaluations: the first are practised in the selection process of research programmes/projects to be funded and the second at the end of the funding. Systematic use of the ex-post evaluation results of a particular research group/individual in the next round of financing is becoming a more regular practice.

3.2 Assessment of strengths and weaknesses

Particularly when designing new strategic documents, various systems of identification of knowledge demand are suggested to the policy makers. The technology foresight exercise has been attempted, which suggested on the basis of comparing strengths of research and business sector in key areas where the

[37] The indicators, OECD standardly uses in its biannual publication "Main Science and Technology Indicators" as well as in OECD Science, Technology and Industry Scoreboard and OECD Science, technology and Industry Outlook. (For details see: http://www.oecd.org/department/0,3355,en_2649_34409_1_1_1_1_1,00.html)

priorities for funding should be in medium and long-term. Also, new mechanisms are being developed, which could be used in identification of knowledge demand, but the crucial weakness of the system is the translation of the identified priorities into funding programmes. While the attention to scientific excellence is important criteria in allocation of funding to different research programmes and projects, more systematic channelling of the public resources towards priorities needs to be implemented. The current system allows for disproportional impact of the public R&D sphere on priority setting.

Main strengths	Main weaknesses
• Several existing systems for identification of knowledge demand.	• Internal setting of priorities in public R&D sphere; • Poor translation of identified priorities and knowledge demand to funding programmes of the public institutions (Agencies, Ministries); • Weaknesses of the R&D projects' evaluation practice so far have been that evaluation criteria were often set only once the specific research programme/project had been completed or that the criteria changed during the duration of the programme/project.

3.3 Analysis of recent policy changes

To improve the identification of knowledge demand as well as business opportunities, supported by new knowledge, the Competitiveness council organised development groups. As described above, their task is to suggest future direction of allocation of public R&D funding. Yet the impact of their work will not be significant unless also the policy coordination in R&D and innovation among main stakeholders (MHEST, SRA, Office for Growth, Ministry of Economy, TIA) is improved.

Challenges	Main policy changes
Identifying the drivers of knowledge demand	• Establishment of the development groups within the Competitiveness Council.
Co-ordinating and channelling knowledge demands	• Continuation of status quo in terms of effective policy coordination (lack of).
Monitoring demand fulfilment	• More systematic ex-ante and ex-post evaluation at the level of research programmes/ projects by SRA; • Introduction of socio-economic relevance as one of the assessment criteria, introduced in annual reports on programme implementation (ex-post).

Evaluation and monitoring of the research programmes / projects as well as different support mechanisms has improved. While dominant criteria remain standard indicators of scientific excellence, socio-economic relevance is assessed more and more frequently by SRA.

3.4 Assessment of policy opportunities and risks

With improved and expanded systems of identification of knowledge demand, the policy makers have the tools available to better channel their resources. Yet this policy opportunity is seriously hindered by the lack of systematic framework for

translating the identified priorities in the funding system either through SRA (the major financier of public R&D) or TIA, latter being particularly relevant for the support of business-oriented R&D. Due to the existing insufficient policy coordination among the main stakeholders, the systems of identification of priorities risk that their results will not be implemented as proposed.

Main policy opportunities	Main policy-related risks
• Improved system of identification of knowledge demand in business sector.	• Insufficient policy coordination; • Lack of appropriate mechanisms to translate knowledge demand of business sector in public R&D priorities.

3.5 Summary of the role of the ERA dimension

During the discussion on priorities for the current NRDP, significant attention was given to the issue of internationalisation of R&D and promotion of cooperation in ERA. As mentioned, the research priorities identified are in line with the research priorities identified in 6th Framework Programme. Increased participation of Slovenian research sector in ERA itself is a priority of the NRDP.

As already mentioned, the establishment of Slovenian technology platforms was also supported to align national technology development closer with the European Technology Platforms. Part of the financial support to TPs is directed specifically for their active participation in the respective European Technology Platforms (ETPs).

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

The backbone of Slovenian knowledge production in public sector is the 47 research institutes and four universities. More than 30% or 1805 of researchers (in FTE) in 2006 were employed in research institutes, and only slightly fewer (1740) at higher education institutions. Except for the largest public institute Jozef Stefan Institute with more than 800 employees only few research institutes employ more than 50 people. Even smaller research groups exist at the universities, where current regulations allow regular teaching staff with 100% pedagogical assignment to participate on top of these 100% in the amount of 20% of FTE in publicly funded research[38]. It is quite customary that each department / chair is involved in research around the topic of their own interest, but some faculties / universities have their own research institutes as well[39].

The improvement of quality and excellence in knowledge production has been one of the major goals of the current NRDP. Several policies have been introduced with this in mind. Probably most direct impact on the increase of quality (especially if measured by bibliometric criteria) has been the evaluation system for publicly funded research as well as promotion criteria in R&D and higher education sphere. Both have most directly affected everyday life of researchers in public sphere. The drive to higher quality has focused primarily on increasing the thresholds: on one hand for the eligibility for the application for research programme or project funding and on the other for assessing the success of a particular programme / project. The potential project manager who wants to apply with his / her team for programme funding at the SRA needs to meet set criteria, which include sufficient number of highly qualified papers, manuscripts, etc. published in high ranking journals and / or by recognised publishing house. For each type of funding, SRA also has a set of evaluation rules, where expert assessment is matched with bibliographic data to form the final grade.

This increased attention to publicising has resulted in high growth of output in public research sphere – Slovenia ranks 6th among OECD+ countries in terms of ratio between scientific publications and R&D expenses in the period 2004-2006. Since 2002, Slovenia has an annual average growth rate of 8 % in publications, resulting in 30% increase by now (Sorcan et al., 2008, pp. 71–8).

Also important indicator of quality is the citation index, which has been built in all evaluation systems currently applied (both by the SRA as well as by the Universities in their promotion criteria). The share of Slovenian science in all citations is rather small (0.11%), but the rate of growth is again quite impressive with more than 16% during the period 2002-2006 (ibid., data taken from Thomson ISI Science Indicators, 2006). In terms of impact factor, Slovenia is below OECD and EU (4.89) average at 3.13 (relative impact factor is 0.68%) (ibid., p 76). For appropriate assessment of these results, one needs to take into account the size of Slovenian research sector as well as the resources available.

[38] This explains the difference between the head count of the number of persons employed in R&D in higher education (3552) and the figure expressed in FTE (1740).

[39] For example, Faculty of Economics at the University of Ljubljana has its own Research centre with 137 researchers, most of them being involved also in teaching (but not all of them); many similar specialised research centres exist in faculties in the fields of natural sciences and medicine.

Looking at the sectoral distribution of publication results, the highest share (59%) comes from natural sciences, followed by technical sciences (19%) and medicine (15%). The relative impact factor shows somewhat different ranking: for technical sciences the relative impact factor is 0.81, followed by agricultural sciences (0.78) and natural sciences (0.69). What is characteristic for all scientific fields is gradual increase in relative impact factor in the recent period (from 2002 onwards).

Slovenian higher education system is currently engaged in the implementation of the Bologna reform. The regulator allowed different dynamics in introduction of the Bologna system, depending on the individual programme of each faculty. In practice this means that even within each university, some faculties may already be fully adjusted to the new system, while some will only start with Bologna process in the school year 2009/10. The reform, as well as 2008 Resolution on higher education[40], have the increase of quality of research work as well as of teaching high on their agendas.

One of the ways of assuring the quality of research is through promotion criteria, which is becoming more and more rigorous at all four universities and attaches increasing importance to the quality of the research work of the candidates. In particular, the overall publication record is considered as well as number of papers in top ranking journal and number of citations. Still, this is the assessment at the individual level and not at the institutional one.

At the moment, Slovenia does not have an independent national evaluation agency for higher education or research institutes. The accreditation of the programmes / new faculties / new universities is done by the Higher Education Board at the MHEST[41], which should also have the tasks of evaluation of the universities. The Law on higher education, passed in 2004[42], envisaged the establishment of Public Agency for Higher Education with the task of accreditation, monitoring and evaluation of programmes in higher education institutions, but this section of the Law was changed in 2006 upon the insistence of the minister of MHEST. His argument against the formation of the public agency was that this is not needed and is too expensive; therefore the Board can carry out these tasks just as well.

Some faculties / universities have decided to carry out their own self-evaluation to help them improve their quality or to get international certification of their programmes. Yet the systematic evaluation of HE as practiced in several other EU countries has not yet been introduced in Slovenia.

4.1.2 Improving exploitability of knowledge production

One of the relatively common critical observations in analyses of recent trends in Slovenian science is that in striving to achieve scientific excellence according to SRA evaluation criteria, the research agendas in public R&D are moving away from potential exploitability of new knowledge.

[40] http://www.uradni-list.si/1/content?id=82672

[41] The Board has often been criticised as subjective and politically biased, since the members are appointed by the Minister. Also, several of their decisions on accreditation of various higher education programmes submitted particularly by private institutions have been criticised as not being based on quality assessment but on the political orientation of the founders.

[42] http://zakonodaja.gov.si/rpsi/r02/predpis_ZAKO4172.html

Looking at the figures from the Innovation surveys, we see that only 5.7% of Slovenian enterprises find the information coming from higher education institutions as highly relevant for their innovation activity, which one could interpret as indicator of low exploitability of knowledge production[43]. Looking at the patent data, the developments contradict this: in spite of still relatively low number of patents per capita (54 European Patent Office-EPO patents/ per million inhabitants in 2004), the growth rate in patenting is impressive: with 26.2% annual growth rate in EPO patent applications during 1999-2004, Slovenia ranks 4th in EU (Statistics in focus, Science and technology, Patent Statistics, 17/2008[44]). During the period 2000- 2007, 373 researchers, employed in business R&D units were granted a patent[45], 473 researchers at higher education institutions and 345 in the public research institutes. The distribution of researchers according to the research unit, shows a less harmonised picture: as many as 200 patents came from Institute Jozef Stefan, the largest public R&D institute, followed by 100 from the University of Ljubljana, Faculty of Engineering and 94 from Chemical institute. Out of 400 research institutions, receiving financial support from SRA, less than one quarter received a patent during the last eight years and out of these about a half have more than a single one (Sorcan et al., 2008, p. 158). This would suggest that exploitability of produced knowledge is highly differentiated, depending on the scientific field as well as the institution.

The National Research and Development Programme 2006-2010 anticipates a shift from programme financing towards project financing within the Programme's period (2006-2010). More project financing where typically co-financing from business sector is required should also increase the exploitability of knowledge production. Yet with limited additional public resources for R&D the planned shift is not being implemented as suggested in the strategy documents.

4.2 Assessment of strengths and weaknesses

There is no doubt that measuring by standard indicators (publications, citations, impact factor) the quality of Slovenian research is improving. Since the publications abroad have a higher merit than the ones nationally, a higher level of internationalisation of Slovenian science has been achieved recently as well. On the other hand, the evaluation processes are still predominantly based on individual researcher and not on the institutions, where a lack of independent evaluation agency is increasingly felt as a weakness in the process of assuring the quality of institutions, especially in higher education.

Main strengths	Main weaknesses
• Improvement in publications data; • Growing internationalisation of R&D.	• Lack of systematic independent evaluation of higher education institutions and public research institutes.

[43] The figure is less dramatic if put in comparison with figures from other countries: even in Finland only 4.9% of enterprises find information from universities as highly important for their innovation activity.

[44] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-08-017/EN/KS-SF-08-017-EN.PDF

[45] Figures are based on data in Co-operative Online Bibliographic System and Services – COBISS – a Slovenian R&D information system, where bibliographic data on all registered researchers in Slovenia is maintained.

4.3 Analysis of recent policy changes

Challenges	Main policy changes
Improving quality and excellence of knowledge production	• A complex evaluation system developed by SRA for public research funding, with more systematic use of foreign evaluators; • Setting up centres of excellence.
Ensuring exploitability of knowledge production	• Increased importance of socio-economic relevance of research for obtaining further/ additional financing.

Improvement of quality of publicly funded R&D has been one of the objectives of SRA. This has led to development of rather complex evaluation system the agency applies in the distribution of funds. Since mid 2006 SRA had prepared numerous regulative documents, specifying the procedures, eligibility and evaluation criteria for every type of financing it provides, from programme and project research funding to financing of participation of Slovenian scientists at international conferences.

One of the policy measures to improve the quality of research was the establishment of the centres of excellence. Within the financial perspective 2004-2006, the government supported the establishment of 10 centres, which were established in order to provide new form of cooperation between business and public research. The centres of excellence also contributed to the improvement of research infrastructures, since funding was provided for the purchase of research equipment.

In the R&D policy papers, more attention has been given to the issue of exploitability of newly acquired knowledge. This has led the SRA to introduce another set of criteria in evaluation of the research results by programme/ project research teams. The annual reports have to include a chapter on socio-economic relevance of research and report on additional financing the programme group was able to secure for its research. While the focus is still on scientific excellence when it comes to final grading, the research groups do get public recognition also for the demonstrated relevance of their work.

In 2007, the MHEST was intensively working on a new law on science and higher education, which was met by strong opposition by the three public universities as well as by the association of research organisations. Both groups assessed the draft proposal as serious breach of the basic postulates of academic freedom and independence, since the law would give the government a much more influential role in several areas (regulations on establishment, on financing, on nominating the management, promotion process for academic staff, etc.). The opposition to the Law along with several other disputed issues led to the Minister's resignation in the fall of 2007. Since then, there has been no open public debate on the Law.

4.4 Assessment of policy opportunities and risks

The elaborate system that SRA has put in place for different types of evaluations (eligibility criteria, ex-ante and ex-post evaluation of research programmes / projects) is relatively new. In spite of its complexity, it would be important from the viewpoint of producing desired effect – i.e. increase of scientific excellence – to maintain the system for certain period of time and not cave in to various pressure groups which prefer frequent changes of criteria, which cause lack of transparency and comparability. The science lobby in Slovenia is known to be quite influential, especially representatives of the largest research institutes. This presents a serious

risk to any more substantial policy change, especially one which would favour redistribution of funds from programme to project funding (as envisaged in the National Research and Development Programme) and could harm current main recipients of public money.

In view of the growing need (as well as commitment under the Bologna reform) for an independent evaluation body in the area of higher education, the establishment of such institution is an important policy opportunity for the MHEST. If ensuring the growth of quality is one of the key objectives of the higher education reform, such an independent body is essential to provide the Ministry with much needed credibility, especially with regard to on-going criticism of the Council for Higher Education[46].

Main policy opportunities	Main policy-related risks
• Regularity and stability of evaluation procedures; • Systematic development of independent evaluation body.	• Powerful internal lobby groups who have strong impact on evaluation results; • Difficulty in assuring objectivity in relatively small R&D and higher education community.

4.5 Summary of the role of the ERA dimension

Close monitoring of the best practices in EU in the R&D and innovation policy field has been practiced by respective ministries during the accession period already. Several improved evaluation practices were stimulated by the evaluation systems observed at the level of Framework programmes. The EU average has become a benchmark systematically employed when assessing the success of R&D policies. With the introduction of Bologna reform this Europeanization of policies has moved to the area of higher education as well. Overall, the impact of European policies has been significant for the development of higher education, R&D and innovation system in Slovenia.

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

[46] http://www.svs.gov.si/en/working_fields/

- 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

Over the years, Slovenia has built relatively extensive R&D, innovation and entrepreneurship support network. Several bridging institutions were introduced with the aim of improving knowledge flows from public R&D institutions to business enterprises. They include: technology parks and centres (1994), university / business incubators (2003), clusters (from 2001 onwards), technology networks (2003 onwards), technology platforms (2004), centres of excellence (2005), different business information units like the Small Business Development Centre[47], Innovation Relay Centres, Euro-Info-Centres, regional development agencies, the Slovene Enterprise Fund, etc. There is some overlap in tasks of different intermediary institutions. Due to the changes in policy and in the organisational setting some are no longer supported by government while new ones have been introduced as a specific policy response. The support has varied through the years, both in terms of what type of activity was co-financed as well as in the amount of support provided – this affected the programmes of the work and the survival rate of the bridging institutions.

In 2000, Slovenia launched the cluster support programme, which ended in 2005. The aim of the programme was to stimulate cooperation among the business firms as well as cooperation in a particular sector with the public R&D institutes. The cluster promotion started carefully: during the first year of the programme only three pilot clusters were established. But in the subsequent years, the interest of the business sector far surpassed the ability of government to support this initiative, in spite of high priority assigned to clustering. All together 29 projects related to clustering were supported: 3 pilot cluster projects, 13 early stage clusters and additional 13 cluster initiatives, bringing together 350 companies and 40 education / research institutes. With the change of the government in the end of 2004, it was decided to discontinue the cluster support programme (see more in Trendchart Country report on Slovenia 2007 and earlier reports) and since then, only some of the more developed clusters have survived with the help of resources from their members, financial support received through other measures (support to joint R&D projects) and even the European R&D funds.

Within the financial perspective 2004-2006, the government, with co-financing from the EU, supported the establishment of centres of excellence. The established ten Centres of Excellence[48] combine research facilities at different public research units

[47] Integrated in 2005 into PAEFI, Public Agency for Entrepreneurship and Foreign Investment.
[48] http://www.mvzt.gov.si/index.php?id=962

(both institutes and universities are involved) with research units in the business sector – members of the centres of excellence. The financial resources go to the main research unit, but co-financing must be coming from business sector for each individual project. The formation of the Centres of Excellence provided an opportunity to join together key researchers and their institutions in a particular area, regardless of the sector they belong to. They join research teams at research institutes, at universities and in business firms on equal footing: more common cooperation has been that the business commissions the research carried out at a single institute or research unit. The novelty is also joint sharing of the research equipment not only between the public research units, but in particular with the business community. Most of the high tech equipment for research in the areas where centres of excellence have been established is for Slovenian circumstances extremely expensive and only the formation of such Centres and co-operation at such scale made it possible for the researchers in all sectors to get access to this type of equipment. The current model of centres of excellence provides for pooling of the resources from public R&D and with the high participation of business sector in setting the priorities, helps in changing the orientation of basic research towards higher level of relevance for Slovenian economic and technology development. The continued support to centres of excellence is planned for the current financial perspective 2007-2013.

University incubators were introduced in 2004 at the three main (public) universities and continue to be supported by the Ministry of Economy. Yet sporadic funding in the past has led to relatively unimpressive activity, except for the one incubator, which was able to secure additional funds through providing consultancy in the area of Structural funding (not quite within its main mandate). To follow the EU scheme, the MHEST also introduced support to technology platforms (seed money for their establishment and participation at the EU TP level), so currently 16 are being funded via TIA.

The key objective of setting up this wide variety of support institutions has been the promotion of the cooperation between public R&D sphere and business sector. This, however, remains one of the deficiencies of the Slovenian R&D and innovation system. In fact, in spite of growing business sector R&D investment, improving participation rate of enterprises in innovation activity[49] and the support network, the figures reflect lower cooperation levels than in the 1990s. The EC EIS 2007 analysis indicates that Slovenia is below average efficiency in transforming innovation inputs into outputs. According to Eurostat[50] (2008), Slovene high-tech export is increasing, and amounted to 4.66 % of total exports in 2006, yet is still much bellow average for EU27. Several other indicators of innovation output remain under the average of EU27 (European Commission, 2008). But since the data on patents and publications are strongly rising, there is evidence also of increased efficiency.

One of the reasons for low effectiveness of the support network is insufficient coordination and specialisation, where no clear demarcation of the tasks is done. Many of the existing institutions are underfinanced and understaffed and preoccupied

[49] 35.1% of enterprises were active in innovation during 2004-2006; up from 27% during 2002-2004 (SURS, April 2008).

[50] http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,39140985&_dad=portal&_schema=PORTAL&screen=detailref&language=en&product=REF_TB_high_tech&root=REF_TB_high_tech/t_htec/tsiir160

with their own survival. In many ways, the fragmented network is a reflection of numerous actors involved in R&D and innovation policy at the level of government: Ministry of Higher Education, Science and Technology; Ministry of Economy; Ministry for local self-governance and regional development[51] and the Office for Growth, each working with its own set of supporting institutions / instruments.

Since facilitation of the knowledge flows is an important R&D and development policy orientation, the challenge of coordinated approach to design the most efficient network, combining the roles of university incubators, technology parks, technology centres, platforms, centres of excellence, regional development agencies, clusters, business promotion centres, etc. in a coherent and transparent support system should be given more policy attention.

5.1.2 Profiting from access to international knowledge

Increased participation of Slovenian researchers in international R&D cooperation is one of the objectives of the NRDP and is actively promoted through various measures. Co-financing is provided for participation of Slovenian researchers at international conferences and their membership fees in international research associations, preparations of project proposals for EU Framework Programmes is encouraged not only via providing technical and information assistance, but also financially stimulated. More and more research programmes are open to foreign participation. Slovenia has signed numerous bilateral agreements on cooperation in S&T field and is actively engaged in several multilateral programmes with the ambition to secure itself access to international knowledge.

From the viewpoint of the business sector, one of the most successful programmes has been participation in EUREKA programme. A member of EUREKA since 1994, Slovenia has been involved in 75 completed EUREKA projects with a total budget of €26.8m. Slovenian companies, research institutes and universities are working on projects in a variety of areas from medicine, biotechnology and the environment to information technology and transport. During 2007, 44 EUREKA projects were running with Slovenian participation of 83 different organisations (enterprises, higher education institutions, research institutes, etc.) and received €2.03m of public support[52]. For 2008, €2.9m public funds are planned for Slovenian participation in the programme. Slovenia has chaired EUREKA for the period 2007-2008, and successfully participated in the launch of the new EUROSTARS programme, the first one to be jointly financed and implemented by EUREKA and the European Commission (MHEST, 2008).

Slovenia's economy has not been among important recipients of FDI and R&D sector even less so. According to the Bank of Slovenia data on FDI, the stock of FDI in R&D sector was only €1m at the end of 2006.

5.1.3 Absorptive capacity of knowledge users

Judging by the improved innovation activity, reported in the period 2004-2006, and the growing business investment in R&D, the absorptive capacity of Slovenian business firms is growing as well. On the other hand, the high tech export is not increasing and slow technological restructuring is often mentioned as one of the main

[51] In charge of coordination of Cohesion and Structural Funds.
[52] This usually covers up to 25% of total project costs of Slovenian participant.

problems of long-term competitiveness of manufacturing sector (IMAD, 2008). Since no recent data on break-down of innovation activity by sector is available, it is difficult to identify sectors where the absorption capacity is low. Based on high concentration of research activity in a small number of sectors, it can be concluded that one of the challenges of R&D and innovation policies is the increase of absorptive capacity in non-R&D active sectors and among small enterprises, where innovation activity is still relatively low – 27% (SURS, April 2008).

Most of the attention of the policy makers has so far been focused on the increase of resources, which was slow in the past. With expected increase new questions are being opened in the area of absorption capacity of Slovenian entrepreneurship sector.

5.2 Assessment of strengths and weaknesses

Main strengths	Main weaknesses
• Many different bridging institutions to facilitate knowledge flow.	• Insufficient specialisation of support institutions; • Lack of systematic coordination of support measures and institutions.

One of the key strengths in facilitating knowledge flow from public R&D system to business sector is a network of existing bridging institutions, established through the years. To serve business needs better, current weakness of relatively limited specialisation of these institutions as well as poor coordination of their activities needs to be improved.

5.3 Analysis of recent policy changes

Challenges	Main policy changes
Facilitating knowledge circulation between university, PRO and business sectors	• Increased financial support for different types of bridging institutions; • Support to centres of excellence; • Increased support to joint R&D projects.
Profiting from access to international knowledge	• Continuous support to participation in international R&D programmes, both for public and private R&D sector.
Absorptive capacity of knowledge users	• Mobility scheme; • Voucher scheme.

The problem of insufficient cooperation between public R&D institutions and business sector have been addressed through a wide variety of different support measures, from co-financing of research projects to formation of technology platforms to identify the possible priority cooperation areas to assistance in mobility. The ineffectiveness of these measures has usually been attributed to their insufficient financing, but with 2008, increased financial support is expected also through co-financing from the Structural Funds. Already during the previous financial perspective, the European funds helped support the establishment of centres of excellence, which positively contributed to knowledge flow between public and business R&D. Planned schemes for the financial perspective 2007-2013 is further increasing financial support to joint R&D projects.

Internationalisation of R&D activity through participation of Slovenian researchers in various EU programmes is maintained and supported and gradually more Slovenian funded research programmes are opened to international participation.[53]

The attention to the issue of insufficient human resources in R&D in business sector as one of the most important elements of low absorption capacity is reflected in the recent policy responses: an expansion of the funds available for support of mobility of researchers from public R&D institutions has been announced along with additional mobility scheme, supporting transfer of R&D personnel from large enterprises to small and micro enterprises. The expansion of the voucher scheme[54], where consultancy fees are co-financed to SMEs to potential new businesses, may also alleviate some of the problems faced by small enterprises or to-be-entrepreneurs. While the latter measure is of more general nature of entrepreneurial support, it is also relevant for knowledge circulation, since consultancy can be provided to people with new R&D-based business ideas. Under the 2008 call, vouchers can be used to cover part of the human resources' training costs – indirectly this can improve absorption capacity of small firms as well.

5.4 Assessment of policy opportunities and risks

Main policy opportunities	Main policy-related risks
• Additional financial resources to support knowledge transfer; • Built a transparent and sufficiently client-friendly support network.	• Fragmented support network/ instruments for knowledge transfer; • Low absorption capacity of SMEs, especially small enterprises.

The promotion of knowledge transfer has been set as one of the national objectives supported also through the Operational Programme for strengthening regional development potentials (OP SRDP) as a part of the financial perspective 2007-2013. This will provide additional financial resources to support the network of bridging institutions and offers a good opportunity to build a more transparent and user-friendly support network. The most important issue is to achieve as good as possible coordination among the main executing agencies in terms of the definitions of each specific measure / institution to avoid overlapping. With numerous measures now existing at the PAEFI, TIA, SEF as well as through some other agencies/ministries, the transparency is of key importance for the enterprises as well as synchronisation of the requirements and the procedures in a user-friendly manner. The continuation of existing fragmented support only with added funds would not optimise the invested resources. Potential policy risk in achieving better knowledge flow lies in low absorption capacity of small and micro enterprises, which represent majority of SMEs in Slovenia.

5.5 Summary of the role of the ERA dimension

The basic concept of R&D and innovation system and policy as promoted by Lisbon strategy and ERA Green Paper had significant impact on design and formulation of Slovenian R&D policies. Also, the continuous stress on cooperation between

[53] Currently, most programmes allow for foreign participation, but do not finance it. The one programme where financing is available also to foreign citizens is the Young researchers' programme.
[54] http://cordis.europa.eu/erawatch/index.cfm?fuseaction=prog.document&UUID=C5FEDE03-8B63-407C-B123BD02B261FFDD&hwd=

university, research institutes and business sector, is the result of "Europeanisation" of R&D policies. The R&D and innovation support network in Slovenia has been modelled according to mechanisms and institutions observed to have worked successfully in other EU member countries. Also, the policy attention to SMEs in designing support measures has been influenced by EU policies. Opening up the international research cooperation to business sector through programmes like EUREKA, ERA-Nets and EUROSTARS and increased participation of business R&D units in different international programmes is an outcome of the increasing awareness and implementation of the ERA principles in Slovenia.

6 - Overall assessment and conclusions

6.1 Strengths and weaknesses of research system and governance

Since its independence, Slovenia has been developing its R&D and innovation system in several fields: institutional set-up, the content of the R&D programmes, the financing modes as well as other support measures and instruments. Key strengths and weaknesses of the research system are summarised below.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying re-source provision for research activities	The recognition of the importance of R&D and innovation for long-term growth and increased competitiveness in all strategic papers has not been translated in more dynamic allocation of public resources for R&D.
	Securing long term investment in research	Relative stability of public resources in spite of other pressures on the budget expenses is a result of medium-term contractual commitments of Slovenian Research Agency. Also, the inclusion of different R&D and innovation support measures in OP for strengthening regional development potentials 2007-2013 provides for certain stability in public investment in R&D.
	Dealing with barriers to private R&D investment	Several support measures for R&D in business sector exist, but their fragmentation and insufficient coordination can be seen as a weakness. Venture capital is lacking.
	Providing qualified human resources	A well-developed system of support for young researchers, both in public R&D as well as in business sector can be considered as a strength, while limited interest of youth to pursue S&T studies as well as inefficient higher education system in term of length of studying weaken the supply of human resources. Slow transition to Bologna system in higher education can be depicted as weakness, too.
Knowledge demand	Identifying the drivers of knowledge demand	Several systems for identification of knowledge demand exist, but translation of identified priorities and knowledge demand to funding programmes of the public institutions is slow and not systematic. Particularly in public R&D sphere internal setting of priorities dominates, with little regard for external knowledge demand.
	Co-ordination and channelling knowledge demands	Non-existence of a system for co-ordination and channelling of identified knowledge demand into public R&D financing is a serious weakness.
	Monitoring of demand fulfilment	Development of a more systematic ex-ante and ex-post evaluation at the level of research programmes / projects by SRA as well as the introduction of socio-economic relevance as one of the assessment criteria has improved evaluation practice. Still, this remains an internal system within publicly funded science and does not assess how the knowledge demand in society / economy at large is met.

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge production	Ensuring quality and excellence of knowledge production	With increased internationalisation also improvement in publications, citations and impact factors of Slovenian science. Higher education still lacks systematic practice of independent evaluation of quality of teaching and overall output.
	Ensuring exploitability of knowledge	Increased attention to socio-economic relevance of research for obtaining further / additional financing makes cooperation with business sector more important for public R&D units, but at the same time the scientific excellence prevails as key criterion, maintaining current gap between the two sectors.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Many different bridging institutions to facilitate knowledge flow exist, but are not sufficiently specialised. Lack of systematic coordination of support measures and institutions prevents optimal functioning of the support network.
	Profiting from international knowledge	Stable and continuous support to participation in international R&D programmes, including the ERA-NETs, ETPs, JTI, EUREKA has been beneficial for the participants as well as policy makers, since Europeanization of R&D and innovation policy accounts for several improvements of the system.
	Enhancing absorptive capacity of knowledge users	Increased BERD as well as swift response to tax subsidy suggest there is significant absorptive capacity of certain knowledge users in business sector, yet low innovation activity among small enterprises may indicate both low demand and low absorption capacity for new knowledge there.

Policy learning, in particular from EU member countries has had important implications on current structure of the system. Setting up of the public agencies (Slovenian Research Agency- SRA, Technology Agency – TIA, Public Agency for Entrepreneurship and Foreign Investment – PAEFI) was a model seen in Scandinavian countries and were to help streamline the process of knowledge production and circulation.

Numerous support measures such as technology parks, incubators, clusters, technology platforms, centres of excellence, etc. were established as a response to observed deficiencies of the system, most notably insufficient knowledge transfer from public R&D to business sector. Due to lack of systematic coordination and stable support of their activities, they have not yet fulfilled their tasks.

The public research sector's performance with regard to publications, citations and impact factor has been satisfactory – this has been the result of more systematic evaluation practice stressing scientific excellence as dominant criterion. On the other hand, the level of cooperation with business sector has declined in spite of recent policy attempts to integrate economic and social relevance of research in assessment criteria.

Evaluation practice as such has developed and most institutions provide regular ex-post evaluation of their activities, some also ex-ante. In this segment of research policy as in many others, more cooperation among stakeholders could lead to further system improvement in terms of higher transparency, systematics and synchronisation of criteria.

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

R&D and innovation policy has focused on two domains in particular: on securing necessary resources and on building a comprehensive institutional framework. While overall level of R&D expenditures has not progressed as anticipated – Slovenia had subscribed to 3% Barcelona target early on in its strategic documents – encouraging dynamics has been achieved in business sector. At least in part this is attributed to R&D tax subsidy and maintaining this stimulus for the continuation of investment is an important policy opportunity. At the same time, the public expenditures on R&D is expected to be under pressure due to other growing budget expenditures, especially various types of social transfers, presenting thus serious risk that the allocations for R&D and innovation could not be maintained, let alone increased. The difficulty of achieving the Barcelona target had been recognised by the government in the 2007 Report on the implementation of NRP – with the statement that the goal of 3% will take longer to achieve.

With the functioning of the public agencies in the research (SRA), innovation and technology (TIA) and entrepreneurship (PAEFI) in place, the only missing institution may still be the independent evaluation body for higher education. With several policy-makers and other stakeholders in R&D and innovation system, the key task is to improve the governance of the system in view of better harmonisation of activities, support measures, evaluation practices and especially overall monitoring of knowledge demand, production and circulation.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	Continued support to R&D in business sector; Higher education reform to stimulate enrolment in S&T studies.	Pressure for public budget allocation to other, non R&D related issues and consequent decline of public funds available for R&D; Insufficient measures to support human resource development.
Knowledge demand	Improved system of identification of knowledge demand in business sector.	Insufficient policy coordination; Lack of appropriate mechanisms to translate knowledge demand of business sector in public R&D priorities.
Knowledge production	Regularity and stability of evaluation procedures; Systematic development of independent evaluation body.	Powerful internal lobby groups who have strong impact on evaluation results; Difficulty in assuring objectivity in relatively small R&D and higher education community.
Knowledge circulation	Additional financial resources to support knowledge transfer; Built a transparent and sufficiently client-friendly support network.	Fragmented support network/ instruments for knowledge transfer; Low absorption capacity of SMEs, especially small enterprises.

The challenge for R&D policy makers in the near future is the removal of existing bottlenecks and deficiencies in the system – like the lack of systematic transfer of identified priorities in the knowledge demand towards public funding schemes. The risk of maintaining the present fragmented policy and support network and allow internal lobby groups to direct the priorities and keep the status quo, can result in sub-optimal functioning of the R&D system and therefore also diminish the potential contribution of R&D and innovation to socio-economic development. In the long run,

such developments may endanger the stability of public resource mobilisation for R&D and innovation.

6.3 System and policy dynamics from the perspective of the ERA

The integration of Slovenian research sphere into ERA is one of the priorities in the strategic documents on R&D and in daily practice of policy-makers. The participation of researchers in different programmes is supported by providing information, advice as well as financial means. Slovenia tries to participate in most of the activities within ERA and is gradually opening up its public research programmes to foreign participation. The impact of European R&D and innovation policies on the shaping of national policies and even R&D priorities has been substantial. While up to now most of the attention was given to the promotion of participation per se, one of the challenges for the future R&D policies is going to be a selection of key thematic areas where it is important to cooperate from the viewpoint of national economic and social benefit, not only for personal gain of an individual researcher.

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List of Abbreviations

BERD	Business Sector Expenditures on R&D
CA	Coordinated Action
EIS	European Innovation Scoreboard
EPO	European Patent Office
ERA	European Research Area
ERDF	European Regional Development Fund
EU	European Union
FTE	full time equivalent
GDP	Gross domestic product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
HE	Higher Education
HERD	Higher Education Expenditure on R&D
IMAD	Institute for Macroeconomic Analysis and Development
KORIS	Coordination of directors of research institutes
MD	Ministry of Defence
MHEST	Ministry of Higher Education, Science and Technology
ME	Ministry of Economy
NRDP	National Research and Development Programme
NRP	National Reform Programme
OECD	Organisation for Economic Co-operation and Development
OP	Operational Programme
PAEFI	Public Agency for Entrepreneurship and Foreign Investment
R&D	Research and Development
RTD	Research, Technology and Development
S&T	Science and Technology
SEF	Slovene Enterprise Fund
SME	Small and Medium Enterprises
SRA	Slovenian Research Agency
SSA	Specific Support Actions
STREP	Specific Targeted Research Projects
SURS	Statistical Office of Republic of Slovenia
TIA	Technology Agency
TP	Technology platform

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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 Slovenia.

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