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Peer-Review of the Estonian Research and Innovation System

Steady Progress Towards Knowledge Society

Innovation studies

19 | 2012

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Steady Progress Towards Knowledge Society

Expert Group Report prepared for the
European Research Area Committee

Innovation studies

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Foreword

In the process of preparation for the new research, development and innovation (RDI) strategic period of 2014–2020, the Ministry of Economic Affairs and Communications together with the Ministry of Education and Research, asked the European Research Area Committee (ERAC) for an external evaluation of the policy mix.

Having received the final report, we are delighted about the credit that has been given to the progress of our RDI performance over the past decade. But there are many aspects that need a considerable attention. Among these, two strategic issues emerge as particularly important for Estonia: addressing the economic and societal goals through the RDI policies and using these to accelerate the structural change in the economy.

Firstly, the peers suggest that the RDI measures should be harnessed to drive the structural change in the economy. Today the RDI measures are focused on the development of the top end of the economy, where the economic scale is still to emerge. At the same time, it is the low-added value part of the manufacturing industry along with the services sector that carries the real weight in the economy in terms of employment and exports. Since the value added in these sectors could be much higher, we must also improve their performance. This calls for a stronger integration between the RDI and the enterprise policies on the strategic level.

Secondly, we agree with the recommendation that the RDI policy should be perceived to achieve the economic goals and improve the societal issues. RDI should not be treated as an objective in itself, but rather as an opportunity to provide real benefits both for the state and the enterprises. On one hand it allows the state to acquire solutions for problems facing the society at large. On the other hand, developing solutions for these challenges allows Estonian companies to create new competences. These could be used in other countries to create new business opportunities and expand to new markets in the fast-growing economic sectors. Therefore, a concentration on the societal challenges should invite the sectoral ministries to co-operate more and improve the implementation mechanisms on the RDI policy.

In conclusion, the peer report provides a valuable view on the Estonian RDI system. Particularly the two strategic issues that we need to keep in mind: addressing the grand challenges in the economy and speeding up the structural change through the RDI policy. Moreover, the conclusion of the peer-review shows the importance to focus on the actual needs of enterprises and forces the state to set the focal points of the RDI policy more precisely.

Juhan Parts
Minister of Economic Affairs and Communications

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Preface

The Innovation Union[1] Flagship initiative, in the context of Europe 2020 strategy, highlights the role of peer-reviews in supporting the reform of national research and innovation systems. It also invites EU Member States to carry out self-assessments, according to a jointly agreed methodology, to identify key challenges and critical reforms as part of their National Reform Programmes.

In the European Research Area Committee (ERAC) meeting on 24th May 2011 the Estonian government proposed that a peer-review evaluation of their research and innovation system be carried out in accordance to the Innovation Union Self-assessment framework. This report synthesises the outcomes of the peer-review sessions that took place in Tallinn during 6–8 November 2011.

The review process was overseen from the Estonian side by **Tea Danilov** and **Mart Laatsit** from the Ministry of Enterprise and Communications, and by **Indrek Reimand** and **Taivo Raud** from the Ministry of Education and Research.

Four international experts were invited to carry out the peer-review:

- **Thomas Alslev Christensen** from the Danish Agency for Science, Technology and Innovation,
- **Shaul Freireich** from the Office of the Chief Scientist, Ministry of Industry, Trade and Labour Israel,
- **Jana Kolar** from the Science and Technology Directorate, Ministry of Higher Education, Science and Technology Slovenia,
- **Paula Nybergh** from the Innovation Department, at the Ministry of Employment and the Economy Finland.

To assist the reviewers and to facilitate the process, as well as to report the outcomes, three consultants were commissioned; **Kimmo Halme** from Ramboll Management Consulting, Finland (rapporteur), **Professor Christian H.M. Ketels** from Harvard Business School, USA and **Helena Acheson** from Technopolis Group, Brussels. **Dr. Kalle A. Piirainen** from Ramboll Management Consulting provided technical support to the process.

Mikko Salo from European Commission Directorate-General for Research and Innovation was an observer to the process.

Disclaimer: This report does not represent the views of the European Commission or the European Research Area Committee, but solely those of the Expert Group named above.

1 http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf COM(2010) 546 final; p. 28

1 Introduction

This[1]report documents the outcomes of an expert group assigned to carry out a peer-review of the Estonian Research Development and Innovation (RDI) system for the European Research Area Committee (ERAC). ERAC is a policy advisory body that advises the European Council, Commission and the member states on Science and Research, Development and Innovation (RDI) policy. The mandate of ERAC decrees that it facilitates formation and function of the European Research Area[2] by, *inter alia,* providing strategic guidance for RDI policy and monitoring the European Research Area (ERA) and promoting, as well as evaluation of the policy mix in the member states. This review is part of the series of reviews of national research, development and innovation systems, conducted in the spirit of Open Method of Coordination (OMC) earlier under CREST and presently as peer-reviews of national innovation systems under ERAC, first of which was the Belgian review conducted in May 2011.

The peer-review process was organised between September 2011 and January 2012 (see Annex), starting with an Estonian self-assessment using the restructured self-assessment tool (SAT) published in the Europe 2020 Flagship Initiative "Innovation Union" Communication[3]. The self-assessment gave rise to specific themes for the actual peer-review, which was organised between November 6th and 8th 2011 in Tallinn. The compilation of this report draws on the foregoing and documents the findings. The following sections discuss these specific themes, starting with a general overview of the performance of Estonian RDI and a discussion of the scope of RDI policy, continuing to governance and funding of RDI, and through to public sector innovation, concluding with remarks and recommendations.

The overall objective of the peer-review is to support the development of Estonian RDI policy and support coordination within ERA. However, Estonia is also updating its RDI strategy, and the peer-review outputs will also act as an input to that process. Thus the objectives of the peer-review are to assess the Estonian RDI system within the European context, to raise systemic issues that should be addressed in the upcoming RDI strategy update, to give policy guidance and, indicate best practices that could be implemented in the Estonian environment.

The Innovation Union (IU) SAT and its questions have given a practical framework for analysing the overall performance of the Estonian innovation system and the country's progress with regard to the European Research Area. In this respect, the questions raised by the SAT are highly relevant to Estonia.

The current peer-review has put additional emphasis on a few aspects that were less obvious in the Innovation Union SAT, and which have proven important in the Estonian innovation context. These are a) the overall economic performance and the economic structure in Estonia and b) international research and innovation collaboration and performance of Estonia, in particular towards the EU. At the same time, we consider it important to highlight to the reader that

- Estonia is a relatively small country and regained its independence in the 1990's, which makes the Research, Development and Innovation system quite young. Estonia has also limited administrative capacity (partly by choice in having a lean government). Thus, the full scope of innovation policy instruments that would be appropriate for Germany, Sweden, or even Poland is just not appropriate given this context. This has lead us to recommend a more targeted approach
- Estonia is at a stage of development where increasing efficiency and capital intensity predominates science-driven innovation. The current policy aims to develop a science-driven system to create innovation. It succeeds at that to a large degree, but almost completely fails in supporting the overall upgrading of the existing Estonian economy.

None of this disregards what has been successfully conducted and built up over the last two decades in Estonia. On the contrary, Estonia's innovation performance reflects how the country has been able to develop a remarkably robust innovation system over the last two decades. On this path it has been significantly more successful than many of its peers, and Estonia has been able to approach many of its benchmark countries. Nevertheless, the peer-reviewers suggest further improvements to the existing tools and structures within the boundaries of the current strategy and in view of the revision.

2 Council of the European Union. Resolution on the developments and the governance of the European Research Area, 3016th Competitiveness Council Meeting, 26th of May 2010.
3 European Commission – DG Research and Innovation, Europe 2020 Flagship Initiative Innovation Union, SEC(2010) 1161

2 Research and Innovation in Estonia

2.1 Overall innovation performance

A critical benchmark in the review of Estonia's innovation system is the overall performance that the system delivers. The starting point for the analysis is the innovation performance of the Estonian economy. But innovation is not an ultimate goal in itself; its full value is revealed in the way that innovative capacity is reflected in strong underlying competitiveness, dynamic patterns of economic activity, and ultimately economic outcomes that support the rising standard of living. The second dimension of the initial benchmark is thus the analysis of how far Estonia's innovative performance is reflected in these broader measures of economic performance.

Estonia's *innovation performance* is solid on many dimensions. In the 2010 EU Innovation Union scoreboard, *Estonia is positioned in the middle of the crowd,* roughly 0.05 point below EU27 average, but at the same time exhibits one of the fastest growth rates in innovation performance.[4] In the summary index of the Innovation Union scoreboard the country ranks above all other central European countries except Slovenia. The gap with its Baltic neighbours is remarkably high, given that these countries started from similar initial conditions in the early 1990s. Estonia has in the mid-2000s also surpassed a number of Western European EU member countries, like Italy and Spain.

Innovation Performance Estonia's Rank among European countries

ENABLERS		FIRM ACTIVITIES		OUTPUTS	
HUMAN RESOURCES		FIRM INVESTMENTS		INNOVATORS	
New doctorate graduates per 1000 population aged 25–34	21	Business R&D expenditures (% of GDP)	12	SMEs introducing product or process innovations (% of SMEs)	21
Percentage population aged 30–34 having completed tertiary education	16	Non-R&D innovation expenditures (% of turnover)	1	SMEs introducing product or process innovations (% of SMEs)	16
Percentage youth aged 20–24 having attained at least upper secondary level education	17	LINKAGES & ENTREPRENEURSHIP		ECONOMIC EFFECTS	
		SMEs innovating in-house (% of SMEs)	12	Imployment in knowledge-intensive activities	
OPEN, EXCELLENT AND ATTRACTIVE RESEARCH SYSTEM		Innovative SMEs collaborating with others (% of SMEs)	3	(% of workforce)	23
		Public-private co-publications per million population	19	Medium tech and high-tech exports (% of total exports)	26
International scientific co-publications per million population	14			Knowledge-intensive services exports (% of total service exports)	10
Scientific publications among top 10% most cited publications worldwide	20	INTELLECTUAL ASSETS	16		
		PCT patents applications per billion GDP		New-to-market and new-to-firm sales	
Non-EU doctorate students as % of all doctorate students	25	PCT patents applications in societal challenges per billion GDP	16	(% of turnover)	23
			16	Licence and patent revenues from abroad (% of GDP)	16
FINANCE AND SUPPORT		Community trademarks per billion GDP			
Public R&D expenditures (% of GDP)	10	Community designs per billion GDP	21		

Figure 1. Details of Estonian ranking in the Innovation Union Scoreboard 2010

Note: Coloring indicates relative ***strengths*** *and* ***weaknesses****; numbers in brackets are changes relative to last available year*
Source: Innovation Union Scoreboard (2011), author's analysis.

4 2010 Summary Innovation Index 0.466 vs. EU27 avg. 0.516 and 0.75 for Sweden, 0.7 Finland, 0.73 for Denmark, and ~0.20 Latvia and Lithuania; growth rate ~7% for Estonia, vs. 1% EU27 average, ~0.5% in Sweden and Denmark, 3% in Finland and Lithuania and -0.5% in Latvia Source: PRO INNO Europe 2011 Innovation Union Scoreboard (IUS) 2010: The Innovation Union's performance scoreboard for Research and Innovation, PRO INNO Europe Paper no. 18, European Commission Directorate-General Enterprise and Industry, Available at http://www.proinno-europe.eu/metrics

Looking more closely at the patterns of innovation performance, Estonia scores particularly high on inputs like skills, finance, and the general structure of the science system as well as the activities of R&D-driven companies. The main weaknesses are in the economic returns that the science system generates and, more narrowly, in the attraction and education of doctoral students in the right areas. There is a particular need to strengthen the base of skilled professionals in dynamic sectors, for example in IT, marketing, etc.

Estonia's *economic performance* measured in terms of GDP per capita and labour productivity is much less remarkable than its innovation performance. Estonia's prosperity level is behind all Western European countries as well as the leading Central European economies. While it is ahead of its Baltic peers on prosperity and productivity, the gap is much less pronounced than in terms of innovation indicators.

The Estonian economy remains *structurally* dominated by traditional sectors, and sectors with on average relatively low levels of value added like transportation, furniture, and paper products dominate in respect of both employment and exports. The three sectors mentioned are also those in which Estonia is most specialised relative to the average employment profile of European economies; their respective location quotients[5] are all above 2.5 underlining quite high specialisation. There are however good examples from other countries on how traditional manufacturing sectors can be turned into innovative and globally competitive industries again.[6]

The share of exports from industries qualified as 'high-tech' has dropped over the last decade; however, this categorisation of exports is by end product, not by the type of activity conducted in Estonia. Whether or not the loss of exports in these industries reflects a loss of high value added is thus questionable.

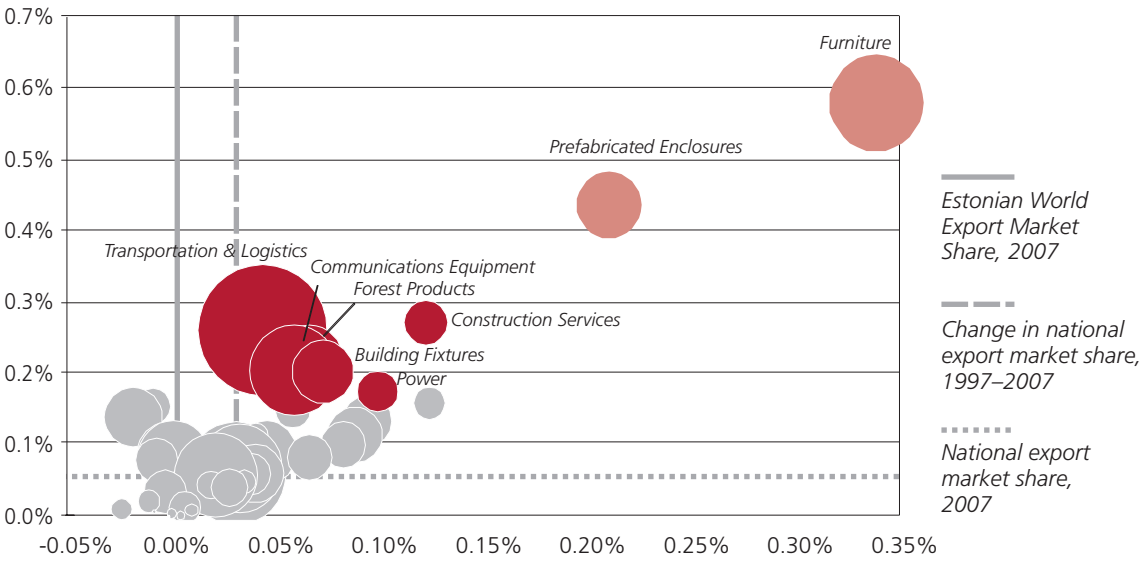

Figure 2. Estonian export market share and growth by cluster[7]

It is revealing to look at the competitiveness fundamentals of the Estonian economy. Its strengths are on macroeconomic policy and institutions much more than on microeconomic competitiveness. Within the area of microeconomic competitiveness, the business environment conditions are stronger than the sophistication of the companies themselves. In particular, Estonia is open to competition, efficient in terms of its administrative infrastructure and the rules and regulations affecting business. It also provides, as was noted above, a solid innovation system. There are issues, however, on physical infrastructure, access to advanced skills, and the dynamism of clusters. Interestingly, Estonia ranks overall significantly higher on competitiveness than on prosperity, which can be an indication of a mismatch between key advantages in terms of competitiveness fundamentals and the overall economic structure of the economy that is not able to leverage these advantages.

5 Location quotient analysis identifies the basic industries of a given region (or a country) by comparing employment in the region to national (or international) norms. If the national norm for employment in, e.g. Egyptian woodwind manufacturing is five percent and the region's employment is eight percent, then three percent of the region's woodwind employment is basic. Once basic employment is identified, the outlook for basic employment is investigated sector by sector and projections made sector by sector. In turn, this permits the projection of total employment in the region. Typically the basic/non-basic employment ratio is about 1:1. (Source: Wikipedia contributors, "Economic base analysis," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/w/index.php?title=Economic_base_analysis&oldid=422558367 (accessed January 13, 2012))

6 E.g. the transition of pulp and paper industries in Finland, furniture industries in Sweden or clothing in Italy

7 'Prefabricated enclosures' include enclosures for electrical installations, electronics and machinery, often in standard and modular configurations.

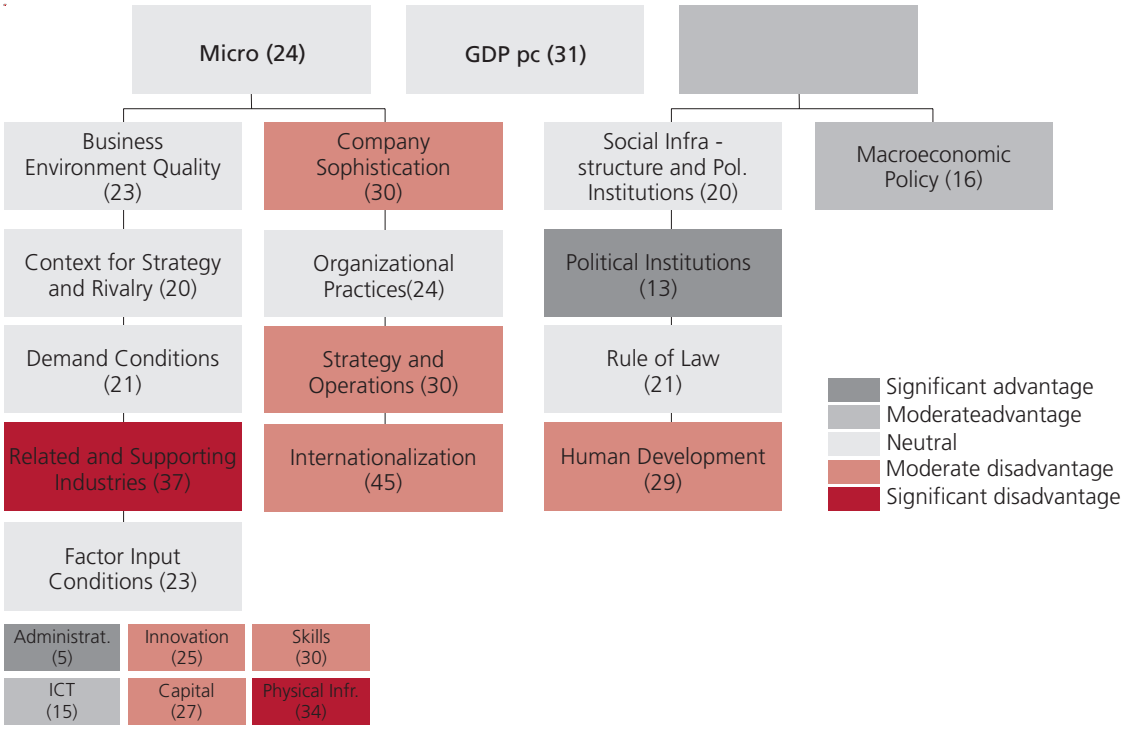

Figure 3. Estonian competitiveness profile (based on Global Competiveness report)[8]

2.2 Performance of research, development and innovation system in Estonia[9]

Estonia has made significant progress with regard to research and innovation over the last decade. The gross expenditure on research and development (GERD) in Estonia increased from 0.60% of GDP in 2000 to 1.63% in 2010, which represents an impressive annual average growth rate of above 10%. The trend is significant, even if the increase in 2009 was largely due to the drop in GDP.

EU 2020 has reconfirmed the European RDI investment at the ambitious 3% level of GDP. According to the latest Estonian strategy papers[10], Estonia is committed to the 3% goal. Most recent figures indicate that GERD was 1.63% in 2010 and according to some estimates it was around 1.8 in 2011. The target for 2012 is 1.8%, and for 2015 it is 2% and it is foreseen that 3% is reachable by 2020 at the present rate. The targets are supported e.g. by a political commitment to RDI, relatively sound public finances and temporary support provided by frontloaded (RDI focused) Structural funds and by continuous efforts to create competitive framework conditions for businesses.

Regarding employment, the labour force in 2010 (people between 15–74) as defined by Statistics Estonia was 1.03 million people out of total 1.3 million people. 33.6% of the total force are inactive for various reasons (most commonly they are students or retired). Out of active labour force 54.9% have a secondary or upper secondary education, and 35.3% hold a tertiary or university-level education, while 9.6% are below secondary degree. During the previous three years, the annual amount of graduates from general secondary education has been between 12 and 10 thousand persons, and number of graduates from vocational educations has risen from ~7,300 to ~8,900 in 2010, and the number of post secondary graduates has been between 8,300

8 The framework used for the Estonia Competitiveness Profile (Figure 3) is based on two publications, first being "Moving to a New Global Competitiveness Index" (by Michael E. Porter, Mercedes Delgado, Christian Ketels and Scott Stern, Global Competitiveness Report 2008/2009, Geneva: World Economic Forum: 2008) and second "The Determinants of National Competitiveness" (by Mercedes Delgado, Christian Ketels, Michael E. Porter, and Scott Stern, mimeo., 2012). It organizes a wide range of factors that influence prosperity levels into micro- and macroeconomic dimensions, two areas with different properties in terms of policy process and impact on productivity as the ultimate driver of prosperity levels. Delgado et al. (Ibid.) shows that all of these elements matter for explaining cross-country differences in prosperity levels. The specific rankings for Estonia are derived from a dataset covering more than 100 countries along 80+ indicators from the WEF Global Executive Opinion Survey, the World Bank Doing Business database, and a number of other international data sources. The colouring indicates deviations in the quality of Estonia's competitiveness drivers on particular groups of indicators relative to other countries at similar levels of overall competitiveness.

9 Based on Innovation Union Competiveness Report 2011, Country Profile: EE - Estonia http://ec.europa.eu/research/innovation-union/pdf/competitiveness-report/2011/countries/estonia.pdf#view=fit&pagemode=none

10 See e.g. National Reform Programme "Estonia 2020", submitted to the European Commission as a response for the Europe 2020 strategy, Available: http://www.valitsus.ee/en/government-office/estonia-2020

and 8,700 quite consistently, while number of graduates with a Master's was around 3,000 and PhDs between 160 and 175. During the academic year of 2010/2011 the number of PhDs rose to 275. Innovation Union Competiveness Report 2011 indicates that employment in knowledge intensive activities is 31.8% against EU average 35.1%.[11]

The Estonian RDI system is characterised by *government sector dominated funding and the important role of higher education institutions* (especially universities) in performing research and innovation. By source of funding, Gross Expenditure on Research and Development (GERD) continues to be dominated by the government sector, which provides, via various instruments, 44.3% of total GERD in 2010, compared with 34.9% in the EU27 (in 2009). In terms of RDI performance, business sector exceeds the higher education sector in its share of GERD (respectively 0.82% and 0.62% of GDP) while the government sector is a more marginal performer (0.17% of GDP). The majority of academic research and development in Estonia is performed at the four public universities; University of Tallinn, University of Tartu, Tallinn University of Technology Estonian University of Life Sciences, and further one private university which is specialised in business administration and management.

Estonia scores already at EU-average in scientific output measured by international scientific co-publications and is equal to its reference group in top cited publications. Articles registered in the ISI Web of Knowledge has been on the rapid rise during the 2000s. In 2010 the number of articles by Estonian researchers was 1,358. In the same comparison, Estonia produces 491 international scientific publications per million inhabitants, which is the EU average, out of which 11.3% were published in the 10% of most cited journals, against the EU average of 11.6%. However patent applications were filed 2 per billion of GDP against the EU average 4.

Business Enterprise Expenditure on Research and Development (BERD) is dominated by *a limited number of high-tech small and medium-sized enterprises* (SMEs), namely those in the ICT and biotech fields, and the service sector (financial and telecom services providers). Their RDI activity is largely intramural. The share of the business enterprise sector in R&D funding in 2010 was 43.6% (compared to that of 54.1% in EU27 in 2009), and the third largest source is from abroad with 11.4% in 2010 (EU27 8.4% in 2009). Other sources like private non-profit and higher education sectors finance together 0.8% of national GERD.

It has been estimated that there are approximately 400 companies actively involved in conducting R&D in Estonia[12]. However, the share of innovative companies[13] amongst all companies was, according to the 2009 Community Innovation Survey (CIS6), 56% when the EU average was 51.6%. Out of the total number of 4,023 enterprises identified by the survey, altogether 1,755 were non innovative and 2,268 had ongoing or abandoned activities, out of which 1,925 reported that their innovative activities were technological and 852 undertook only technological innovations and 343 on non-technical (organisational and marketing) innovations.

The business sector has made constant progress, but the output measured in patents remains relatively modest in an EU comparison. This is also partly a product of the industry structure, as the present companies are not generally RDI intensive. Nevertheless, in dynamic terms Estonia has improved faster than its reference group during the last decade[14]. The trade balance indicator, however, underlines that for many parts the *Estonian manufacturing sector is not strong enough to compete in high-tech goods*.

With regard to international cooperation, Estonia has actively integrated within the European research system. The Innovation Union Competitiveness Report[15] illustrates several aspects of Estonian scientific and technological cooperation. The strongest links of the Estonian science and technology cooperation are with Germany, Sweden, Finland and the United Kingdom. *Estonian researchers have fared quite well for example in the Seventh EU Framework Programme for Research and innovation*. As of October 2010 altogether 1,027 proposal were submitted involving 1,216 applicants from Estonia, with a success rate of 23.7% (EU27 aver-

11 Source Statistics Estonia Available through http://www.stat.ee/; Eurostat Available through http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/

12 Presentations during the Peer Review

13 Definition: "enterprises that introduce new or significantly improved products (goods or services) to the market or enterprises that implement new or significantly improved processes. Innovations are based on the results of new technological developments, new combinations of existing technology or the utilisation of other knowledge acquired by the enterprise. The term covers all types of innovator, namely product innovators, process innovators, as well as enterprises with only on-going and/or abandoned innovation activities" Source: Community Innovation Survey, Eurostat metadata, version certified 12.12.2011, Available at: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/inn_esms.htm

14 The performance of Estonia is often viewed against the performance of a) other Baltic countries (Latvia, Lithuania), b) small innovation performers in EU (Sweden, Finland, Denmark), and c)specific EU countries of similar economic nature (Slovenia, Ireland)

15 European Commission DG Research & Innovation, 2011, Innovation Union Competitiveness report 2011, Publication Offices of the European Union, Luxembourg.

age 21.9%) of applications and 18.5% of total requested funds (46.6 M€ from 251.4 M€), in relative terms retaining 2.5 times more FP7 funding as a share of GDP that EU27 average. However, in terms of volume of EU contribution per project it is roughly half of the EU27 average.

The key question that arises from the overview of the RDI performance is: as the Estonian economy is small and while GDP is now back on the growth track, unemployment is high and threatens to turn into an ongoing structural problem, *how in the medium and long-term can the national research and innovation policy play a role to support sustainable growth, economic renewal and structural change in Estonia*? This is analysed in the following sections.

3 Scope of Innovation Policy

3.1 General overview – committed to a knowledge society with a broad spectrum

Estonian innovation policy is based on broad based collaboration led by the advisory Research and Development Council involving representatives of industry, academia, Government as well as ministries of Education and Research and Economic Affairs and Communications. In practice the main responsibility of strategy making, implementation and evaluation lies on the two ministries, while the content of the strategy is approved the government and parliament. The two key strategies are the Knowledge-based Estonia 2007–2013" and "Estonia 2020" where the first is the current RDI strategy, and the latter is a general economic development strategy in response to the Europe 2020 strategy. Both of these strategies exhibit a strong commitment to sustainable economic development through research, development and innovation, including measures aimed at improving education, quality of life, and creating a sustainable yet attractive industry and business environment[16]. An important underlying trend is development of IT infrastructure and the general thrust to create knowledge-based economy.

Estonian Research and Development and Innovation (RDI) Strategy "*Knowledge-Based Estonia*"[17] describes a strategy to propel Estonia towards a knowledge-based economy and follows the previous Estonian Research and Development Strategy implemented between 2002–2006, also called "*Knowledge-Based Estonia*". The current strategy aims to enable sustainable development of the society by means of research and development, and innovation. It is tied to Estonia's long-term development strategy "*Sustainable Estonia 21*" as well as the Lisbon Agenda. The RDI strategy sets out to launch national research and development programmes for:

- developing *key technologies*;
- solving *socio-economic problems* and achieving the objectives in socio-economic sectors that are important to every resident of Estonia, as for instance energy, national defence and security, health care and welfare services, environmental protection, and information society;
- ensuring *and promoting the sustainability of research* related to Estonian national culture, language, history, nature and the Estonian state

The "*Estonia 2020*" sets the goals that gross expenditure on research and development is to be increased to 2% of GDP by 2015 and to 3% of GDP by 2020, of which the business sector research and development investments is to cover more than a half (1.6% of GDP). The proportion of employees involved in research and development should increase to 8 researchers and engineers per 1,000 employees and the productivity of enterprises per employee is intended to reach 80% of the average of the European Union member states (now EU27).

The earlier CREST OMC peer-review[18] on Estonia concludes that Estonian RDI policy has been largely focused on excellence in S&T, or the R-component of RDI, and especially universities and research organisations are focused specifically on 'high science' as befits their mission.

In short, it appears that the Estonian STI and knowledge strategies have been ambitious and rightly tuned to guide the country's development, but at the same time they would have benefited from a more narrow sectoral focus and detailed objectives. Further, the strategy should be supported with a set of instruments that covers the process from research to market. Successful implementation also requires that the strategy is properly understood, adopted and delivered by the system.

16 See, e.g. Estonia 2020 Action Plan 2011–2015. Available at: http://www.valitsus.ee/en/government-office/estonia-2020
17 Estonian Ministry of Education and Research, 2007, Knowledge-Based Estonia: Estonian Research and Development and Innovation Strategy 2007–2013.
18 Polt, W. 2007 OMC Policy Mix Review Report: Country Report Estonia

3.2 Specific issues raised in the peer-review

The peer-review paid particular notice to the following aspects concerning the scope of research and innovation policy in Estonia:

- There has been **a steady progress in the Estonian research**, which is reflected also in the very positive development of Estonia's STI performance and higher rankings in competitiveness comparisons over the past two decades. However, over the long-term few big reforms have been introduced in the organisation of Estonian research[19] and sustaining the attractiveness of research as a career remains a challenge. Given the limited resources (both in terms of human capital and finance) consideration should be given to identifying a smaller number of focus areas that are systemically developed and receive a significant proportion of both public and private R&D investments. Bringing together actors and pooling resources both from the public and the private sector, might help in developing the critical mass necessary to achieve world-class competence and competitiveness in a couple of selected sectors.

- **Research and innovation is instrumental for the structural development of the Estonian economy**. Productivity in the traditional sectors is a concern, while RDI policies are refocused on the activities in high value added sectors, especially on human resources in high value added sectors. Support is also moving toward service and knowledge based economy. Similarly, it is important to pay attention to the existing and emerging industrial clusters in Estonia, which are often parts of international value chains. Due to the small number of endogenous RDI intensive companies, attention should be paid on engaging those not yet involved in RDI activities.

  RDI instruments should also be considered for stimulating cross-sector high value-added services. Besides developing human resources in high-value added sectors, attention should be paid to improving productivity and innovation in traditionally strong sectors, e.g. by enabling the learning of new skills etc. A tighter integration of RDI and industrial policy is needed in order to support both small high value-added business and upgrading traditional industries. The level of technological competence in Estonian industry is largely lagging behind the level of the universities and cannot adequately absorb and utilise research knowledge being produced.
  The discrepancy between supply of knowledge and demand from the local industry is exhibited for example in the relatively low amount of funding universities receive form the business sector through e.g. commissioned research (e.g. in University of Tartu Institute of Technology, approx. 15% of yearly budget is covered by commissioned research). In the root of this challenge is the low number of highly educated workforce in industry; there were only 32 PhDs working in all traditional industrial sectors in 2009. This makes it very difficult to initiate ambitious RDI collaboration between industry and academia.

- **Scarcity of skilled human resources is currently and likely to remain a bottle neck** for sustaining the rapid growth of RDI in Estonia. Organic growth of resources is not enough in Estonia to respond to the needs of high growth sectors. The pool of RDI competent talent is small and easily absorbed by the needs of a few larger enterprises. The lack of available human resources currently hampers Estonian efforts to attract further foreign direct investments and may in the future affect the possibility to retain existing FDI. Industry representatives highlighted the lack of educated and skilled workers being a challenge for growth, and underlined that in some key areas in within the IT field there might be as little as two new PhD graduates per year. As a small country, it is unlikely that Estonia solves the talent challenge alone. Coordination is needed between economic, RDI, industrial, social and immigration policies.

- There is a need to **boost and broaden the innovation culture**. Currently *innovation policy is not present in all relevant sectors*. The role of public sector as a driver of innovation should be further explored, involving also a change in mind-set and demand side measures could be introduced more widely. Research and innovation perspectives should be more evident in a broader range of policy fields including, inter alia, Health, Environment, Telecoms and Transport, and including for example increasing tolerance toward immigration and entrepreneurship, and building more positive attitude towards risk taking, change and innovation.

19 During the 1990s the majority of former research institutes of the Estonian Academy of Science were incorporated into universities. Although the general arrangements for research funding have remained unchanged, several new instruments have been introduced during the past decade, such as the base-line funding in 2005 and the EU Structural Funds in 2006. Estonia is currently reorganising its funding agencies.

- There is a need to **ensure that the implementation of RDI instruments is better aligned with the national RDI strategy priorities**. Estonian strategic RDI priorities are chosen to support research-driven, technology-driven and problem-driven R&D. National R&D programmes constitute the main vehicle for implementing the national strategy of 'Knowledge-based Estonia'. Three of the seven national programmes are selected with a technological focus (ICT, biotech and material technologies) and four are focusing on societal challenges (energy, defence and security, health care and welfare services, environmental protection).

  The strategy was adopted in 2007, but to date only two (biotech & energy) of the seven planned programmes have been implemented and others are waiting for approval, postponed or cancelled. This fact also calls for the question whether there are too many programmes to be implemented with the resources available. The implementation of national programmes has been also criticised for a lack of cross-sector collaboration and ownership. The overall responsibility of coordination and implementation of the national strategy lies with the Research and Development Council.

- Research and innovation policy is increasingly international and Estonian economic and innovation contexts are strongly integrated to and influenced by the European policies and instruments. Although Estonia has been smartly utilising the EU instruments, **there is an inherent opportunity and rationale for a greater utilisation of the European research and innovation support instruments in Estonia**. This also means utilising the synergies and opportunities opening up within the Baltic Sea Region and Nordic countries. Countries of the size of Estonia cannot effectively address all societal challenges alone, mostly due to the lack of critical mass and economies of scale. Many of the large societal challenges are universal, or at least European, and are therefore well-suited to be addressed jointly between the partners of European Research Area and with the support of European policies and measures for example through the Joint Programming Initiatives. This provides a clear argument for a continued strong Estonian cooperation and contribution within the ERA.

4 Governance and Funding of Research and Innovation

4.1 General overview – more attention on implementation aspects

The *Organisation of Research and Development Act* sets the formal framework for RDI policy making in Estonia. Within that framework the highest political responsibilities for deciding the budget for RDI is with the Government and Parliament of Estonia. The state budget, including RDI funding is prepared by the government, and the ministries and proposed to and ratified by the parliament.

The Government of the Republic, advised by the *Research and Development Council* (RDC), organises the overall implementation of the national Knowledge-Based Estonia strategy. The *State Chancellery's Strategy Office* is an active intermediary in the RDI-related strategy and policy consultations, and acts as a secretariat for the Research and Development Council and together they provide policy coordination and guide the national RDI policy. The national strategy including its associated programmes, are implemented under the leadership of the *Ministry of Education and Research* (MER) and the *Ministry of Economic Affairs and Communications* (MEAC) in cooperation with other ministries, which are responsible for initiating and implementing national R&D programmes in their areas of administration. While the power in policy making is in principle distributed between ministries and boards, the *two ministries that are primarily involved in financing RDI, and respectively formulating and implementing policies for RDI, are MER and the MEAC.* Also the main responsibility for implementing and designing policy is split between these two ministries.

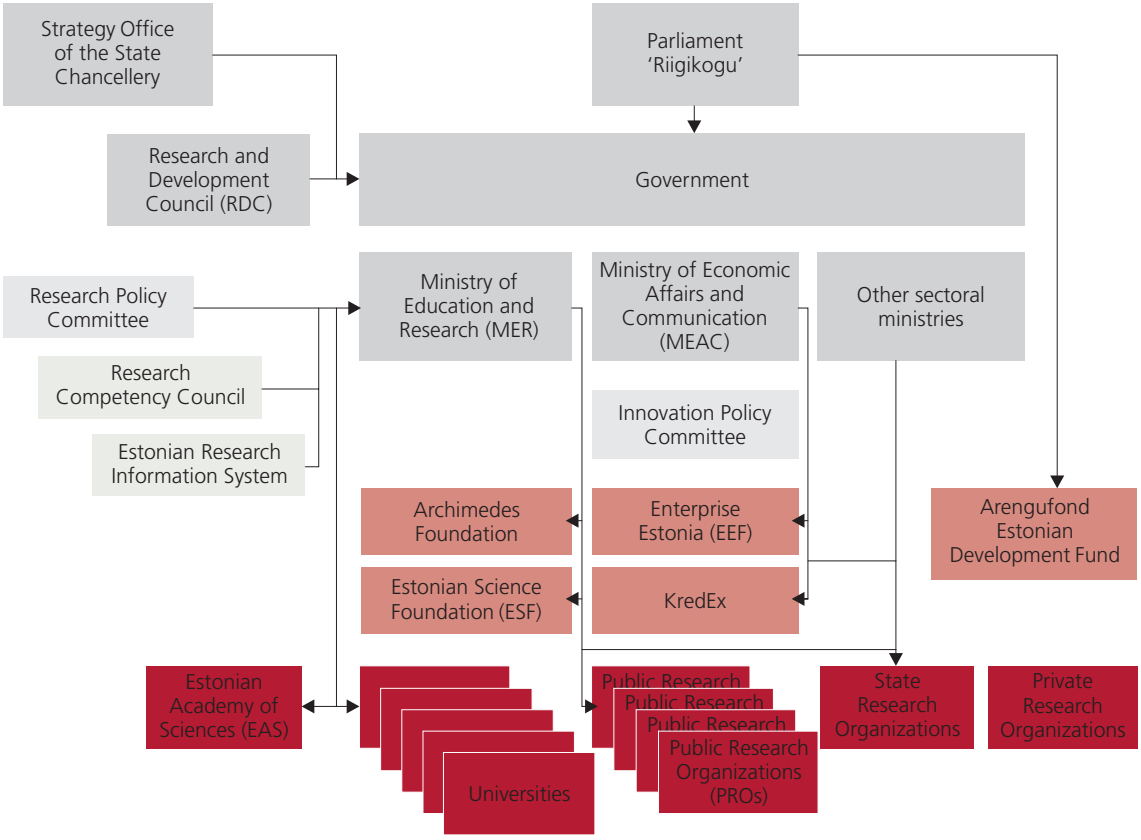

Figure 4: Overview of the Estonia's research system governance structure
Source: ERAWATCH/MER

At the operational level, both the MER and MEAC have implementing agencies/bodies and intermediaries. The main implementing body of the MEAC is the *Enterprise Estonia Foundation*, which is responsible for managing business support, innovation and technology programmes. Additional funding is available from *KredEx in* the form of risk capital that is available for start-up ventures and business enterprises in general, as well as households. The MER has two main agencies that deliver funding and support: the *Archimedes Foundation* is responsible for national activities related to the ERA, international research programmes, academic mobility measures, etc.; and the *Estonian Science Foundation (ESF)* provides grants to researchers. A new *Estonian*

Research Council will be established in March 2012 by merging the Estonian Science Foundation and part of the Archimedes Foundation.

Table 1. RDI funding by ministries

	2011	*2012*	*Change M€*	*Change %*
MER	134.9	135.5	0.6	0.4
MEAC	20.4	19.3	-1.0	-5.1
Other ministries	7.6	8.2	0.6	7.5
TOTAL	**162.8**	**163.0**	**0.1**	**0.1**
EU Structural funds	104.5	104.8	0.3	0.3
% of SF in total R&D	64.2	64.3		
GDP (Billions of €)	16.0	17.0		
RDI costs as % of GDP	1.0	1.0		

The Estonian RDI expenditure has increased positively over the past years and is slowly approaching the EU average (in 2010 GERD was ~1.63% vs. EU27 average ~1.9%), with the target 3% of GDP in 2020. The challenges for the coming years are, raising business expenditure on RDI (BERD) and balancing the prevalent use of EU Structural Funds (EUSF) and Regional Development Funds (EURDF) with national RDI funding.

Table 2. Volumes of Estonian business development and RDI instruments for enterprises

Main focus of measure	*Measures (financial engineering instruments indicated with italic style)*	*Volume, Million Euros*
Business development & exports	EEF Start-up and development grant	0.53*
	EEF Support for research and development projects: preliminary research	1.00*
	EEF Support for research and development projects: applied research	6.33*
	EEF Export plan programme: preparation	0.05*
	Export plan programme: implementation	4.53*
	EEF Support for developing knowledge and skills	2.32*
	KredEx start-up loan guarantee	6.01****
	KredEx technology loan	19.00***
	Kredex business loan	17.99***
	Kredex subordinate loan	25.57***
	EEF Technology investment programme for industrial enterprises	4.16*
	EEF Innovation vouchers	2**
Innovation and technology development	Competence Centres	64**
	SPINNO Programme	6.5** (1.3 per year)
	Cluster Programme	7.5**
	Human resources	9**
	RDI infrastructures	2**
	Start-up Eesti	2**

* *Funding delivered between Q3/2006-Q4/2009 Source: MEAC*
** *Budget for the period 2007–2013 Source: MEAC*
*** *Financed from ERDF funding period 2011–2015*
**** *Financed from ESF funding period 2008–2013*

4.2 Specific issues raised in the peer-review

The peer-review paid particular notice to the following aspects concerning the governance and funding of research and innovation in Estonia:

1) **The growth of RDI investments has been impressive, but questions remain as to whether the current trajectory is sustainable**. While BERD has been growing steadily, an increasing share of RDI expenditure is financed through public sources, namely from European Structural Funds. In 2011, 64% of all public sector RDI funding was financed by Structural Funds. Further, all the loans and guarantees that KredEx passes for business development and RDI are funded from EURDF or EUSF. As national funding has not increased as much as expected and as was agreed in the strategy, the share of EU structural funds in the general R&D budget has increased significantly in recent years. As the funding from the structural funds is specifically targeted for infrastructure development, mobility schemes and internationalisation, the possibilities to use it for other general needs, such as researchers' salaries, maintenance costs and indirect costs are limited. Much of the growth in RDI funding this far is explained by filling in the gap in infrastructure investment. To improve sustainability of RDI funding, focus and balance between Human Capital and infrastructure investment are needed, as well as thinking and planning devoted to avoiding a dependency on EU Structural Funds.

2) Innovation policy seems high on the Estonian policy agenda and RDI policy is systematically planned, however **there is a need for more active RDI policy coordination**. RDI policy making is in general restricted to MER and MEAC and there is a lack of coordination between the ministries. Apart from the MER and MEAC other ministries are not represented in the Research and Development Council, the Research Policy Committee or the Innovation Policy Committee. It appears that the Research and Development Council is not working optimally as clear results of the advice given by the council are hard to identify and attribute.

   The connection between sector ministries, societal stakeholders and the core RDI system is insufficient. Also, the participation and activity of other stakeholders and societal partners (entrepreneurs, civil society organisations) in advisory bodies is low and thereby limiting the capability of advisory bodies and stakeholders to define the social demand for RDI policy. That is probably one of the reasons why it is difficult to design RDI policies oriented towards addressing major societal challenges as "owners" of these challenges are not involved or they cannot define the social demand for R&D policy.

3) **The implementation of research and innovation policies is fragmented** and therefore multiple foundations and agencies implement policies through overlapping funding instruments, which poses a hurdle for applicants. At least partially overlapping or complementary instruments are offered by e.g. Enterprise Estonia and KredEx. Currently same industrial RDI projects are funded from different sources as separate projects during the life time of the idea to market. This results in large project administration overheads and reduced impact of funding. Different grant award criteria between the instruments leads to funding discontinuities. Instruments fund plans/activities rather than delivery. Coordination of international cooperation is weak. Although a lean public sector is an aim by itself, the shortage of resources in a small country may become a challenge in solving problems that need stronger public intervention and coordination, e.g. setting up and implementing cross-sector instruments. Handling systemic/cross cutting issues is hindered because of a lack of resources and processes for coordination between ministries, e.g. launching sector/thematic programmes have proved to be challenging.

4) There is a need **to strengthen ownership and implementation of national RDI programmes**. Currently there is a lack of clear 'ownership' for the national RDI programmes, which makes their implementation challenging. Sector ministries are not sufficiently engaged in objective setting and administration of RDI programmes. E.g. the Health RDI programme is run currently outside the Ministry of Social Affairs although MAS would have the best expertise in the substance area. Furthermore, there is a lack of strategic RDI programmes. Ownership of the objectives is outside the research system, and objectives do not engage all the players.

5) There is a need to put **more focus on increasing the impact from RDI investments**. There is a lack of knowledge on the impact of RDI funding. There are relatively few evaluations for RDI programmes and instruments, and even the few are executed by the ministries themselves. Better monitoring of the progress and assessment of impact of programmes and other RDI support measures is needed. The planned establishment of the new Estonian Research Council and its monitoring and evaluation responsibilities is a welcome introduction to this end.

6) **The knowledge-intensive private sector is very narrowly-based and needs specific measures**. There are around 400 companies actively conducting R&D in Estonia and around 10% of them account for most of the RDI investments. Future of RDI policy needs to address how to support the best 10% and at the same time, attract and help the rest 90% of domestic companies to get engaged with research and development work in order to move up in the value chain and to gain competitiveness.

5 Public Sector Innovation and the Linkages Between the Public and Private Sectors

5.1 General overview – private sector innovation fragile, public sector innovation emergent

Within the context of this review, public sector innovation and linkages between public and private sectors is one area of particular attention. As discussed above, while the government sector is the largest source of RDI funding, providing 44.3% of total GERD in 2010, compared with an average of 34.9% in the EU27 (in 2009), the *public sector itself does not perform research and innovation activities extensively* (Public sector RDI expenditure makes up 0.17% of GDP). Most of academic research and development in Estonia is performed by the four public universities and public research institutions have a lesser role in Estonia, as the majority of the former research institutes of the Estonian Academy of Science were incorporated into universities during the 1990s.

Outside the main RDI sectors and eGovernment activities, the Estonian public sector is not considered very much innovation-oriented. With regard to innovation in the public sector, the e-government initiatives have had a prominent position in the innovation agenda of public administration policies. The most recent initiatives involve using more ICT in the field of social and medical services (e-Health). However, the development of the innovative public procurement concept is still at an early stage in Estonia.

Since early 2000s, there are a considerable number of policy measures aimed at increasing extramural R&D by enterprises carried out in cooperation with the public sector as well as support for commercialisation of research by HEIs and knowledge transfer. These include, for example the *Competence Centre Programme*, *R&D grant support* and the *Innovation vouchers programme*, which are expected to contribute to a change of academic attitudes towards interactions with business and more business-thinking in universities. In addition, certain higher education *in cooperation with businesses* programme are intended to assist innovative companies who successfully apply research results, technology and professional design in their services and products by funding the creation of supported doctoral student places. This activity is intended to foster development in the priority areas specified in Estonia's national RDI strategy (ICT, materials technology, environmental technology, biotechnology, power engineering and health).

The OECD Economic Review[20] concluded that *Estonia has one of the most open and competitive economies in the world*. The dynamism of the business environment is reflected in high rates of firm and job creation, also relative to other European emerging market economies, as well as by large inflows of foreign direct investment (FDI). Estonia is particularly highly regarded in the area of *network readiness*, and also scores relatively highly on measures of *corporate governance and transparency*. Estonia's good business environment is further supported by e-government, which *is considered as one of the most outstanding examples in Europe*, and in several aspects (such as e-governance or delivering e-services for businesses) even exceeds the standards of the OECD countries on average. Despite the encouraging business conditions, the *Estonian companies do not perceive the public sector as an important source of knowledge provision[21]. From the business sector's perspective, the public sector is a rather unattractive cooperation partner and Estonian companies tend to cooperate more often with their national competitors or foreign partners than with public sector research.*

The share of production in high tech sectors and knowledge-intensive services is relatively low, and the share of high technology products in exports has slowed. To become a knowledge-based economy, production will need to shift towards knowledge-intensive sectors and productivity gains from innovation will need to drive growth in the future. Moreover, application of the OECD product market regulation methodology indicated that the overall product market policies in Estonia were only slightly less restrictive than on average in the OECD countries, signalling room for further reforms to catch-up with best performers.

*Management of IPR*s remains an issue about which Estonian entrepreneurs have limited awareness, especially in SMEs. The general trend for patent applications is rising, though. Patents registered with the European Patent Office (EPO) increased from just above two in 1995 to being constantly between four and eight since the year 2000. Also patents registered with WIPO[22] indicate an upward trend. The rate of patenting is far below the EU27 average, which may reflect the Estonian industry structure, the small number of innovative firms, the cost

20 OECD 2009 Economic Survey of Estonia, 2009, Policy Brief, May 2009.
21 Community Innovation Survey CIS8: More than 60% of the respondents point to the business sector as the source of knowledge (the own enterprise, suppliers, competitors).
22 WIPO=World Intellectual Property Organisation

of patenting and the associated bureaucracy as well as strong focus in 'high science' in the academic field, where publications are larger merits than patents .

Presently it seems that public sector innovation is still in the emerging phase in Estonia. Examples of successful public-private partnership in innovation are found amongst the IT and knowledge society initiatives that have been driven by determined public policy and public procurements. While innovative thinking and active public-private partnership may be present or even a common practice in certain sectors, this is not the case in most policy sectors. Hence the key question is how to expand these policies and practices to other sectors. At the same time, attention and further development is needed on the prevailing conditions to support and encourage knowledge transfer, such as awareness on the IPR issues.

5.2 Specific issues raised in the peer-review

The peer-review paid particular notice to the following aspects concerning the public and private sector innovation and their linkages in Estonia:

- **Collaboration between higher education institutions and enterprises needs further attention**. There seems to be an inherent mismatch between the needs of business sector and the provision of knowledge from the public sector. The investments in BERD are increasing faster than the volume of contracted research between higher education institutions and the industry, indicating a growing misalignment or a widening gap between the two sectors. Although innovation vouchers have brought a lot of new, typically non-RDI-intensive, companies to Universities, there may be a large latent need for RDI funding. There is also a lack of government sector research organisations that could provide contract research services for the business sector, as is the case in most countries. Moreover, the Industrial-PhD-scheme appears not to sufficiently address the competence needs and volumes of business sector.
- There is a need **to focus on fewer and stronger clusters**. The current Competence Centre approach appears too broadly focused for the Estonian context. It engages 100 companies, finance is granted for RDI work, the applications are bottom up and decisions are based on international peer-review. Particular emphasis should be paid on increasing the SME participation. The limited number of enterprises (average of 12 enterprises in eight clusters) in R&D clusters seems to be a choice and not because there are no enterprises in Estonia. There should be a stronger focus on building business driven clusters where all relevant research, education and technology institutions in a certain technology area or a certain scientific area should participate. More emphasis should be given to matchmaking activities between knowledge institutions and enterprises and not only on large R&D-collaboration projects with a limited number of enterprises.
- **Demand-side RDI policy instruments need further development**, but the current ways of working in the public sector are an impediment. The harmonised legislation for public procurement calls for competitive calls for major procurements, which tends to drive for short-term relationships and supports cost-oriented mindset. The majority of innovative procurements are solution-oriented, where the public sector defines the solution to the problem and procures the solution, whereas to date the use of the problem-oriented approach has been limited. This is rather a question of existing procurement practices and a risk averse culture than a question of restrictions in laws and regulations.
- **Capacity for knowledge transfer and IPR** needs raising both in public and private sectors. There is little systematic technology transfer from universities to private sector. Lack of knowledge transfer lowers the impact of research to society; research could be used to upgrade existing industries. In this light, universities should also take technology commercialisation and transfer more seriously and systematically. There remains a gap between 'high science' research and enterprises' needs, with a lack of knowledge transfer and innovation initiatives for non-innovative SME's. Universities in general do not have sufficient facilities and processes to systematically handle the IP they create.
- Attention has been paid to building attractive career conditions for both young and experienced researchers, as **brain drain and attractiveness of research careers overall remain constant challenges**. One particular challenge has been the low level of research salaries. Strategies and measures are needed for improving Estonia's attractiveness in international race for competent skills. Attention should be paid on the opportunities of better utilising European Research Area and EU Framework Programmes for increasing researcher mobility and attracting foreign researchers. The objectives to increase private sector RDI are ambitious, not only in terms of financing, but equally in terms of available human resources. The standing challenge is availability of skilled labour, as indicated by multiple industry representatives who cited problems in recruitment as a major barrier of growth for knowledge intensive enterprises in Estonia. However, at the same time statistics indicate that there is a relatively large share of long-term unemployed in the economy, which indicates that the supply of workforce does not meet the economic demand in terms of skills and knowledge.

6 Conclusions and Recommendations

6.1 Outstanding progress, but not without challenges

Estonian research policies have been driven by a steady development based on quality, excellence and competition. The development of innovation policy and the Estonian innovation system have been inspired by what is done in the Nordic and in other European countries. This has worked well so far, but in the longer run it will not be sufficient. *The challenge for Estonia is arguably to further develop its research and innovation system in ways that will make a difference for the economy at large* without in the process dismantling the solid innovation assets created that will matter more in the medium- to long-term than they do now. There are, of course, many other aspects in which the Estonian innovation system can be improved. But the overall impact of any reforms on the Estonian innovation system will to a large degree depend on whether it can do more of the things that are right for the Estonian economy as it looks like today, not just doing things that are generally viewed as important aspects of an innovation system.

The development and performance of the Estonian innovation system has been, without a doubt, remarkable over the past two decades. On the other hand, Estonia's innovation system is so far quite *detached from a vast part of its economy* and, as a consequence, delivers relatively little value for the average Estonian. This is the result of the innovation system being focused on areas other than those that dominate the Estonian economy today; it is not a simple failure to commercialise scientific activity.

These observations also raise the question whether the past efforts to build an innovation system have properly addressed the indigenous structural features of the Estonian economy. The policy has aimed to develop a science-driven system in order to create innovation. It succeeds at that to a large degree, but is still incapable of supporting the upgrading of the existing Estonian economy. It is not our suggestion that the future policy mix should abandon research, but to include investing more strongly in creating public-private partnerships in innovation and to broaden the scope of policy to include instruments that support upgrading traditionally strong industries.

The Estonian industrial sector is largely driven by basic subcontracting manufacturing. Any efforts to *upgrade the role of Estonian industry in the global value chains*, by means of stimulating RDI, with the emphasis on the D and I, is of paramount importance to raise the productivity and value added of the economy. However, innovation should not be understood narrowly as technology and new product development, but also as process and manufacturing development, training, IPR development, organisational innovation and service development that all contribute to productivity and value creation.

Thus the gamut of RDI instruments should include not only funding for excellence in research, but in a balanced way also technology transfer, IPR and technology acquisition, process and organisational development or innovation as well as service innovation. At the same time, attention should be paid to further develop the demand side policy instruments, particularly making better use of public procurement in driving innovation and change.

Lack of trained personnel hinders both domestic growth as companies need to start growing outside Estonia early on as the resources in home country are exhausted easily, and lack of resources also acts as a disincentive for foreign investment, negating the effect of favourable industry conditions. In short, a lack of educated and skilled labour is a major underlying constraint for growth of productivity and value creation in Estonian economy, that should be addressed through policy coordination on multiple fronts, including education, particularly adult and secondary/vocational education beside tertiary education, as well as labour and immigration policy supporting RDI policy.

At the end, the most evident and fundamental RDI framework factor in Estonia is its small size, which is directly reflected in the small number of companies, lack of economies of scale or critical mass in many areas of research and in particular, is evident in the availability of human resources, especially in knowledge intensive sectors. The mere fact of the size cannot be changed, but to a great extent, Estonia has been able to turn its small size into an advantage, by means of greater agility, focus and specialisation. This objective should be further pursued, but with a stronger emphasis on internal and external networking and a more effective use of policy instruments.

6.2 Recommendations

The following recommendation are based on the interviews which focused on selected areas of the SAT tool and supplied background information. In our view, the following recommendations would help Estonia to increase the performance and overall impact of its research and innovation policy.

- **Perceive RDI as a means to achieve economic and societal goals**

  Estonia has been strongly committed to developing a competitive economy and a knowledge-based society. Developing the national research and innovation system has been an essential part of that development. This development should not cease or lessen, but continue with a slight change of emphasis and a more clear set of *priorities that are directly responding to the needs of the Estonian society and the economy*. Investments into the development of national innovation system and RDI should not be seen as objectives in themselves, but rather as means to drive change and to achieve more fundamental economic and societal objectives, which are becoming ever more important to Estonia.

  Subsequently, the support instruments and the performance of RDI should be developed and measured against their anticipated impact on the society, such as changes in economic structures, employment, health or education-base. For example, Estonia has a strong tradition for education of its population compared to many other countries. It should be recommended that Estonia as part of a future innovation strategy involve the education system much more since skills are important for innovative capacity in enterprises and the productivity impact of R&D investments.

- **More clear focus for Estonian RDI programmes**

  The national RDI programmes are key instruments in delivering the RDI policy in Estonia. Hence the prioritisation of the up-coming programme focus areas and topics should be *directly linked to the objectives of the next national strategy* and selection done on that basis.

  The current strategy includes seven national programmes, which has proven to be both broad and challenging to implement in Estonia. It is our suggestion that the next national strategy Estonia could be more targeted and focus on a *fewer programmes* with key importance. This would allow for better awareness, resourcing and coordination, with a higher probability for greater efficiency and effectiveness of measures as well.

  It is of key importance that the selected programmes are *properly operationalised*, with clear objectives, measures, management and project resourcing. In this manner, their progress and impact can also be measured and monitored.[23]

  It is highly likely that some key topics are of international relevance, such as responding to environmental and climate change, ageing of population, etc. In these topics, it is recommended that Estonia liaises closely with the European and Nordic / Baltic Sea Region's developments.

- **Ensure coherent and systemic RDI policy**

  There is a good tradition of collaborative RDI policy planning in Estonia, while the tradition for synchronised implementation and coordination of policies is not equally strong. Much of this task is coordinated through the RDC and its implementation falls under the responsibilities of sector ministries, in particular the MER and MEAC.

  It is our suggestion that in the preparation of the next national strategy, more attention is paid to its actual implementation and on the coordination of activities in order to ensure better policy effectiveness. In this respect, the horizontal coordination role of Research and Development Council (RDC) should be strengthened. This will mean in practice that RDC has a bigger role in monitoring the implementation of strategic RDI activities under sector ministries and reporting it back to the council, for example on annual basis.

  At the same time, it is important to fully engage the relevant sector ministries in the planning and implementation of RDI policy through RDC. This may require further development of horizontal collaboration procedures and practices with sector ministries. It is a task to be led by the RDC.

23 See for example the structure, operationalisation and monitoring of Tekes Programmes in Finland (www.tekes.fi)

- **Ensuring the availability of competent human capital**

One of the key bottlenecks for the Estonian knowledge-economy development is the *limited base of competent human capital*. This becomes an evident hindrance in certain growth sectors and a limitation to foreign investments, too. Measures should be developed to attract and train more people, particularly to respond to the needs of current and potential growth sectors. Policies to support this could also include many other measures, such as the attraction of competent professionals from abroad[24], trainings to up-grade lower degrees, etc. High unemployment is a severe economic and social challenge in Estonia. In this regard, addressing the currently high unemployment through training and skills development will also be one additional and much needed source of competent workforce.

- **Harness RDI measures to drive structural change in the economy**

Estonian RDI policy has so far been rather detached from the practical needs of the industry. Partially this has been due to the lack of absorptive capacity at the industry. However, in future the RDI policy should more strongly contribute to the upgrading of the low-tech and low added-value industries, and thereby drive the much needed structural change in the economy[25].

In practice, this could mean the introduction of state-of-the-art production methods, providing further incentives for in RDI projects, promoting domestic excellence such as 'Made in Estonia', etc in order to activate and engage the traditional industries to develop new own products. Much of this task falls under the responsibility to Enterprise Estonia, but it could be complemented with other instruments, such as by the competence centers.

At the same time, further attention should be put on supporting endogenous growth companies, knowledge-intensive companies and other RDI performers with an interest to collaborate with Academia and government and to contribute to the joint strategies. Measures like the Estonian Competence Centre Programme should play an instrumental role in this.

- **Lessen RDI dependency on EU structural funds**

A growing share of the Estonian public expenditure on RDI has been coming from the EU Structural Funds, and partially replacing national government funding to RDI. This may not be a problem by itself, particularly when these investments have been much needed for the Estonian RDI infrastructure. However, when the Structural Funds proportion becomes dominant, it does raise concerns with regard to the flexibility and continuity of the RDI the funding in the long-term.

Development of a knowledge society requires a long-term commitment with determined and continued investments. Therefore, as part of the longer-term strategy, Estonia should anticipate how it can lessen its dependency on Structural Funds as a source of RDI funding. Ideally, this could be done by increasing the share of private sector investments and foreign direct investments, by systematically building the Estonian innovation environment to become an attractive location for dynamic enterprises and innovation hubs.

- **Increase the connectivity of the innovation system**

The new national strategy should clearly introduce objectives and measures to increase the connectivity of Estonian RDI organisations and enterprises both within the country and internationally. This could be achieved for example by encouraging such collaboration through competitive university RDI funding criteria.

Estonian top scientists are well integrated internationally and successfully participate in the EU framework programmes. This is however only a small proportion of the overall research community, while the rest and most of the Estonian enterprises are not interacting actively. Some evident channels for increasing this collaboration would be the ongoing and planned EU Framework Programmes for research and innovation, as well as the various collaboration activities with the Baltic-Nordic countries.

At least equally important to the development of international RDI collaboration is to strengthen the collaboration between Estonian universities and domestic enterprises[26]. For the moment, the academia is

24 See for example the smart immigration policy of Canada: http://www.siiscanada.com/CDN/index.php
25 Within the EU, one country to benchmark in this regard is Slovenia, which has taken deliberate steps in economic management and reform with clear results.
26 Only some 4% of Estonian SMEs have collaborated with universities (CIS 2008)

not actively engaged with the majority of companies. Part of the solution can be found through education and training, university-industry researcher mobility and exchange, as well as by introducing collaboration projects with industry.

- **Extend the reach and variety of innovation instruments**

  The absolute number of RDI performing companies is minimal in Estonia. This needs to be increased. Hence, more attention should be paid on reaching and engaging companies that are not yet performing RDI. This could be done, for example, by strengthening the cluster organisations' possibilities to finance and initiative projects with enterprises not having yet RDI activities. The experience from Enterprise Estonia innovation vouchers is an encouraging one to this end.

  Furthermore, there is a need for employing a broader set of RDI policy instruments. This would mean including actions such as to support service innovation, technology transfer, IPR acquisition and protection, entrepreneurship, as well as process and organisational innovation in all sectors. Moreover, innovation in the public sector should be encouraged.

  Effective management of IPR is a challenge in Estonia and there would be a good reason for the universities to collaborate in establishing a national technology transfer office, which could also service other research institutions in Estonia. Technology Transfer Offices require critical mass in competences to work effectively.

- **Monitoring the progress of the new strategy and its measures**

  The new national strategy would benefit from clear progress and performance indicators, and a set-up which reports the progress back to the policy-makers. This would greatly enhance the success of strategy implementation.

  More generally, a practice of systematic ex-post impact assessment and policy learning should be developed in order to improve the planning and adaption of policies in the course of their implementation. The appropriate owner of this task would be the RDC, while progress monitoring of various RDI support measures should be done by the relevant implementing agencies.

Annex 1 Adapted Innovation Union Self-Assessment Tool

The structure of the report is based on the Self-assessment Tool (SAT) originally published in the Innovation Union Communication[27]. Original structure of the SAT is indicated in parentheses.

GOVERNANCE

Importance of research and innovation in the overall policy agenda (SAT 1)

Statement to be tested: Promoting research and innovation is considered as a key policy instrument to enhance competitiveness and job creation, address major societal challenges and improve quality of life and is communicated as such to the public

Leading questions:

- Is public action in all relevant policy areas designed and implemented in a strategic, coherent and integrated framework geared towards fostering innovation and strengthening the knowledge base and fundamental research?
- Are relevant policies and public funding increasingly oriented towards addressing major societal challenges and towards deriving competitive advantage from finding new solutions to tackle them?

Scope of innovation policy (SAT 3)

Statement to be tested: Innovation policy is pursued in a broad sense going beyond technological research and its applications

Leading questions:

- Is a broad concept of innovation - including innovation in services, improvements of processes and organisational change, business models, marketing, branding and design - actively promoted, inter alia through more interdisciplinary work involving groups of users or consumers as important constituencies of open innovation?
- Are supply and demand-side policies developed in a consistent manner, building on and increasing the absorptive capacity of the Single Market?

Governance of research and innovation (SAT 2)

Statement to be tested: Design and implementation of research and innovation policies is steered at the highest political level and based on a multi-annual strategy. Policies and instruments are targeted at exploiting current or emerging national/regional strengths within an EU context ("smart specialisation")

Leading questions:

- Are the broad, multi-annual policy orientations in the field of research and innovation defined by an effective and stable centre-of-government structure, typically at the top political level? Does this structure also ensure sustained and properly coordinated implementation of the policy orientations? Is it backed up by networks involving all relevant stakeholders, such as industry, regional and local authorities, parliaments and citizens, in view of stimulating an innovation culture and building mutual trust between science and society?
- Is there a multi-annual strategy defining a limited number of priorities and providing a predictable policy and budgetary framework? Was it preceded by an international analysis of strengths and weaknesses at national and regional level and of emerging opportunities ('smart specialisation') and market developments? Does the strategy duly reflects EU priorities, avoiding unnecessary duplication and fragmentation of efforts, and actively seeks to exploit opportunities for joint programming, cross-border co-operation and exploiting the leverage effects of EU instruments? Is bilateral co-operation with non-EU countries based on a clear strategy and is it co-ordinated with other EU Member States?
- Is an effective monitoring and review system in place, making full use of output indicators, international benchmarking and ex-post evaluation tools?

27 European Commission – DG Research and Innovation, Europe 2020 Flagship Initiative Innovation Union, SEC(2010) 1161

PUBLIC FUNDING

Aims of public funding (SAT 4)

Statement to be tested: There is adequate and predictable public investment in research and innovation focused in particular on stimulating private investment

Leading questions:

- Is R&D public funding oriented towards providing a high quality knowledge infrastructure and incentives for maintaining excellence in education and research (including through access to world-class research infrastructures, building regional S&T capacity and supporting innovation activity especially during periods of economic recessions). Are public investments in education, research and innovation prioritised and budgeted in the framework of multi-annual plans to ensure predictability and long term impact, drawing on the Structural Funds where appropriate?
- Is R&D public funding aimed at leveraging greater private sector investments? Are innovative financing solutions (e.g. public-private partnerships) and the use of tax incentives explored and/or adopted? Are reforms implemented to reflect changing conditions and ensure optimal returns on R&D investments?

Criteria for allocating public funding (SAT 5/1)

Statement to be tested: Excellence is a key criterion for research and education policy

Leading questions:

- Is the share of R&D public funding allocated on a competitive basis increasing while ensuring a balance between institutional and project-based funding? Are research institutions evaluated on the basis of internationally recognised criteria? Are projects selected on the basis of the quality of proposals and expected results, subject to external peer-review?
- Are grants to researchers portable across borders and research institutions?
- Are the results of publicly funded research protected and published in a way that encourages their exploitation?

Means of delivering public funding (SAT 9)

Statement to be tested: Public support to research and innovation in businesses is simple, easy to access, and high quality

Leading questions:

- Is there a limited number of well targeted, clearly differentiated, and easy-to-access business support schemes consistent with support available at EU level and that address well identified market failures in the provision of private funding for innovation?
- Is public funding tailored to the needs of companies, particularly SMEs? Is the emphasis placed on outputs rather than on inputs and controls? Is bureaucracy kept to a minimum, are selection criteria straightforward and time-to-contract and to-payment as short as possible? Are funding schemes regularly evaluated and benchmarked against comparable schemes in other countries?
- Is public funding allocated through international evaluation procedures? Is trans-national cooperation encouraged? Are national rules, procedures and time-tables aligned in order to facilitate participation in EU programmes and co-operation with other Member States?
- Is there specific support to young innovative companies to help them commercialise ideas rapidly and promote their internationalisation?

PUBLIC POLICIES AIMED AT THE PUBLIC SECTOR

Autonomy of research institutions (SAT 5/2)

Statement to be tested: Higher education and research institutions enjoy the necessary autonomy

Leading questions:

- Are higher education and research institutions free to organise their activities in the areas of education, research, and innovation?
- Can they apply open recruitment methods and draw on alternative sources of funding such as philanthropy?

Research careers (SAT 5/3)

Statement to be tested: Research careers are considered as attractive

Leading questions:

- Do the legal, financial and social frameworks for research careers, including doctoral studies, offer sufficiently attractive conditions to both men and women in comparison to international standards, especially those in the US?
- Are there incentives in place to attract leading international talents?

Human resources in S&T (SAT 6)

Statement to be tested: Education and training systems provide the right mix of skills

Leading questions:

- Are policies and incentives in place to ensure a sufficient supply of (post)graduates in science, technology, engineering and mathematics and an appropriate mix of skills among the population (including through strong vocational and education and training systems) in the medium-to-longer term?
- Is there sufficient focus in education and training curricula on equipping people with the capacity to learn and to develop transversal competences such as critical thinking, problem solving, creativity, teamwork, and intercultural and communication skills? Special attention is paid to address innovation skills gaps. Entrepreneurship education and training is widely available or included in curricula. Partnerships between formal education and other sectors are actively promoted to that end.

Public sector innovation (SAT 10)

Statement to be tested: The public sector itself is a driver of innovation

Leading questions:

- Is the public sector providing incentives to stimulate innovation within its organisations and in the delivery of public services?
- Is innovative public procurement being actively used to improve public services, including through dedicated budgets? Are tenders based on output-based performance specifications and contracts awarded on the basis of qualitative criteria which favour innovative solutions such as life-cycle analysis, rather than lowest price only? Is joint procurement being used?
- Are government-owned data freely available as a resource for innovation?

PUBLIC POLICIES AIMED AT THE BUSINESS SECTOR

Linkages between the public and private sectors (SAT 7)

Statement to be tested: Partnerships between higher education institutes, research centres and businesses, at regional, national and international level, are actively promoted

Leading questions:

- Where possible, research efforts are accompanied by instruments to support the commercialisation of innovative ideas. Policies and instruments such as innovation/knowledge clusters, knowledge transfer platforms, and voucher systems, are in place to encourage co-operation and knowledge sharing and at creating a more favourable business environment for SMEs.
- Researchers and innovators are able to move easily between public and private institutes. There are clear rules on the ownership of intellectual property rights and sharing and support systems are in place to facilitate knowledge transfer and the creation of university spin-offs and to attract (venture) capital and business angels.
- There are no obstacles to setting up and operating transnational partnerships and collaborations.

Business environment (SAT 8)

Statement to be tested: Framework conditions promote business investment in R&D, entrepreneurship and innovation

Leading questions:

- Policies to promote innovation, entrepreneurship and enhance the quality of the business environment are closely interconnected.

- Favourable conditions are in place to foster a growing and robust venture capital market, especially for early stage investments.
- Consistent with the Small Business Act for Europe, the rules for starting up and running a business are simple and designed from an SME perspective. The legal framework is transparent and up-to-date. Rules are properly enforced. Markets are dynamic and competitive. Willingness to take risks is promoted. Insolvency regulations support the financial reorganisation of enterprises. There is no discrimination against entrepreneurs who may have failed the first time around.
- An efficient, affordable and effective system for the protection of intellectual property is in place, which fosters innovation and preserves investment incentives. The market for innovative products and services is kept constantly up to date by means of an efficient standard-setting system.

Annex 2 The Peer-Review Process

The structure of the review and assessment of the Estonian research, development and innovation system was structured around the restructured Self-assessment Tool (SAT), initially published with the Europe 2020 Flagship Initiative "Innovation Union" (see Annex 1). The Innovation Union (IU) SAT and its questions gave a practical framework for analysing the overall performance of the Estonian innovation system and the country's progress with regard to the European Research Area

The peer-review exercise was initiated with simultaneous Estonian self-assessment using the restructured SAT tool and organisation of the peer-review. The self-assessment included two meetings where each of the SAT dimensions were discussed between personnel from the Ministries of Economic Affairs and Communication and Education and Research reinforced with invited experts from related branches of government and institutions. Following the self-assessment, the participants prepared a report on the self-assessment, raising the issues they felt needing further investigation and where the external peer review could provide best value added. These issues were carried over to the actual peer-review, which is to say the peer review with its interviews was focused on four of the total ten aspects of the SAT. Simultaneously with the self-assessment, the rapporteur team initiated the preparations for the actual peer review interviews, and the background document (attached) was devised to inform and support the peers.

The peer-review itself was executed during two working days between November 6th and 8th 2011 in Tallinn, with the aim of providing peer reviewers a chance to discuss directly with the key stakeholders and build on the written background material. The program included three sessions which focused on the pre-selected key themes (features). In each session there was an introductory key note followed by presentations from experts on their respective policy fields. The agenda for the peer-review is presented below. The peer review group met also internally to discuss the observations and further steps.

Following the peer review, the rapporteur team prepared notes from the sessions and ensuing discussion and prepared a report draft for circulation to the peers. The prepared report was reviewed for completeness and correctness by the peers, who submitted/added their own conclusions and recommendations. The report distils the discussion from the peer-review sessions and end ensuing discussions and raises the specific issues that were highlighted by the peers. Following this discussion the report presents recommendations. The following table presents the outline of the process.

Table 3. Outline of the peer-review process

Activity	*September*	*October*	*November*	*December*	*January*
Estonian self-assessment					
Preparations for the peer-review					
Peer-review (interviews)					
Reporting					

Peer-review Agenda

The detailed agenda for the peer review is presented in the vignette below.

Day 0

19.00–20.00 Briefing for the rapporteur team and peers

Day 1

09.00–12.00 Session I - Scope of innovation policy (SAT I Governance)

1. Introduction (30 min)
   - Christian Ketels
   - Tea Danilov, Ministry of Economic Affairs and Communications

2. Presentations (2h, *à* 20 min + 15 min discussion)
   - Kitty Kubo – Head of Foresight Division, Estonian Development Fund
   - Sten Tamkivi – CEO, Skype Estonia
   - Linnar Viik – Research and Innovation Council of Estonia
   - Richard Villems – President of the Estonian Academy of Sciences

12.00–13.00 Lunch

13.00–17.00 Session II - Governance and funding of research and innovation (SAT I Governance)

1. Introduction (30 min)
   - Kimmo Halme
   - Indrek Reimand, Ministry of Education and Research

2. Presentations (2.5h, *à* 20 min + 15 min discussion)
   - Märt Loite – Deputy Director of Strategy Unit, State Chancellery
   - Ilmar Pralla – Director, Innovation Division, Enterprise Estonia
   - Ivi Normet – Deputy Secretary General on Health, Ministry of Social Affairs
   - Kristjan Haller – Vice Rector for Research, University of Tartu
   - Urmas Koidu – Head of Public Finance and Strategies Department, Ministry of Finance

Day 2

09.00–10.00 Presentation of Estonian ICT solutions (ICT Democenter)

10.00–3.00 Session III - Public sector innovation (SAT II Public policies aimed at the public sector), Linkages between the public and private sectors (SAT IV Public policies aimed at the business sector)

1. Introduction (30 min)
   - Helena Acheson
   - Jarmo Tuisk, Ministry of Economic Affairs and Communications

2. Presentations (2h, *à* 20 min + 15 min discussion)
   - Tarmo Kalvet, Veiko Lember – Research fellows, Innovation Policy and Technology Governance, Tallinn University of Technology
   - Seth Lackman – CEO, Ericsson Estonia
   - Toomas Neuman – Professor, Tallinn University of Technology
   - Erik Puura – Director, Institute of Technology, University of Tartu

13.00–14.00 Lunch

14.00 –16.30 Discussion and debriefing among peers and rapporteur team

List of participants in the peer-review process

Peers

- **Thomas Alslev Christensen**, *Head of Department, Danish Agency for Science, Technology and Innovation, Ministry of Science, Technology and Innovation, Denmark*
  Thomas Alslev Christensen graduated from Copenhagen University and he has a PhD in international economics from Copenhagen Business School. He was a special advisor on European Integration in the Danish Prime Minister's Office in 1995–1997. Since 1997 he has been working as the head of department of the Danish Ministry for Economic Affairs, The Nordic Council of Ministers and the Danish Ministry for Science, Technology and Innovation (DMSTI). He is also the head of the secretariat of the Danish Council for Technology and Innovation (DCTI)

- **Shaul Freireich**, *Deputy Director, Office of the Chief Scientist, Ministry of Industry, Trade and Labour Israel*
  Shaul Freireich has a PhD in chemistry from the Hebrew University in Jerusalem. He has worked in the field of chemical research until moving to the Ministry of Industry, Trade and Labour. He is currently the Deputy Chief Scientist at the Chief Scientist Office, Ministry of Industry, Trade & Labour where he is responsible for running R&D programmes and the evaluation system and he is a member of several R&D committees.

- **Jana Kolar**, *Director General of Science and Technology Directorate for Higher Education at the Ministry of Higher Education, Science and Technology Slovenia*
  Jana Kolar holds a degree in chemistry a Ph.D. in Chemistry in from University of Ljubljana, Slovenia. Jana Kolar is the Director General of Science and Technology Directorate at the Ministry of Education Science and Technology. She has previously worked in MORANA RTD, University of Ljubljana and at the Laboratory for cultural heritage, in the National and University Library. She has also published extensively and participated in a host of research projects.

- **Paula Nybergh**, *Head of Division, Innovation Department, Ministry of Employment and the Economy, Finland*
  Paula Nybergh is the head of division at the Innovation Department of the Ministry of Employment and the Economy. She has a MSc (Eng) and a lic. techn. degree from the Helsinki University of Technology (TKK). She has been the director general and deputy director general of technology department at the Ministry of Trade and Industry, a technology manager at Tekes, head of industrial enzymes group at Oy Alko Ab, head of process technology group at VTT biotechnology and researcher at TKK. She has been the member of the board of several research institutes, foundations and companies.

Invited speakers

- Tea Danilov, Ministry of Economic Affairs and Communications
- Kristjan Haller, Vice Rector for Research, University of Tartu
- Tarmo Kalvet, Research fellow, Innovation Policy and Technology Governance, Tallinn University of Technology
- Urmas Koidu, Head of Public Finance and Strategies Department, Ministry of Finance
- Kitty Kubo, Head of Foresight Division, Estonian Development Fund
- Seth Lackman, CEO, Ericsson Estonia
- Veiko Lember, Research fellow, Innovation Policy and Technology Governance, Tallinn University of Technology
- Märt Loite, Deputy Director of Strategy Unit, State Chancellery
- Toomas Neuman, Professor, Tallinn University of Technology
- Ivi Normet, Deputy Secretary General on Health, Ministry of Social Affairs
- Ilmar Pralla, Director, Innovation Division, Enterprise Estonia
- Erik Puura, Director, Institute of Technology, University of Tartu
- Indrek Reimand, Ministry of Education and Research
- Sten Tamkivi, CEO, Skype Estonia
- Jarmo Tuisk, Ministry of Economic Affairs and Communications
- Linnar Viik, Research and Innovation Council of Estonia
- Richard Villems, President of the Estonian Academy of Sciences

Organisers and rapporteurs

- Helena Acheson, *Technopolis Group*
- Kimmo Halme, *Ramboll Management Consulting (Rapporteur)*
- Christian Ketels, *Harvard Business School*
- Mart Laatsit, *Ministry of Economic Affairs and Communications (Host)*
- Kalle A. Piirainen, *Ramboll Management Consulting (Technical assistant)*
- Mikko Salo, *Directorate General Innovation and Research, European Commission (Observer)*

Annex 3 | ERA Committee Estonian Innovation System Peer-Review Background Document

Background document

Intended for	Ministry of Economic Affairs and Communications of Estonia Ministry of Education and Research of Estonia European Research Area Committee (ERAC)
Document type	Report
Date	October, 19th 2011
Authors	Kalle A. Piirainen, Kimmo Halme With contributions by Christian H.M. Ketels and Helena Acheson
Revision	3
Date	2011/10/29
Made by	KPII, KIHA
Checked by	KIHA
Approved by	KIHA

Table of Contents

1 Introduction

This report is a background document aimed to support the European Research Area Committee (henceforth ERAC, formerly the Scientific and Technical Research Committee CREST) peer review of Estonian Research Development and Innovation (RDI) system. ERAC is a policy advisory body that advises the European Council, Commission and the member states on Science and Research, Development and Innovation (RDI) policy. The mandate of ERAC degrees that it facilitates formation and function of the European Research Area[28] by, *inter alia,* providing strategic guidance for RDI policy and monitoring the ERA and promoting, as well as evaluation of the policy mix in the member states.

The report is structured around the updated self assessment tool (SAT) published in the Europe 2020 Flagship Initiative "Innovation Union" Communication[29]. The second section of this document discusses the governance of RDI policy, including the main actors, and delivery of the innovation policy. The third section discusses public funding for RDI in more detail. The fourth and fifth sections then discuss other policies and instruments aimed for public and private sectors respectively. The sixth and last section presents a summary of the report and discussion on the findings.

In each of the following sections, the relevant Innovation Union SAT questions and hypotheses are placed in boxes at the beginning of each sub section. Also the observations related to the assessment raised both by the authors and by the Estonian stakeholders during the Self Assessment exercise are outlined at the end of each section.

The description of the innovation system and the assessment are based on the following key documents: ERAWATCH Country Report 2010 on Estonia[30], the Assessment of the Estonian Research Development Technology and Innovation Funding System[31] and CREST Open Method of Coordination (OMC) Policy Mix Review Country Report on Estonia[32]. These key documents are complemented by numerous others, cited in footnotes where appropriate.

2 Governance

2.1 Overview to the Estonian economy and national innovation system[33]

Estonia is one of the smallest EU Member States with just over 1.34 million inhabitants or 0.26% of the total EU population. Gross domestic product (GDP, in current prices) was 14,305,3M€ and GDP per capita (purchasing power standard, PPS) was at 64% of the EU27 average in 2010. As a result of the recent financial and economic crisis, GDP fell by 14.2% in 2009, but exhibited a balanced and healthy growth of 2.3% in 2010 (projected growth for 2011 is as high as 4.7% in Eurostat, even higher in Estonian figures, see Table 1). Unemployment has increased significantly from 4.1% in first quarter of 2008 to 18% in February 2011 and is now around 13% as of May 2011 compared to EU27 average of 9.5%. The value of exports has also risen to the level of 2008 and past that of 2007 in 2010.

Table 1. Present and projected key indicators for Estonian Economy

	2010	*2011*	*2012**	*2013**	*2014**	*2015**
GDP, billion €	14.3	16.0	17.0	18.1	19.2	20.5
Real growth of GDP, %	2.3	7.0	3.0	3.3	3.5	3.5
Consumer price index, %	3.0	4.9	2.8	3.1	2.7	2.7
Employed, thousands	570.9	599.6	609.9	616.6	622.1	627.1
Growth of Employment, %	-4.2	5.0	1.7	1.1	0.9	0.8
Unemployment rate (ILO definition), %	16.9	12.7	11.1	9.1	7.9	7.1

28 Council of the European Union. Resolution on the developments and the governance of the European Research Area, 3016th Competitiveness Council Meeting, 26th of May 2010.
29 European Commission – DG Research and Innovation, Europe 2020 Flagship Initiative Innovation Union, SEC(2010) 1161
30 Rannala, R, Männik, K. 2010. ERAWATCH Country Reports 2010: Estonia, ERAWATCH Network
31 Nedeva, M., Georghiou, L. 2003. Assessment of the Estonian Reseach Technology and Innovation Funding Systems – Final Report, Policy research in Engineering Science and Technology (PREST), Victoria University of Manchester.
32 Polt, W. 2007 OMC Policy Mix Review Report: Country Report Estonia
33 Based on ERAWATCH Country Report 2010 on Estonia

	2010	2011	2012*	2013*	2014*	2015*
Average gross wages and salaries, euro	792	831	873	919	967	1018
Real growth of wages, %	-1.8	0.0	2.2	1.9	2.3	2.4
Balance of current account, % of GDP	3.6	3.3	2.0	1.2	0.1	-1.5
Private consumption expenditure, %	-1.8	4.5	3.3	4.0	3.8	4.2
Gross fixed capital formation, %	-9.0	16.7	9.3	6.0	6.1	8.0
Exports of goods and services, %	22.5	26.1	4.6	6.2	6.8	6.8
Imports of goods and services, %	20.6	28.0	5.5	6.8	7.4	7.9

Source: Estonian Ministry of Economic Affairs and Communications

In general it can be said that the financial crisis has hit Estonia hard, as it is a relatively small and open economy that implements generally a libertarian-oriented economic policy, and thus is quite dependent on exporting industry as a source of welfare. However, the latest figures also indicate that Estonia is recovering quite well. Estonia fares well in terms of index of economic freedom and Ease of doing business-rankings, trailing countries such as United States of America, Japan and United Kingdom rather closely. Estonia has also one of the lowest public debts (4.6% of GDP compared to EU27 average of whopping 61.5% as of 2008)and fiscal deficits in EU27 as a result of consistently maintained liberal policy. However, despite the business friendly environment and relatively developed infrastructure, and relatively low labor cost (28% of EU27 average in 2006), work productivity in Estonia has remained quite low (42% of EU27 average in 2007).

In terms of industry structure, Estonian economy is heavily built on construction and surrounding industries, at least judging by the volume of exports (see Appendix 2 and Figure 1). However the export figures are only indicative about the national market, and comparing the export market share with productivity/value added created by the respective industries, the industries with most export volume have almost the least added value (see Appendix 2).

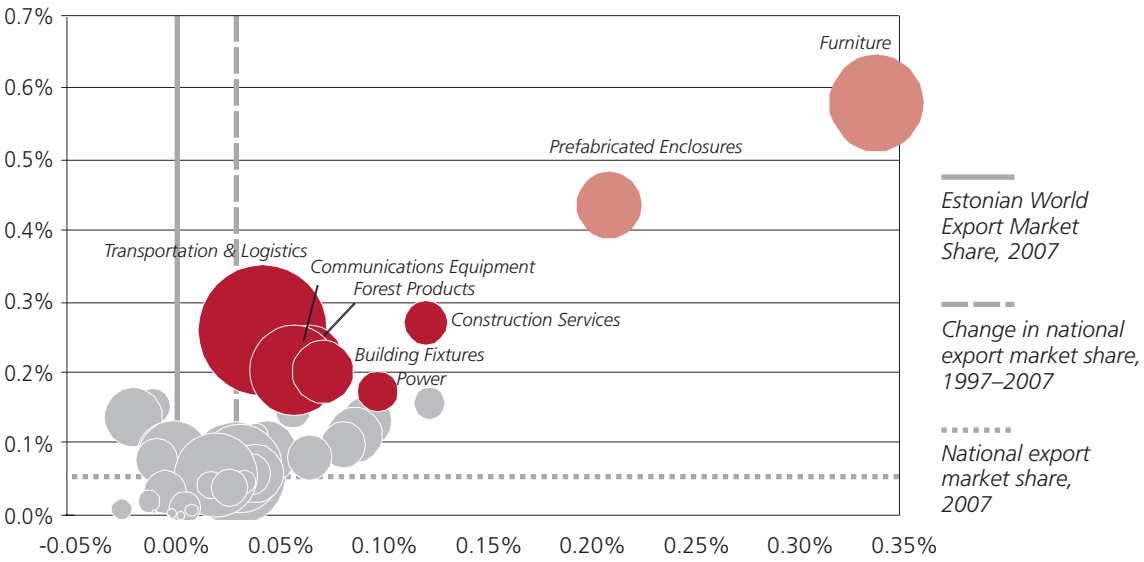

Figure 1. Estonian industrial clusters plotted by global market share and share of exports
Source: Ketels[34]

Looking at some key performance indicators of Estonian economy and innovation system compares well with the other Baltic States as well as with other transitional economies (see e.g. Annex 2). In terms of innovation performance, Estonia is positioned in the middle of the crow in the EU Innovation Union scoreboard results, roughly 0.05 point below EU27 average (2010 Summary Innovation Index 0.466 vs. EU27 avg. 0.516 and .75 for Sweden), but at the same time exhibits one of the fastest growth rates in innovation performance[35].

34 Ketels, C. 2010. Towards an Economic Strategy of Estonia, Presentation at the Estonia Futures Forum 2010.
35 PRO INNO Europe 2011 Innovation Union Scoreboard (IUS) 2010: The Innovation Union's performance scoreboard for Research and Innovation, PRO INNO Europe Paper no. 18, European Commission Directorate-General Enterprise and Industry, Available at http://www.proinno-europe.eu/metrics

Innovation governance in Estonia is overseen by the Research and Development Council (RDC), which is an expert consultative body that advises the Government on RDI policy. The State Chancellery's Strategy Office is an active intermediary in the R&D-related strategy and policy consultations, and acts as a secretariat of the Research and Development Council Together they provide policy coordination and guide the national RDI policy.

One of the more influential policies in Estonian innovation governance is the *Organisation of Research and Development Act*, which effectively form the legal basis and main regulation for the organization of RDI in Estonia. The Act is to provide a basis for the organization of research and development and to ensure legal means for the preservation and further development of scientific and technological creation as a component of Estonian culture and Estonian economy. This document entered into force in May 1997 and has been amended several times (last amendment was in 2011) More specifically, the Organisation of Research and Development Act:

- Defines the key concepts used by it (research, development, innovation and evaluation);
- Outlines the institutional structure of R&D in Estonia (institutions and their areas of responsibility);
- Postulates the rules and areas of governance; and
- Makes explicit the general principles of financing R&D in Estonia.

Policy design and evaluation is carried out, principally, by the Ministry of Economic Affairs and Communications (MEAC), and the Ministry of Education and Research (MER). The former oversees support for and funding of industrial R&D, as well as planning, coordination and implementation of technology development and innovation policy; the latter is responsible for research and development (R&D) as well as education policies, the financing and evaluation of R&D institutes and coordination of international cooperation in R&D. Besides the RDC, both of the ministries have their own permanent advisory bodies; the Research Policy Committee and the Research Competence Council provide advice to the MER; whilst the Innovation Policy Commission advises the MEAC.

At the operational level, both the MER and MEAC have implementing agencies/bodies and intermediaries. The main implementing body of the MEAC is the Enterprise Estonia Foundation, which is responsible for managing business support, innovation and technology programs. Additional funding is available from KredEx in the form of risk capital that is available for start-up ventures and business enterprises in general, as well as households. The MER has two main agencies that deliver funding and support: the Archimedes Foundation is responsible for national activities related to the ERA, international research programs, academic mobility measures, etc.; and the Estonian Science Foundation (ESF) provides grants to researchers.

By source of funding, Gross Expenditure on Research and Development (GERD) continues to be dominated by the government sector, which provides, via various instruments, around 50% of total GERD, compared with an average of 33.5% in the EU27 (in 2008). The share of the business enterprise sector was 33.6% (EU27 55%), and the third largest source is from abroad with 15.5% (EU27 8.9%). In 2009 the share of BES funding grew up to 38.5% and the share of funding from abroad dropped to 11.3%. Other sources like private non-profit and higher education sectors finance together 0.8% of national GERD.

In terms of performance, the higher education and business sectors have an equivalent share of GERD (0.56% of GDP) while the government sector is a more marginal performer (0.15% of GDP). The majority of academic research and development in Estonia is performed at the four public universities. Business Enterprise on Research and Development (BERD) is dominated by a limited number of high-tech small and medium-sized enterprises (SMEs) (ICT, biotech) and the service sector (financial and telecom services providers). Their RDI actively is largely intramural.

Compared with many other EU Member States, public research organizations (PROs) have a marginal role as the majority of the former research institutes of the Estonian Academy of Science were incorporated into universities during the 1990s. Hence, despite a wide range of actors in the national research and innovation system (see Figure 1), in operational terms the MER, MEAC, the public universities and a limited number of enterprises play a decisive role.

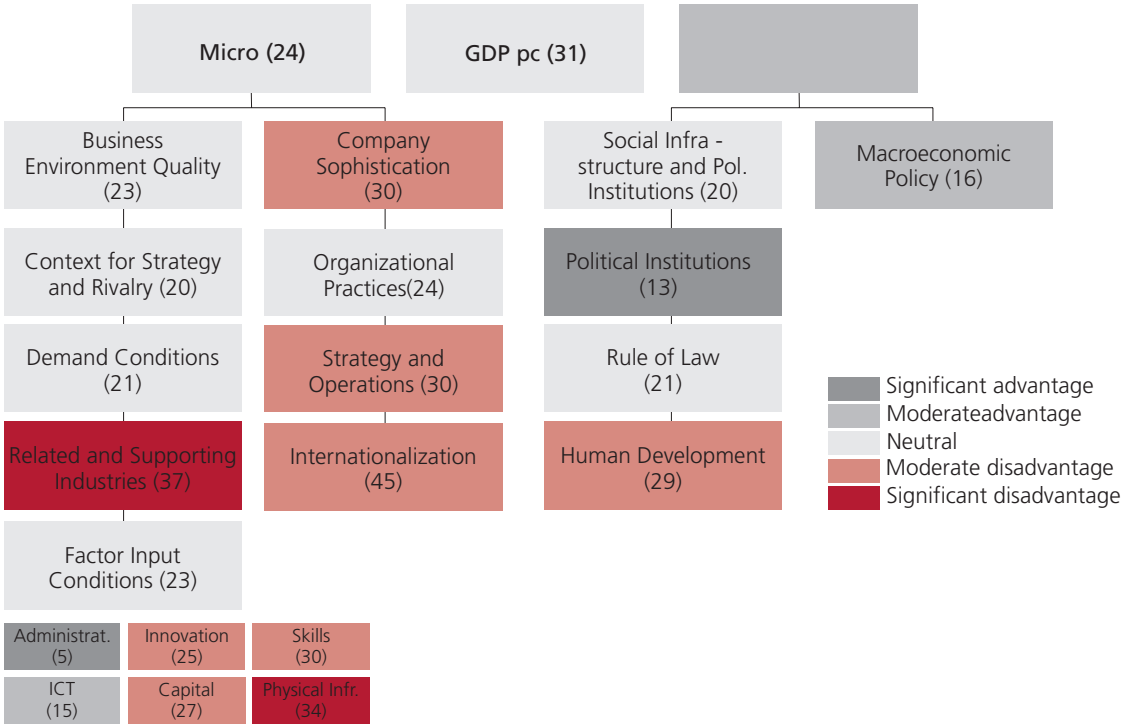

Figure 2: Overview of the Estonia's research system governance structure
Source: ERAWATCH/MER

2.2 Importance of research, development and innovation in the overall policy agenda

Estonian Research and Development and Innovation (RDI) Strategy "Knowledge-Based Estonia"[36] draws a strategy to propel Estonia towards knowledge base economy and follows the previous Estonian Research and Development Strategy implemented between 2002–2006, also called "Knowledge-Based Estonia". The strategy aims to enable sustainable development of the society by means of research and development, and innovation. It is tied to Estonia's long-term development strategy "Sustainable Estonia 21" as well as the Lisbon Agenda. The RDI strategy addresses the following challenges that Estonia is facing, i.e. challenges:

- to the organization of RDI;
- to entrepreneurship and economic competitiveness;
- to the public sector and development of RDI policy.

As a token of importance of innovation policy in the highest level, the design of the innovation strategy "Knowledge –Based Estonia" involved a committee set by the ministry of education and research, led by the Vice President of the Estonian Academy of Sciences (EAS), including representatives from key ministries, such as the Ministry of Education and Research, the Ministry of Economic Affairs and Communications, the State Chancellery, the Enterprise Estonia Foundation (EEF), Tallinn University of Technology, University of Tartu, Estonian University of Life Sciences and individual entrepreneurs.

The strategy underlines three main areas of development for the period of implementation:

- Research and development based on the internal logic of the development of research (researcher-driven research). The primary objective of these investments is to maintain and raise the level of education and research in Estonia. It concerns investments which direct socio-economic output may occur only after a very long time but which are important for Estonia in order to develop the nation state and culture as well as for cohesiveness with global development.
- Research and development based on the logic of global markets and technological development (technology-driven research), regarding the established economic specialization of Estonia and its partner countries, and the needs of enterprises considering their long term development.

36 Estonian Ministry of Education and Research, 2007, Knowledge-Based Estonia: Estonian Research and Development and Innovation Strategy 2007–2013.

- Research and development with the aim to find solutions to specific socio-economic tasks (problem-driven research). This mainly includes applied research and development, which helps Estonia to accommodate to various socio-economic challenges and supports the implementation of sector policies (e.g. health care, environment protection, energy, agriculture, etc).

And sets out three main objectives, which are more specific than the areas of development:

- competitive quality and increased intensity of research and development;
- innovative enterprises creating new value in the global economy;
- innovation friendly society aimed at a long-term development.

The objectives set in the strategy will be achieved through four measures:

- development of human capital;
- organizing the public sector RDI more efficiently;
- increasing enterprises' innovation capacity;
- policy-making aimed at long-term development of Estonia.

The activities planned in this strategy follow the "Estonian Action Plans for Growth and Jobs" approved by the Government of the Republic, Estonian Strategy for Competitiveness, The "Estonia 2020" competitiveness strategy and the "Estonian National Strategic Reference Framework 2007–2013" (NSRF). Implementation of the activities and achievement of the objectives of the strategy is connected with successful implementation of several other area-specific development plans (particularly the "Estonian Higher Education Strategy 2006–2015", "Estonian Enterprise Policy 2007–2013", "Lifelong Learning Strategy 2005–2008" and the "Estonian Information Society Development Plan until 2013").

The strategy including the associated programs will be implemented under the leadership of MER and MEAC in cooperation with other ministries, which are responsible for initiating and implementing national R&D programs in their areas of administration. The Government of the Republic, advised by the RDC, organizes the overall implementation of the strategy. As for general indicators of implementation of the strategy, the Estonia 2020 strategy sets the goals that gross expenditure on research and development is planned to be increased to 2% of GDP by 2015 and to 3% of GDP by 2020, of which the business sector research and development investments cover more than a half (1.6% of GDP). The proportion of employees involved in research and development has to increase to 8 researchers and engineers per 1000 employees and the productivity of enterprises per employee has to reach 80% of the average of the European Union 25 member states (now EU27).

2.3 Scope of innovation policy

Statement to be tested (SAT 3): Innovation policy is pursued in a broad sense going beyond technological research and its applications Leading questions:

- Is a broad concept of innovation - including innovation in services, improvements of processes and organisational change, business models, marketing, branding and design - actively promoted, inter alia through more interdisciplinary work involving groups of users or consumers as important constituencies of open innovation?
- Are supply and demand-side policies developed in a consistent manner, building on and increasing the absorptive capacity of the Single Market?

As described above, the "Knowledge-Based Estonia" sets certain focus areas for research, specifying three technology areas that are to be developed to support RDI across the board:

- information and communication technologies;
- biotechnologies;
- material technologies;

Development and subsequent adoption/diffusion of these technologies are argued to increase value added in the economy, as supposedly developing IT infrastructure and modern materials and manufacturing technologies enables catching up whatever gap remains in industrial productivity between Estonia and EU27 average and enable also efficient production of new innovation.

Besides these foci, which might be called building up industrial infrastructure, the Knowledge-Based Estonia strategy includes innovations that transcend science and technology, and proposes e.g. creating synergy between culture and business, as a way to create value past improving the quality and efficiency of work operations. The strategy document charts the scope of innovation policy in writing that "[a]chieving success at international level requires the concentration of human as well as material resources, the increase of specialisation, and the division of tasks among research and development institutions. Resources are preferably directed into those fields of RDI which have the potential to achieve results in frontier research at global level, are important for sustainable economic development and support important socio-economic objectives as well as the preservation of a nation and its culture."

Further, the strategy sets out to launch national research and development programs for:

- for developing key technologies;
- for solving socio-economic problems and achieving the objectives in socio-economic sectors that are important to every resident of Estonia, as for instance energy, national defense and security, health care and welfare services, environmental protection, and information society;
- for ensuring and promoting the sustainability of research related to Estonian national culture, language, history, nature and the Estonian state

These programs might mark a departure from the previous track noted in the OMC peer review, which concludes that Estonian RDI policy has been largely focused on excellence in S&T, or the R-component of RDI, despite the fact that the RDI-strategy puts a considerable weight on innovation as a source of welfare through growth, following a similar thought pattern exhibited in the EU2020 strategy.

While the supply side of innovation policy is actively developed and coordinated, as we can see, the demand side is left to a lesser attention, the ERAWATCH Country report concludes that there are only very few demand-side RDI support instruments.

2.4 Governance of research and innovation

Statement to be tested (SAT 2): Design and implementation of research and innovation policies is steered at the highest political level and based on a multi-annual strategy. Policies and instruments are targeted at exploiting current or emerging national/regional strengths within an EU context ("smart specialisation")

Leading questions:

- Are the broad, multi-annual policy orientations in the field of research and innovation defined by an effective and stable centre-of-government structure, typically at the top political level? Does this structure also ensure sustained and properly coordinated implementation of the policy orientations? Is it backed up by networks involving all relevant stakeholders, such as industry, regional and local authorities, parliaments and citizens, in view of stimulating an innovation culture and building mutual trust between science and society?
- Is there a multi-annual strategy defining a limited number of priorities and providing a predictable policy and budgetary framework? Was it preceded by an international analysis of strengths and weaknesses at national and regional level and of emerging opportunities ('smart specialisation') and market developments? Does the strategy duly reflects EU priorities, avoiding unnecessary duplication and fragmentation of efforts, and actively seeks to exploit opportunities for joint programming, cross-border co-operation and exploiting the leverage effects of EU instruments? Is bilateral co-operation with non-EU countries based on a clear strategy and is it co-ordinated with other EU Member States?
- Is an effective monitoring and review system in place, making full use of output indicators, international benchmarking and ex-post evaluation tools?

As discussed above, the main policy document that regulates RDI policy is the Organisation of Research and Development Act that sets the framework for policy making. Within that framework the highest political responsibilities for deciding the budget for RDI is with the Government and Parliament of Estonia. The state budget, including RDI funding is prepared, and proposed to the parliament, by the government and the ministries. The government's responsibilities in terms of RDI policy are:

- to develop a research and development policy which takes into consideration the potential, conditions and needs of Estonia, and shall prepare national development plans for research and development and submit them to the parliament (Riigikogu);
- at least once a year, the Prime Minister shall, on behalf of the Government of the Republic, present an overview of the research and development situation and of government policy in this field to the parliament;
- shall approve national research and development programs according to national development plans and ensure cooperation between the ministries in the implementation of research and development policy, taking into consideration the proposals of the Research and Development Council;
- shall establish the procedure for the formation of the Scientific Competence Council and shall establish its rules of procedure and approve its membership; etc.

Policy design and evaluation is carried out, principally, by MEAC and MER. The former oversees support for and funding of industrial R&D, as well as planning, coordination and implementation of innovation policy; the latter is responsible for research and education policies, the financing and evaluation of research institutes and coordination of international cooperation in research. The responsibilities are divided between the ministries as follows (see also table below). The area of government of the MER[37] includes the planning of state research policy and in relation to that organization of research and development, and the preparation of corresponding draft legislation. The area of government of the MEAC[38] includes the development and implementation of technological development and innovation policy and the preparation of corresponding draft legislation.

Table 2. Responsibilities of MER and MEAC in RDI governance

Ministry of Education and Research (MER) shall	*Ministry of Economic Affairs and Communications (MEAC) shall*
■ Implement the national research policy and organise research and development activities; ■ Prepare proposals concerning research policy and research and development strategy and submit them to the Government of the Republic; ■ Organise the financing of research and development at research and development institutions; ■ Organise the financing of the acquisition of scientific information for research libraries and of data media for archives libraries; ■ Co-ordinate international co-operation at state level in the field of research and organise the financing thereof; ■ Organise the evaluation of research and development; ■ Organise national research competitions and establish the conditions and procedure for conducting such competitions; etc	■ Organise technological development and innovation policy; ■ Prepare proposals concerning technological development and innovation policy and submit them to the Government of the Republic; ■ Organise the financing of applied research, development and innovation; ■ Co-ordinate and organise international co-operation in the field of technology and, if necessary, organise Estonian financing thereof; etc.

The RDC is an expert consultative body that advises the Government on RDI matters, The Council is chaired by the Prime Minister and it houses a total of twelve members from the government offices, academia and industry, with four representatives each. The RDC has two subsidiary bodies, 1) the research policy council advising the minister of education and research 2) the innovation policy council advising the minister of economic affairs and communications (see also Figure 1). The State Chancellery's Strategy Office is an active intermediary in the RDI-related strategy and policy consultations, and acts as a secretariat of the RDC and together they provide policy coordination and guide the national RDI policy.

The permanent members of RDC are appointed for three-year terms, and include the Prime Minister, the Minister of Education and Research, the Minister of Economic Affairs and Communication, one member of the Government appointed by the Prime Minister and rest of the members appointed by the Government. Despite the extensive government representation, RDC does not in fact have executive power other than through its advice. The responsibilities of the RDC are to:

- Advise the Government on R&D strategy;
- Offer opinion regarding national R&D programs presented by the ministries;

37 MER, Research, The system of research and development, Available: http://www.hm.ee/index.php?148664
38 MEAC The move towards knowledge based economy, Available http://www.mkm.ee/index.php?id=8415

- Submit annually a report to government on R&D in Estonia and on R&D objectives for the forthcoming period;
- Advise government regarding the preparation of the draft state budget (in terms of overall amount and allocation among different ministries and types of finance); etc.

The Scientific Competence Council (SCC) then is an advisory body to the Minister of Education and Research, which is required to report on its activities to the MER and to the RDC at least once every three years. The government appoints nine recognized scientists from different research disciplines to the SCC. The SCC is in charge of the following:

- Assessing the effectiveness of the targeted financing of R&D institutions and the conformity of the research results with international standards;
- Making proposals for the approval of the results of evaluation of R&D;
- Making proposals concerning the covering of infrastructure expenses of research and development institutions within the government of the Ministry of Education and Research;

While the power in policy making is in principle distributed between ministries and boards, OMC peer review notes that at least in the past the two ministries that are primarily involved in financing RDI (and respectively formulating and implementing policies for RDI) are *de facto* MER and the MEAC. Also the main responsibility of implementing and designing policy is split between these two ministries. The MER is responsible for organizing, designing and delivering research and development policy as well research evaluations and coordinating international cooperation, both *de facto* and *de jure*, while MEAC is responsible particularly for design and delivery of innovation and applied research policy and cooperation in technology development.

As discussed above, the operational level the main implementing body of the MEAC is the Enterprise Estonia Foundation, which is responsible for managing business support, innovation and technology programs. The MER has two main agencies that deliver funding and support: the Archimedes Foundation is responsible for national activities related to the ERA, international research programs, academic mobility measures, etc.; and the Estonian Science Foundation (ESF) provides grants to scientific researchers.

Compared with many other EU Member States, public research organizations (PROs) have a marginal role as the majority of the former research institutes of the Estonian Academy of Science were incorporated into universities during the 1990s according to the recommendation of Estonian Research and development system carried by the Swedish Academy in 1993. Hence, despite a wide range of actors in the national research and innovation system (see Figure 1), in operational terms the MER, MEAC, the public universities and a limited number of enterprises play a decisive role.

OBSERVATIONS FOR PEER REVIEWERS:

- Innovation policy seems high on the Estonian policy agenda and RDI policy is systematically planned, organised and coordinated. Is this also reflected to the implementation, performance and impact of policies?
- Innovation policy is increasingly international and particularly European policies and policy instruments are gaining importance over national policies. What are the needs and measures to ensure a better linkage of Estonian RDI policy with the EU 2020 and European policy developments?
- The strategic focus of innovation policy isin Estonia does not very specifically address the non-technological or non-research sides of innovation, particularly innovation in services. Should the policy focus be broadened?
- Supply-side innovation support measures have been actively developed in Estonia. Should more attention be paid to demand-side measures (e.g. public procurement)?
- Weak horizontal linkages between different ministries involved in RDI policy has been identified as one of the challenges of the Estonian innovation system. Does this indicate that the role of Research and Development Council is not clearly defined or empowered, in relation to the ministries (MEAC & MER), other policy committees and councils? What would be the respective policy suggestions?
- Public research organisations play a marginal role in Estonian innovation system, unlike in most other EU countries. Is there a need to develop this side? What would be the appropriate policy suggestions?
- Estonian economy is small and strongly hit by the global financial crisis. GDP is down and unemployment high. There are however some signs of growth. What kind of role can the national innovation policy play to better support the economic renewal and growth in Estonia?

- Roughly 2/3 of the GERD in Estonia is financed from government sources. This is an issue already addressed by the national strategy. What kind of further policy measures can be anticipated to increase the private sector's financing of R&D?
- Estonian strategic RDI priorities are selected against three dimensions; research-driven, technology-driven and problem-driven R&D. Is this sufficiently aligned with the current policy situation?
- National R&D programmes constitute the main vehicle for implementing the national strategy of 'Knowledge-based Estonia'. The strategy was adopted in 2007, but to date only two (biotech & energy) of the seven programmes have been implemented and others are waiting for final approval, postponed or cancelled. What kind of suggestions would this imply to ensure the implementation of the forthcoming national strategy?
- Three of the seven national programmes are selected with a technological focus (ICT, biotech and material technologies) and four are focusing on societal challenges (energy, defence and security, health care and welfare services, environmental protection). Is this approach appropriate, and what would be a good rationale for selecting the focus areas of the forthcoming national strategy?
- The implementation of national programmes has been criticized for a lack of cross-sectoral collaboration and ownership. The overall responsibility of coordination and implementation of the national strategy lays at the RDC. What would be good ways to ensure strong engagement and commitment for national programmes?

3 Public funding

3.1 Overview to research funding

According to the Organisation of Research and Development Act, research and development in Estonia is financed '…from the state budget, a city or rural municipality budget, endowments, income from the economic activities of research and development institutions, and other sources.' The same document stipulates that funding from the state budget is allocated as:

- Targeted financing: this is provided through the budget of the Ministry of Education and Research; the annual amount of targeted financing is established in state budget of individual research topics is approved by the Minister of Education and Research on the proposal of the Scientific Competence Council.
- Research grants: funds are allocates through the budget of the Ministry of Education and Research to the Estonian Science Foundation.
- National research and development programs: funds for the implementation of national R&D programs are allocated to the ministry responsible for the implementation of a particular program.
- Infrastructure expenses: additional funds for current expenditure (electricity, heating etc.) currently linked with the allocation of targeted financing.
- Baseline funding (Relatively new instrument, introduced in 2005). Financing R&D institutions on the basis of research quality.
- To support the development and initiative research of R&D institutions
- For co-financing of cooperation projects, international and local, between academia and industry
- No guidelines for spending, the institutions are responsible

Within this framework, the main RDI funders are MER and MEAC. MER is responsible for the funding of R&D (including applied and basic research) at R&D institutions and MEAC for funding applied research, technology development and innovation. The amount of funding of R&D through other ministries is small, e.g. in 2010 less than 7%. Overall, four largest RDI funding instruments envelop 48% of total public funding (in 2008), but more than 80% of MER funding goes directly for supporting research (EU SF excluded).The main RDI instruments are:

- targeted financing of research topics of evaluated R&D institutions, competitive institutional grant for research groups, success rate ca 70% (24% of total Govt. funding 2008)
- baseline funding of evaluated R&D institutions, based on R&D quality and outcome (8% of Govt. funding 2008)
- individual R&D grants, competitive, success rate varies from 70–50% and is dependent of the funding available for new grants (9% of Govt. funding 2008)
- support towards maintenance of the R&D infrastructures (7% of Govt. funding 2008)

The MEAC funding instruments include very high share from EU Structural funds. 2004–2006 Estonia received EEK 12.5 billion/200M€ from the Structural Funds and Cohesion Fund of the European Union[39]. During the period of 2007–2013 Estonia can use funds in the amount of EEK 53.3 billion/3.41M€, thus the support to R&D was respectively 2.0% and will be 12.1% from total support. According to RDI strategy implementation plan Estonia receives in 2007–2014 in average ca 35% from total R&D funding, but from 2009 the planned resources for implementation of R&D structural funds (including co financing and non-eligible VAT, which is covered from national income, reaches to 50–60% of total yearly R&D funding). Most important R&D funding instruments in MEAC budget are:

- R&D Financing Programme (2001–2008 total 29.8 M€; 2008–2013 total 89.58 M€)
- The SPINNO Programme (2004–2006 total 3.8 M€; 2008–20013 7.7 M€)
- International Co-operation Networks (mediation of the information on the international cooperation projects on innovation)
- Technology Competence Centre Programme (2004–2007 total 16.1 M€; 2008–2013 total 63.1 MEUR with additional co-financing 29.8 M€)
- Innovation Awareness Programme (2004–2006 total 0.88 M€)
- Support to Science and Technology Parks (2004–2008 total 2.12 M€)
- Innovation vouchers (2009–2010 total 0.96 M€)
- Support for hiring a development specialist

In practice one of the funding streams is extremely under-developed. This is the one where funding is allocated for the realization of national research and development programs. At present very few programs are operational (one on Estonian Language and Culture under the Ministry of Education and Research) and respectively few ministries are really involved in funding RDI (the Ministry of Agriculture, the Ministry of Social Affairs and the Ministry of Defence are examples where ministries have some, albeit limited role). Moreover, according to the R&D Act the programs are viewed to be the responsibility of a particular ministry, while these programs should be crosscutting to reap the maximum benefit for RDI.

In addition to the Organization of RDI Act, the Estonian Parliament adopted a first national R&D strategy for 2002–2006, Knowledge-Based Estonia: Research and Development Strategy for 2002–2006, which was followed by the second Knowledge-Based Estonia Strategy Research, Development and Innovation Strategy for 2007–2013. The RDI Strategy is supplemented by an implementation plan for 2009–2013 that provides a predictable policy framework for short- and medium-term planning, via annual implementation plans, investment plans, etc.

Table 3. Competitive and institutional funding instruments in the R&D national budget of the Ministry of Education and Research, 2007–2011, (M€ and %)

	2007	*2008*	*2009*	*2010*	*2011*
Competitive (grants + targeted funding) M€	26.3	34.0	32.6	31.1	31.0
Share of Competitive instruments (%)	*69%*	*68%*	*69%*	*69%*	*69%*
Institutional (base-line + infrastructure) M€	12.1	15.7	14.8	14.1	14.0
Share of Institutional instruments (%)	*31%*	*32%*	*31%*	*31%*	*31%*

Source: MER

After initial investments during 2004–2006, RDI are a key priority of the Estonian national reform programs, namely the Action Plan for Growth and Jobs 2008–2011 for implementation of the Lisbon Strategy (hereafter AP Growth and Jobs), the Estonian Strategy for Competitiveness 2009–2011 and the "Estonia 2020" competitiveness strategy.

Partly as a result of this policy commitment, Estonian Gross Expenditure on Research and Development (GERD) has grown by around 20% per year from 1998 until 2008, the second highest growth rate in the EU (see Table 1). Indeed, during the period 2003–2008, GERD has tripled in absolute terms. In terms of the structure of GERD, the business sector share has slightly increased from 45% in 2008 to 47% in 2009.

39 Beside the State budget the share R&D funding from foreign sources has been 11–17%

The steady growth of Government Budget Appropriations or Outlays on Research and Development (GBAORD; i.e. central government RDI budget) reflects the public sector commitment to attaining the 3% objective (the revised target date being 2014) set in the RDI Strategy. The funding allocated for quasi-competitive R&D projects under the defense policies budget has also increased annually: from 0.108M€ in 2001 to 1.66M€ in 2008. Targets set in strategy are revised in a new long-term Estonia 2020 Strategy seeks to implement the Europe 2020 targets, including the 3% target in 2020. Midterm target foresees achievement of GERD intensity 2% from GDP in 2015.

Table 4. R&D expenditures: trends and prognosis

Performers/ sectors	*Estonia*					*EU27 average*	*Target AP Growth & Jobs*	*Target of RDI Strategy*
	2004	*2005*	*2006*	*2007*	*2008*	*2008*	*2015*	*2020*
R&D intensity (GERD as % of GDP) including:	0.85	0.94	1.15	1.14	1.29	1.9	2.0	3.0
■ Government sector, % of GDP	0.11	0.11	0.15	0.1	0.15	0.24	-	-
■ Business sector, % of GDP	0.33	0.42	0.51	0.52	0.56	1.21		
■ Higher education sector, % of GDP	0.39	0.39	0.46	0.46	0.56	0.43	-	-
■ Private non-profit, % of GDP	0.02	0.02	0.02	0.03	0.03	0.02	-	-
GBAORD as share of total general government expenditure	1.11	1.2	1.5	1.43	1.62	1.52	NA	NA

Source: ERAWATCH/MER

The role of government funding is particularly important for the intramural R&D activities in HEIs and PROs which are predominantly publicly funded (state budget and EU Structural Funds). In contrast, the business sector is much less dependent on the state budget with less than 10% of business's total intramural R&D expenses sourced from the state budget (See Table 2).

The majority of public R&D expenditure is distributed via the MER budget to HEIs and PROs (including research and archive libraries, and scientific collections), which receive a mix of institutional non-competitive and project-oriented competitive funding. The second most important source of funding is for industrial R&D, innovation and business-academia collaboration from the MEAC's budget. Support for the business sector is granted through competitive bids for project funding. Program management and financing decisions are delegated to the respective agencies or foundations (Enterprise Estonia, Archimedes, ESF).

Table 5. Government financing of Intramural research and development expenditure by institutional sector, 2004–2009, by share (%)

Year/Sector	*Government*	*Higher education*	*Private non/profit*	*Business*
2004	82	69	22	4
2005	80	73	43	7
2006	63	80	28	8
2007	92	77	52	9
2008	91	82	52	7
2009	85	81	18	11

Source: ERAWATCH/MER

The main institutional, non-competitive instruments providing Higher Education Institutions (HEIs) and PROs with annual baseline funding are allocated on the basis of R&D performance indicators. During 2005–2008, the budget for baseline funding was steadily increased, but since 2009 minor cuts were made leading to 7.2M€ in 2011. For state-funded HEIs and PROs, their operating costs for research infrastructure are provided from the budget of the responsible ministry. The share of infrastructure operating costs is stable and at a level comparable with the baseline funding. Additional non- or quasi-competitive public funding is provided through the multi-annual State research programs in certain key fields as well as the R&D infrastructure program.

Institutional instruments dominate public investment in research, with baseline and infrastructure funding assuring the institutional stability of Estonian HEIs (and PROs). Given this finding and the trends in the available financial means via the State budget, the significance of, or even dependence on EU Structural Funds (SF) for a number of support measures can be stressed. The EU SF is consolidated with and distributed through the State budget, under the National Strategic Reference Framework 2007–2013 (NSRF), in particular via two out of three of the Operational programs (OP**)**. The NSRF is implemented through a special law on Structural Aid, under which Estonia can draw on more than 3.4 Billion €. The SFs are the principal source of funds for competitive support measures and research infrastructure. Currently, there is no alternative source of funds within the national budget.

The RDI strategy does not distinguish between international cooperation inside and outside ERA. In general international cooperation in higher education and research (particularly in the fields of national importance: ICT, energy, material sciences and technologies, biotechnology) is a priority for Estonian R&D institutions. Correspondingly Estonia is involved in a number of international research endeavors such as CERN and other European research infrastructures as well as in the European Framework Programmes. Complementing the list of bi- and multilateral international agreements with the countries outside ERA there are three agreements identified as relevant in the 2009 implementation report of the RDI Strategy. Estonia-USA cooperation takes place in the fields of information technology and materials science and the US Civilian Research & Development Foundation and Estonian Science Foundation co-financed four projects in these fields. In 2009, a call for joint energy projects was announced to co-finance four projects from 2010. The ESF and the Russian Foundation of Humanitarian Sciences co-finance seven projects in the field of society and cultural studies as a result of a call in 2008. The ESF also coordinates post-doctoral stipends for conducting research in Japan for 12–24 months. One researcher was funded in 2009.

Regarding international collaboration and EU funding, the draft "Estonia 2020" strategy prioritizes the international competitiveness of higher education and research institutions. There are state budget support schemes to stimulate and support the participation of Estonian participations in European collaboration programs. They were established by the MER and Archimedes Foundation in 2008. They support directly the Estonian organizations, for example, by compensating for VAT incurred in FP7 projects. Enterprise Estonia, together with the Archimedes Foundation, is the contact point for FP7, EUREKA, Eurostars, ESA, and CIP for RDI institutions and enterprises. The Eurostars program, initiated by EUREKA, offers support of up to €1m a year for international cooperation projects to Estonian R&D intensive SMEs.

Correspondingly Estonia is participating actively in the European Cooperation in Science and Technology (COST) scheme. COST has been an effective form of international cooperation for Estonia. More than 100 researchers from all leading universities and research institutions participated in 78 projects by 2009. Estonian researchers are equally active in the EU Framework Programmes. To date, Estonian researchers have been relatively successful in FP7: 218 participations were supported as of November 2009 representing €3.7m in grants. At 24%, the success rate for applications was slightly above the EU average (EU average: 21.7%). Estonian organizations coordinate project consortiums in the ICT program and the SME program. With four Estonian organizations participate in the Research Potential program which is a positive result. In total, Estonian organizations cooperate with partners from 56 countries. The largest share comes from the UK, Germany, Italy, Spain, Finland, and Sweden. Provisional figures from contracts signed as a result of FP7 calls for proposals launched in 2007 and 2008, show that Estonian cooperation with third countries represents 3% of overall Estonian activities under FP7 (EC Member States 87%, associated countries 10%). In absolute terms, cooperation with third countries is very small, with Russia leading with seven partnerships, followed by South Africa with five and Belarus and Canada with four each.

3.2 Aims of public funding

Statement to be tested (SAT 4): There is adequate and predictable public investment in research and innovation focused in particular on stimulating private investment.

Leading questions:

- Is R&D public funding oriented towards providing a high quality knowledge infrastructure and incentives for maintaining excellence in education and research (including through access to world-class research infrastructures, building regional S&T capacity and supporting innovation activity especially during periods of economic recessions). Are public investments in education, research and innovation prioritised and budgeted in the framework of multi-annual plans to ensure predictability and long term impact, drawing on the Structural Funds where appropriate?
- Is R&D public funding aimed at leveraging greater private sector investments? Are innovative financing solutions (e.g. public-private partnerships) and the use of tax incentives explored and/or adopted? Are reforms implemented to reflect changing conditions and ensure optimal returns on R&D investments?

As discussed above, the governance of innovation is quite centralized in Estonia, and it might be speculated that the funding schemes are quite coherently coordinated with the overall strategy, particularly the Knowledge-Based Estonia strategy. The main instruments for RDI funding are set by the Organization of RDI Act, and the aims of the funding are bound to the Knowledge-Based Estonia Strategy and its implementation plan.

Based on an analysis of the priorities addressed by the 18 support measures in existence in 2009 reported in the ERAWATCH country report support measures (each measure can address more than one priority), the policy measures currently implemented in Estonia strongly gravitate towards: research infrastructures (39% of all measures), R&D cooperation (33%), public research organizations (33%), excellence, relevance, and management of research in universities (33%), and strategic research policies (33%). These priorities are followed by support to sectoral innovation in manufacturing (22%), career development for university researchers (22%), support to innovation in services (17%), and cluster framework policies (17%). Four other priorities are addressed by 11% of the measures; support to organizational innovation, mobility of researchers, stimulation of PhDs, relation between teaching and research, and knowledge transfer.

One conclusion to draw from these figures is that Estonian R&D policies are heavily inclined towards building the fundamentals of a 'knowledge-based economy' in the form of improved higher education and public research and their cooperation with the business sector. This has been identified elsewhere as a bottleneck in the Estonian R&D system and thus such a priority appears adequate. For similar reasons, sectoral innovation in manufacturing and cluster policies are given rather high priority.

The ERAWATCH Country Report concludes that there is a significant tendency for support measures in Estonia to target the broad (ERAWATCH) category 2 (research and technologies) type measures, followed by roughly equal weight on categories 1 (governance and horizontal research and innovation policies), 3 (human resources), and 4 (promote and sustain the creation and growth of innovative enterprises). Category 5 (markets and innovation culture) appears to have gained less attention. However, Estonia put early emphasis on innovation awareness, which has proven fruitful for further policies in other areas. Also various academic practices, such as the limited willingness to engage in cooperation with business, have faced demands for an overhaul. In comparison with the corresponding figures for EU27, the emphasis in Estonia on category 2 stands clearly out. Drawing further conclusions by comparing the figures for Estonia and the EU27 would probably be distorted by the very large difference in absolute numbers, but in general it can be said that Estonia appears to be more focused on a smaller number of priority areas (i.e. the measures in EU27 are more evenly spread).

Looking at the funding distribution by sector, including the most recent competence centers program. would add the following sectors: 1) food, agriculture and fisheries, 2) health, and 3) nanotechnology. In addition to this, it can be mentioned that the national energy technology program has recently been put back on track after having been put on hold due to understaffing. Also similar programs in biotechnology[40], materials technology[41], environmental technology, health and ICT are underway. These programs do not directly fund

40 Augé, P., Brés, A. 2010. Estonian Biotechnology Programme: Feasibility study for an Estonian Biotechnology Programme – Final Report, Innovation Studies 13/2010, Ministry of Economic Affairs and Communication.
41 Kauhanen,L., Ristinen, T., 2011. Feasibility Study for an Estonian Material Technology Programme, Innovation Studies 15/2011, Ministry of Economic Affairs and Communication.

projects, but are created as overarching policies, within the frames of which other programs can be supported. Concerning the corresponding figures for EU27, it can be noted that areas such as biotechnology, ICT, health and the environment attract somewhat more support than others, but the overall picture for EU27 remains rather scattered, probably reflecting the existence of various national strengths.

Looking at the RDI funding as a whole, the distribution mainly follows that of EU27 with relatively few exceptions, which are: the share of measures directed towards the higher education institutions and research centers reaches 72% in Estonia while the corresponding figure for EU27 is 46%. Also measures targeting other research institutions reach 50% in Estonia and 33% in EU27. Private institutions for life-long learning are targeted by 11% of measures in Estonia, but only by 4% in EU27. Once again, the actual numbers in Estonia are so small that one or two programs make a difference in percentage. Having said this, it should be mentioned that in recent years life-long learning has been developed in cooperation between the Ministries of Economic Affairs and Communications, Education and Research, and Social Affairs – all with different stakes in the development.41 These figures strengthen the impression of Estonia actively targeting the identified bottleneck of higher education institutions and their cooperation with the business sector and the general issue of increasing the number of skilled R&D staff.

Also the option of tax incentives are explored, as indicated by a recent analytical report[42], as also proposed by the OMC peer review report. The authors of the report discuss that the main drivers for introducing R&D tax incentives are that Estonia is still lagging behind the European forerunners in terms of business sector R&D investment per GDP as well as in the number of R&D workers employed in businesses. In addition, development strategy ~~–~~Sustainable Estonia 21, as well as the Lisbon Strategy and the more recent EU2020 strategy emphasize redirecting the expenditures towards growth-enhancing activities.

3.3 Criteria for allocating public funding

Statement to be tested (SAT 5/1): Excellence is a key criterion for research and education policy.

Leading questions:

- Is the share of R&D public funding allocated on a competitive basis increasing while ensuring a balance between institutional and project-based funding? Are research institutions evaluated on the basis of internationally recognised criteria? Are projects selected on the basis of the quality of proposals and expected results, subject to external peer review?
- Are grants to researchers portable across borders and research institutions?
- Are the results of publicly funded research protected and published in a way that encourages their exploitation?

As discussed in the overview, the financing for RDI is allocated forming a portfolio directed to building infrastructures, to maintain RDI-relevant institutions and as competitive grants, through four outlets, as:

- Targeted financing: this is provided through the budget of the Ministry of Education and Research; the annual amount of targeted financing of research topics is approved by the Minister of Education and Research on the proposal of the Scientific Competence Council.
- Research grants: funds are allocates through the budget of the Ministry of Education and Research to the Estonian Science Foundation.
- National research and development programs: funds for the implementation of national R&D programs are allocated to the ministry responsible for the implementation of a particular program.
- Infrastructure expenses: additional funds for current expenditure (electricity, heating etc.) currently linked with the allocation of targeted financing.

The OMC peer review concludes that academic excellence is a key aim and criteria in funding, supposedly for competitive grants (see table 4 on the overview section above), but the criteria are not extensively explored in the available material. From main R&D funding instruments in MER budget (70 %) and most of the funding from MEAC budget are competitive. Baseline funding and support to maintenance cost of R&D infrastructures are based on the quality and quantity of the results.

42 Ministry of Economics and Communication, 2010, An Analysis of Tax Incentives to Promote Research and Development in Estonia.

Table 6. RDI funding from MER budget

Instrument	*Description*
1. Targeted financing Largest instrument, *37–40% from MER budget without EU SF*	The aim is to ensure a competitive basic structure for scientific research and to ensure the continuity of research necessary to Estonia. Open to all fields and all evaluated research groups Research Competency Council makes recommendations for funding to the Minister of Educations and Research on international *peer review* bases
2. R&D grants by Estonian Science Foundation *ca 13% from MER budget without EU SF*	The purpose is to support individual high-level initiative research, new ideas and studies ■ Open to all researchers, based on international peer review ■ Special grants for young researchers (My first grant) and postdoctoral fellows ■ Support for international collaboration, incl. ERA-NETs
3. Baseline funding *Introduced in 2005, 10–13% from MER budget without EU SF*	(Financing R&D institutions on the basis of research quality and outcome (output) ■ To support strategic development and initiative research of R&D institutions ■ For co-financing of cooperation projects, international and local, between academia and industry ■ No guidelines for spending, the institutions are responsible ■ The proportion of baseline funding in overall public financing will increase gradually
4. Other instruments	■ Support to R&D infrastructure maintenance expenditures of R&D institutions (11–12% from MER budget) ■ National programs (Estonian Language and Cultural Memory (2009–2013); Language Technology Support for the Estonian Language (2006–2010; 2011–2015) ■ The financing for research libraries ■ The funding of science collections, continuation of the national program Collections for the Humanities and Natural Sciences (2004–2008; 2009 – on regular bases) ■ Support to participation in EU programs
5. EU Structural Funds ESF *Developing the human resource for R&D – 102.6 M€*	■ Mobility of researchers and graduate students ■ Hiring top level professors and researchers, mostly in the fields raising economic competitiveness ■ PhD schools (involves 2/3 of doctoral students); Doctoral studies abroad and (for foreigners) in Estonia ■ Cooperation of universities and enterprises ■ Adaptation to a knowledge-based economy, popularizing research and technology development, raising RTD awareness
6. EU Structural Funds ERDF *Improving the competitiveness of Estonian R&D through the research programs and modernization of higher education and R&D institutions – 310M€*	■ Developing centers of excellence in research and participating in R&D cooperation of the EU and the Baltic Sea region ■ 7 centers of excellence in 2008–2013, +5 centers in 2011–2015 ■ Modernizing the general infrastructure of R&D institutions (incl. general infrastructure of R&D institutions and the educational environment of institutions of professional higher education and universities ■ Modernizing research apparatus and equipment ■ Developing thematic R&D programs aimed at long-term economic development (Support to R&D on ICT, Biotechnology, Energy, Material technology, Environment, Health care)

3.4 Means of delivering public funding

Statement to be tested (SAT 9): Public support to research and innovation in businesses is simple, easy to access, and high quality.

Leading questions:

- Is there a limited number of well targeted, clearly differentiated, and easy-to-access business support schemes consistent with support available at EU level and that address well identified market failures in the provision of private funding for innovation?
- Is public funding tailored to the needs of companies, particularly SMEs? Is the emphasis placed on outputs rather than on inputs and controls? Is bureaucracy kept to a minimum, are selection criteria straightforward and time-to-contract and to-payment as short as possible? Are funding schemes regularly evaluated and benchmarked against comparable schemes in other countries?
- Is public funding allocated through international evaluation procedures? Is trans-national cooperation encouraged? Are national rules, procedures and time-tables aligned in order to facilitate participation in EU programmes and co-operation with other Member States?
- Is there specific support to young innovative companies to help them commercialise ideas rapidly and promote their internationalisation?

The ERAWATCH and INNO-Policy TrendChart Policy database[43] recognizes 21 policy measures for Estonia and the Suggested evaluation framework for RDI and enterprise support policies[44] have explored the measures, concluding that innovation and enterprise policy instruments implemented since 2004 can be divided to into four main groups with respect to the specific objectives of the measures:

- Support to start-ups
- Company development
- Strengthening export capacity and internationalization, and
- Developing product developing and technology capacity.

The instruments can be further divided to direct funding programmes (essentially the EAS grant financing measures), indirect funding (the KredEx guarantee schemes implemented through commercial banks) and indirect support measures (funding for the provision of services by innovation 'intermediaries', networking and promotion actions run 'in-house' by the agencies themselves (essentially EAS).

A variant on the first and third categories are the "State Technology Programmes" which provide no additional funding but are intended to act as "structuring elements" in the public funding system, ensuring a focusing of the various direct funding instruments on certain technologies.

A key additional measure missing from the list is the Estonian Development Fund Arengufond, created, by an act of Parliament, in 2007 in order to both develop an environment for early-stage funding of 'high-tech/value added' start-ups and support a broad participatory debate through foresight on key sectors, technologies and issues (e.g. higher education) and related studies and events.

43 http://proinno.intrasoft.be/index.cfm?fuseaction=wiw.measures&page=list&CO=23
44 Männik, Miedzinski, Reid, 2011. Evaluation framework for innovation and enterpriise support policies in Estonia – Final Report, Technopolis Group.

Table 3. Financial support measures in Estonia before and after 2007, indirect 'financial engineering' instruments are marked with italic style

Launch date/ Main focus of measure	*Prior to 2007 (11 measures)*	*Since 2007 (15 measures)*
Business development & exports	■ EAS Start-up grant ■ EAS Business incubation programme ■ EAS Development of knowledge and skills ■ EAS Export development support ■ KredEx business loan guarantees ■ KredEx long-term large export guarantees, short-term export guarantees.	■ EAS Start-up and development grant ■ EAS Cluster development programme ■ EAS Development of creative industry ■ EAS Recruitment of development personnel ■ KredEx start-up loan guarantee ■ KredEx capital loan ■ Kredex subordinated loan ■ Kredex long-term loan in partnership with commercial banks ■ KredEx credit line for the banks
Innovation and technology development	■ EAS Entrepreneurship and Innovation Awareness Programme ■ EAS SPINNO/SPINNO+ ■ EAS R&D project support programme ■ EAS Competence Centre Programme ■ EAS funding for science & technology parks	■ EAS Technology investment programme for industrial enterprises ■ State Energy Technology Programme 2007 ■ State Biotechnology Programme 2009 ■ EAS Innovation vouchers ■ EAS semi-industrial and testing laboratories ■ Estonian Development Fund

Source: Männik, Miedzinski, Reid, 2011. Evaluation framework for innovation and enterprise support policies in Estonia – Final Report, Technopolis Group

Judging by frequency of measures in each category, there appears to have been a shift towards 'financial engineering' measures in from 2007 onwards and to some extent from 'start-up phase' towards development/ growth of companies (including through recruitment) under the business development objective. The RDI instruments are relatively stable over the entire period, since the two state programs do not add any specific funding and the main novelty is the innovation vouchers scheme. However, both the clusters and technology investment program are more focused on business development than product (service) development.

OBSERVATIONS FOR PEER REVIEWERS:

- The GDP share of Estonian R&D expenditure has increased positively over the past years and is slowly approaching the EU average. The performance of R&D is reasonably well balanced between public and private sectors.
- At the same time however, an increasing share of R&D expenditure is financed through public sources, namely from European Structural Funds. What kind of conclusions should be drawn from this development, with regard to a) sustainability of public R&D funding and b) focus areas of R&D?
- What are the particular measures for Estonia to consider in ensuring a well-functioning and competitive R&D system also in times of international financial turbulence?
- Is the public funding for RDI well balanced between institutional and competitive funding, upstream-downstream innovation, etc to reflect the needs of the Estonian innovation system?
- Does the funding provide sufficient incentives and stimulus for competitiveness, excellence and innovation? Does to the RDI funding facilitate public-private collaboration and internationalisation?
- In particular, RDI tax incentives have been proposed and discussed in earlier reports in order to encourage private sector RDI investments. What other measures or instruments should be considered?
- Does Estonia have sufficient and encouraging conditions to support knowledge-based start-ups and growth companies?
- What are the recommendations for enhancing Estonian participation in EU framework programmes?

4 Public policies aimed at the public sector

4.1 Autonomy of research institutions

Statement to be tested (SAT 5/2): Higher education and research institutions enjoy the necessary autonomy.

Leading questions:
- Are higher education and research institutions free to organise their activities in the areas of education, research, and innovation?
- Can they apply open recruitment methods and draw on alternative sources of funding such as philanthropy?

The Universities Act (1995, consolidated in 2005) determines the procedures for establishment, merging, division and termination a university; the principles of operation, the principles of financing, the limits of autonomy; the principles of management, organization of studies; the legal status of assets of university; the basic rights and obligations of teaching staff and students, and the state supervision over the legality of activities of universities. The law also defines the main terms related to higher education.

The Estonian higher education system consists of academic and professional higher education. Higher education is provided mainly by universities (ülikool) providing academic higher education and professional higher education institutions (rakenduskõrgkool), similar to e.g. German and Finnish Polytechnics, Finnish 'Universities of Applied Science' or Dutch Hogeschools, offering professionally/vocationally oriented education similar. In total, there are 7 universities, 6 are public and 1 is private. Recent trends in higher education, carried out in accordance with the objective to create a European higher education area, have lead to the adoption of a higher education system based on two main cycles – undergraduate and graduate studies. Since the academic year 2002/2003 students have been admitted to reformed professional higher education study programmes, bakalaureus- (Bachelor's), magister- (Master's) and doktor- (Doctorate/PhD) study programs.

The Estonian Universities Act provides universities with a significant degree of self-governance and autonomy, including rights to set their academic and other collaborations, employment requirements and conditions (contract forms, extra remuneration), salary rates. Also according to European University Institute[45] the Estonian academic structure is decentralized. Universities are relatively autonomous on matters related to admission, study programs and budget. The universities have budgetary autonomy and thus distribute internally the state (and other) non-competitive, generic funding allocations, etc. The salary level and other conditions of employment can be based on university regulations as long as they are in full accordance with the articles of the Employment Contract Act (1992) on general working time, holidays and vacations, maternity benefits, parental leave, social and public health securities, etc. To adopt the main principles of the Charter for Researchers, all six Estonian public universities have signed the Agreement on Good Practice in the Internationalization of Estonia's Higher Education Institutions (2007).

Masso and Ukrainski[46] analyze the competition in Estonian RDI funding system and suggest that the system of public funding has converged to a Western-European model with mainly two ministries with their intermediary and counseling bodies are allocating main funds for institutional and project funding. However, the small number of competitors and the possible domination of a single (University of Tartu) or a few (additionally, Tallinn University of Technology and Estonian University of Life Sciences can be considered) players makes the issue of competition even more relevant.

The OMC peer review concludes that "With respect to its public science system, Estonia faces problems that many small transition economies have faced or still are facing: a relatively large university system that (also as a part of the legacy of the former system) is quite decoupled from the enterprise sector." Another assessment of the Estonian innovation system[47] reports that the RDC experienced significant problems almost from the outset. According to some, soon after its establishment RDC became an arena for the scientists to argue for increased (or ever increasing) budgets. While another possible factor reportedly contributing to the difficulties experienced by the Councils might be that during that time neither the government nor industry (or for

45 European University Institute (EUI) Programmes and Fellowships – Academic Careers by Country
46 Masso and Ukrainski, 288, Competition in Estonian Public Research Funding System, in the Proceedings of PRIME-ENID Indicator Conference, Oslo.
47 Nedeva, M., Geoghiou, 2003. Assessment of the Estonian Research Development Technology and Innovation Funding System, Final Report, Policy Research in Engineering Science and Technology (PREST) Group, The Victoria University of Manchester.

that matter the society as a whole) were interested in investing in RDI. Ultimately these drivers resulted in it effectively ceasing to exist by 2000, when it was reorganized. These reports may indicate that the universities are quite autonomous actors and free to speak their mind as it were. However, the HEIs receive much of their funding from the government budget, which on one hand gives a degree of financial security against the fluxes of project-based funding, although on the other, may also result in political pressures due to dependence on government.

4.2 Research careers

Statement to be tested (SAT 5/3): Research careers are considered as attractive.

Leading questions:
- Do the legal, financial and social frameworks for research careers, including doctoral studies, offer sufficiently attractive conditions to both men and women in comparison to international standards, especially those in the US?
- Are there incentives in place to attract leading international talents?

Provision of attractive employment and working conditions is viewed as a priority area for Estonia. This is in particular aimed at young researchers. Estonia aims at increasing the number of doctoral students; with this general objective in mind, the key goal is to change the legal status of PhD students from that of students to that of employee status with related employee rights. Currently**,** PhD students enjoy only health insurance but do not contribute to the pension system nor do they obtain pension rights, but there have been positive developments. However, employment stability in terms of permanent positions is currently secured only for professors who have been (re)selected for the same position for three times and have more than 11 years of experience.

The Parental Benefit Act (2004) has been designed to contribute to the successful intertwining of work and family life. As a regular practice of equal treatment, for female applicants for a researcher's position or funding, the period of maternity (parental) leave is taken into account in the process of evaluation and selection just as compulsory military service is in case of male applicants.

The Estonian career curriculum in teaching positions includes 6 steps from entry level to fully served professor, and research track includes four positions (below the level of professor). The teaching positions in the Estonian academe are the following:

- Teacher
- Assistant
- Lecturer
- Dotsent (Associate Professor)
- Professor
- Professor Emeritus

The research positions are the following:[48]

- Junior Research Fellow
- Research Fellow
- Senior Research Fellow
- Lead Research Fellow

On the teaching track, a lecturer is a member of the teaching staff who fulfils teaching tasks related to lecturing. An assistant is an auxiliary member of the teaching staff, with qualifications in a specific field whose main task is to conduct seminars and practical training. A teacher fulfils teaching tasks of a practical nature. To become Teacher, Assistant and Lecturer positions one must have a magistrikraad (Master's Degree) or a corresponding qualification. An associate professor (dotsent) teaches a subject or a group of subjects and participates in applicable research. All professorship positions require a PhD, either an Estonian PhD or a corresponding foreign degree qualify for these positions. On the research track, candidates for Lead or Senior Research

48 See e.g. University of Tartu Personnel regulations and Documents. Requirements for teaching and research staff: http://www.ut.ee/en/university/structure-and-staff/employment/documents

Fellow must hold a PhD conferred in Estonia or another academic degree of an equivalent level. A Master's is enough for obtaining a Research Fellow position. For example in University of Tartu, the requirements include active research work and proven record in teaching for candidates[49].

The Archimedes Foundation study on researcher mobility[50] concludes the following: The decision to come to Estonia is mostly influenced by the possibility to share one's experiences and establish something new in case of foreign researchers and lecturers, and by the presence of potentially suitable supervisors in case of doctoral students. For both student and researchers, the decision is also significantly influenced by general interest in Estonia and by personal aspects.

Foreigners are generally satisfied with their stay in Estonia. Foreign doctoral students in Estonia are more satisfied than foreign researchers-lecturers with their professional activity in Estonia. Researchers-lecturers, on the other hand, are more satisfied than doctoral students with everyday matters. This explains the variation in problems highlighted by the two groups: doctoral students are more concerned with problems related to language barrier, everyday issues and communication. Researchers, lecturers and post-doctoral students, on the other hand, are more troubled by problems directly related to their work, the low level of research infrastructure, for instance. Both groups are worried about financial problems and about the administrative procedures to do with studying/working in Estonia. Respondents have received help with solving problems encountered in Estonia from their supervisor (doctoral students), from Estonian colleagues/co-students, from friends/acquaintances outside work, and from the support structures of host institutions. Friendly work environment and positive and helpful colleagues were repeatedly listed as the most positive experiences. Several researchers pointed out their satisfaction with the opportunity to have been useful to the local developing society and research circles, and with the fact that they have managed to "accomplish something" in Estonia.

The most negative feedback was given to the low level of remuneration to researchers as well as to the underfinancing of universities and to the lack of necessary research equipment. When looking at the main causes of complaints or challenges in staying in Estonia, the salary issue is at the top, while most of the other problems seem to be associated with dealing with the bureaucracy of immigration, and local authorities as well as daily chores outside the work, much of which are attributable to language and cultural barriers.

While comparing Estonian research environment with that of other countries, foreign researchers and lecturers in Estonia consider the level of remuneration, research infrastructure and the general competence of researchers in their respective research area as being clearly better in the countries of prior employment. Estonia has a slight advantage only in regard to broader possibilities for academic career. Estonian researchers working or having worked abroad regarded the research environment in their country of destination as being better than that in Estonia in all aspects evaluated. Research environment in destination countries is roughly equal to that in Estonian in regard to the legal regulation of the research area and the general competence of undergraduate/graduate students. The advantages of destination countries included better remuneration, research infrastructure and activities regarding recruitment of foreign specialists.

In comparison with studies of researcher mobility conducted in the UK, Finland and Iceland, the simplified interpretation of these differences in attitudes is that researches mostly come to Estonia to give (i.e. share their experiences), whereas they go to the UK and Finland to receive, because the research environment in these countries has more to offer them. People also go to Iceland to receive, but on the other hand, very much like Estonia, Iceland is a unique place for cultivating certain specific interests.

49 See previous document.
50 Murakas, R. (ed.) 2007, Researcher Mobility in Estonia and Factors that Influence Mobility, Archimedes Foundation.

4.3 Human resources in S&T

Statement to be tested (SAT 6): Education and training systems provide the right mix of skill.

Leading questions:

- Are policies and incentives in place to ensure a sufficient supply of (post)graduates in science, technology, engineering and mathematics and an appropriate mix of skills among the population (including through strong vocational and education and training systems) in the medium-to-longer term?
- Is there sufficient focus in education and training curricula on equipping people with the capacity to learn and to develop transversal competences such as critical thinking, problem solving, creativity, teamwork, and intercultural and communication skills? Special attention is paid to address innovation skills gaps. Entrepreneurship education and training is widely available or included in curricula. Partnerships between formal education and other sectors are actively promoted to that end.

The Knowledge-Based Estonia strategy states that "[T]he competition among countries is intensifying, particularly in the area of human resources. First of all, the demand for highly qualified researchers and engineers grows; for instance, the European Union will need approximately 700 000 additional researchers and engineers by 2010 in order to comply with the Lisbon objectives.

With regard to developing a "National Skills Agendas", Estonia is focusing on the enhancement of the quality and efficiency of doctoral studies with a general emphasis on Doctoral Schools and the development of entrepreneurship and economic courses and modules for students of non-business studies in all three university cycles. It is not done at the expense of the core academic programs in certain science fields but it rather supports their links to the business world. Mobility measures for both incoming and outgoing researchers exist to develop and diversify Estonian research potential.

In terms of ensuring better links between academia and industry, the Development of collaboration and innovation in HEIs is a specific measure to support the collaboration between universities and enterprises, co-funded by the European Social Fund. The aim is to create a platform for curricular development to better match the labor market needs. Support is given to programs (including joint programs) on master and professional higher education levels. Also the Estonian Doctoral Studies and the International Programme "DoRa" promote the cooperation of universities and companies in R&D. Under this program a doctoral training in cooperation with industry or other relevant employment sectors is being implemented.

However, low salaries of researchers are one of the main reasons why, despite rapid growth in R&D funding, the number of R&D personnel has not grown sufficiently. The salary rules vary for professors, docents (assistant professors), specialists and other academic positions, and the rules are reviewed on a regular basis. For example an assistant at the University of Tartu obtained in 2008 as a starting salary €610, a full professor €1,500. Compared to other European countries, researchers' salaries in Estonia rank among the lowest[51], and the same is true domestically in comparison to salaries in the private sector. The salary level and other conditions of employment are established in an employment contract, based on the rules of the university and on the Employment Contracts Act. In order to tackle this problem, all state budget-financing instruments that have an impact on research personnel salaries were increased by 30% in the 2008 budget.

However, the 2009 economic downturn also caused cut-back in the research sector. There are two potential impacts the financial crisis can have on the Estonian labor market. If the crisis proves to be both deeper and longer in Estonia than in EU15, there is a serious risk of a brain-drain. Even during the boom years, thousands of Estonians found better-paid employment especially in Finland and therefore the risk of highly-skilled Estonians leaving a crisis-ridden country should not be underestimated. Against the backdrop of the already limited resources of highly trained specialist, such a development could severely hamper Estonia's ambitions to move upward on the innovation ladder.

The general labor market situation in Estonia remains rather complicated due to the recent financial turmoil. If at the end of 2008, the global economic recession had only a limited impact on Estonia's labor market, the situation worsened rapidly, and by the third quarter of 2009, the unemployment rate (officially registered persons) reached 14.6%, and a further increase is forecast. In 2011 the OECD Economic Review concluded that there is a significant risk that (a part of) the cyclical unemployment may turn to structural if employment rate will not rise during the next few years.

51 See e.g. Murakas 2007 above.

4.4 Public sector innovation

Statement to be tested (SAT 10): The public sector itself is a driver of innovation.

Leading questions:
- Is the public sector providing incentives to stimulate innovation within its organisations and in the delivery of public services?
- Is innovative public procurement being actively used to improve public services, including through dedicated budgets? Are tenders based on output-based performance specifications and contracts awarded on the basis of qualitative criteria which favour innovative solutions such as life-cycle analysis, rather than lowest price only? Is joint procurement being used?
- Are government-owned data freely available as a resource for innovation?

As discussed above, while the government sector is the largest source of RDI funding, providing around 50% of total GERD, compared with an average of 33.5% in the EU27 (in 2008), public sector itself does not participate in innovation very actively. In terms of performance, the higher education and business sectors have an equivalent share of GERD (0.56% of GDP) while the government sector is a more marginal performer (0.15% of GDP). The majority of academic research and development in Estonia is performed at the four public universities. Compared with many other EU Member States, PROs have a marginal role as the majority of the former research institutes of the Estonian Academy of Science were incorporated into universities during the 1990s.
In terms of innovative public procurement Estonian public procurement policy is in a very initial development phase according to the ERAWATCH country report and, mostly takes the form of one-off initiatives or specific elements of regular procurement procedures. There is no visible political or organizational leadership so far to define the principles and steps for a more systematic, comprehensive approach. The Ministry of Finance has main responsibility over public procurement policy and drafting the respective laws and hence, formally, should oversee the development of a framework for pre-commercial/innovative public procurement. MEAC has participated in developing innovative procurement instruments.

The Public Procurement Act (in force since 1 July 2010) regulates the "Idea competitions" but there is no reliable data on how often and in which fields such competitions occur. There are other examples of forms of procurement used to stimulate R&D. In 2007, the MEAC and the Ministry of Defence collaborated on a first offset contract worth over €64m. Equally, e-government policy has led to systematic, large-scale public procurement from ICT providers (e.g. creation of novel technology platforms for e-voting, e-health, e-customs and e-taxation).

OBSERVATIONS FOR PEER REVIEWERS:
- Estonian universities are reasonably independent and the academic structure decentralised. This can be both an advantage and a disadvantage in a small country. What are the suggestions to ensure that also critical mass & economies of scale / scope are sustained in the Estonian education system?
- Attention has been paid to building attractive career conditions for both young and experienced researchers, while at the same time, brain drain and attractiveness of research careers overall are constant challenges. One particular challenge has been the low level of research salaries. What are the suggested strategies and measures for improving Estonia's attractiveness in international race for competent skills?
- What are the options and suggestions for Estonia with regard to better utilising European research area and EU framework programmes for increasing researcher mobility and attracting foreign researchers?
- Outside the main RDI sectors and eGovernment activities, the Estonian public sector has not been considered very much innovation-oriented. What are the recommendations with regard to further enhancing public sector innovation for example with active public procurement?

5 Public policies aimed at the business sector

5.1 Overview to business research and development

In absolute terms, Business Enterprise (Expenditure on) Research and Development (BERD) intensity remains about half of the EU27 average and there has only been a slight narrowing of the gap in the last five years. Nevertheless, the share of the business sector in GERD increased from 43% to 45% from 2008 to 2009. As the new program period of EU SF started in 2008, the growth of government financing of RDI activities was significantly higher than in previous years. Hence, it is likely that the various new programs targeting enterprises introduced in 2008 have had a positive impact on the investment capacities of the business sector in the first year of the financial crisis.

In terms of a longer strategic perspective, the BERD trend is more uncertain, as the core investment barriers stemming from the size and structural limitations of the national economy are still in place. The fact that 75% of BERD can be attributed to only 58 firms, reflects a structural weakness of the Estonian economy. Equally, the role of high-tech firms in the economic structure remains weak – the high-tech export share of total exports was 8% (compared to 16.6% in the EU27) in 2006. The high-tech sector employs less personnel than more industrially developed economies. These facts may indicate that the transformation from central planning economy has not yet been complete, as the industry is quite concentrated and work for large parts on so-called traditional industries. The existing fiscal and tax policies have proven to be successful in supporting business investments, but they do not promote particularly knowledge-intensive business, the creation of jobs in research and development and investments in added value production and services.

Still, both the RDI Strategy and the AP Growth and Jobs have estimated that an R&D intensity of 2.0% (GERD/GDP) and BERD/GDP intensity of 1.05% are possible to achieve by 2011. For the business sector intensity, the target level is 1.6% by 2014. These estimates are based on the pre-defined EU SF resources, which until 2013 are incorporated into the state budget. The ERAWATCH Country Report 2010 suggests that the labor market for R&D personnel in the business sector is a challenge for the achievement of the national BERD target.

The share of the higher education sector funded by the business sector (HERD funded by BERD) has declined since 2005 from 5.2% (with a small increase in 2007) to 4.3% in 2009, a development that has been affected by the financial crisis. The EU27 average shows an opposite trend and in 2008 was 7%. However, Estonia compares favorably to several other larger EU countries, such as France or Sweden. This share should also be seen in light of the limited size of the business sector and notably the limited number of R&D personnel in firms.

5.2 Linkages between the public and private sectors

Statement to be tested (SAT 7): Partnerships between higher education institutes, research centres and businesses, at regional and international level, are actively promoted.

Leading questions:

- Where possible, research efforts are accompanied by instruments to support the commercialisation of innovative ideas. Policies and instruments such as innovation/knowledge clusters, knowledge transfer platforms, and voucher systems, are in place to encourage co-operation and knowledge sharing and at creating a more favourable business environment for SMEs.
- Researchers and innovators are able to move easily between public and private institutes. There are clear rules on the ownership of intellectual property rights and sharing and support systems are in place to facilitate knowledge transfer and the creation of university spin-offs and to attract (venture) capital and business angels.
- There are no obstacles to setting up and operating transnational partnerships and collaborations.

As an overview; according to the Community Innovation Survey (CIS8), the public sector is not the main source of knowledge provision. More than 60% of the respondents point to the business sector itself (the own enterprise, suppliers, competitors). Estonian companies use the public research organizations the least as a source of information for innovation (0.9%) while universities and other higher education institutions were mentioned by 2.7% of respondents. This is far below scientific journals (3.9%), consultants (4.4%) or conferences (6.4%). From the business sector's perspective, the public sector is a rather unpopular cooperation partner. Again using CIS8 data, the public research institutes are the least often mentioned with 1.4% and the universities with 3.2% of all co-operation 'encounters'. Estonian companies tend to cooperate more often with their national competitors than with public sector researchers.

These findings may point to a mismatch; it seems likely that the public research sector supply is not matching the business structure's needs. This conclusion is reinforced by the finding in CIS8 that innovative Estonian firms engaged in cooperation, cooperate very often with foreign partners. However, the challenge is recognized by Estonian policy makers, and there are multiple measures in place to stimulate public-private partnerships and to orient researchers toward industrial needs, perhaps most notably the SPINNO program that aims to develop know-how and legal framework for knowledge transfer from HEIs to the industry.

5.2.1 Instruments to support public-private partnerships

Considering the routes available to stimulate private investment to RDI, four are particularly important in terms of the structural reorientation of the Estonian economy:

- Promoting the establishment of new indigenous R&D performing firms;
- Stimulating greater R&D investment in R&D performing firms;
- Stimulating firms that do not perform R&D yet, and
- Increasing extramural R&D carried out in cooperation with the public sector.

A priori, the promotion of new indigenous R&D performing firms (route 1) is supported by various business start-up measures, notably of Enterprise Estonia, and the generally favorable regulatory framework in favor of entrepreneurship (e.g. simple registration of a new business, e-taxation, liberal employment laws, and particularly taxation policies). Moreover, given the scale and structure of the Estonian economy, the needs of micro-companies and SMEs are taken into account by both the RDI Strategy and the 2007–2013 Entrepreneurship Strategy. In October 2010, the MEAC launched a new initiative for start-ups and SMEs, called Start-up Estonia (estimated budget €3.7M). However, the policy effort is focused on the promotion of entrepreneurship in general, not specifically in R&D-intensive sectors. Exceptions include seed-capital investments through the Estonian Development Fund into high-growth, and hence generally technology intensive, early-stage firms.

In terms of routes 2 and 3, and given the acknowledged need to re-orientate the Estonian economy to knowledge-intensive business activities and promote structural change, there are a number of well-established measures, which have been extended in the 2007–2013 period, including: Technology Competence Centres program (est. in 2002), Research and Development support (est. in 2004), etc. In addition, several new R&D and innovation relevant measures were started in 2008 and 2009, such as the Involvement of Development specialist, the Business cluster and collaboration development, and Innovation voucher measures. The common goal of these programs is to stimulate local companies to shift to higher added value or R&D intensive manufacturing via technological modernization.

In 2010, two new programs relevant to routes 3 and 4 were launched, namely: the awareness program for creative industries (this sector is considered to have an increasing role in supporting competitiveness and a knowledge-based economy) and the Testing and semi-industrial laboratories support program. The total budget of the latter is €3.94M (consolidated budget for 2009 and 2010). It is a highly relevant measure for industrial research and contributes further to boosting the R&D capacity of the technology-intensive companies.

While the RDI instruments in Estonia are quite well developed, collaboration between industry and academia (route 5) has proven to be difficult, and e.g. ERAWATCH concludes that insufficient business-academia collaboration is a persistent challenge in the Estonian R&D system. By the end of 2009, the set of competitive support programmes was expanded by several new measures the HEIs-business collaboration development; and for the business sector Involvement of innovation and R&D staff, Manufacturing R&D projects and the academic-business cooperation programmes. Nevertheless, the pre-existing Competence Centres Programme is the key instrument for promoting industry-academic co-operation and spans all types of research in certain thematic areas by integrating activities of public and private sectors.

Since the early 2000s, there are a considerable number of policy measures aimed at increasing extramural R&D by enterprises carried out in cooperation with the public sector as well as support for commercialization of research by HEIs and knowledge transfer, including the Competence Centre Programme, R&D grant support and the Innovation vouchers program is expected to contribute to change of academic attitudes towards interactions with business and more business-thinking in universities. In addition, certain higher education policy measures launched in 2009 address this issue. For example the "Training doctoral students in cooperation with businesses" program is intended to assist innovative companies who successfully apply research results, technology and professional design in their services and products by funding the creation of supported doctoral student places. This activity is intended to foster development in the priority areas specified in Estonia's national RD&I strategy (ICT, materials technology, environmental technology, biotechnology, power engineering and health).

5.2.2 Intellectual property

Considering Intellectual Property Rights (IPR) Policies, the most important legal acts for IPR in Estonia are the Copyright Act and for the protection of patentable inventions the Patents Act. In addition, all universities have their own detailed IPR policies (incl. portfolio, licensed technologies, etc).

In general, Estonian universities own the economic rights of industrial inventions (i.e. patents and utility models) created during the execution of contractual duties of their employees. This rule is generally included in the employment contract but it can also be concluded by a separate contract. Applications for patents and utility models are made to the Estonian Patent Office.

Larger universities manage IP in line with the Code of Practice for universities and public research organizations adopting the main principles in their operational research and knowledge transfer activities. These activities are mainly financed by Enterprise Estonia (SPINNO programme) and from European Commission funding, e.g. Enterprise Europe Network. Indeed, the State support, particularly through SPINNO, has been a key driver in fostering the development of know-how on technology transfer from the universities to the business sector.

While the universities are able to appropriate their IPR, few Estonian universities have separate transfer offices while it is a declared priority of the universities to foster stronger interactions with the business sector. Estonian universities are amongst the 90% of European universities which have a budget for knowledge transfer activities below €500,000. These figures concern both administrative, spin-off activities and IP protection costs of the universities.

Correspondingly, the main constraints for the commercialization of research and proof of concept are, amongst other factors, limited knowledge and practical experience on how to protect and commercially exploit IP in universities. Indeed, the ability to commercialize the research outcomes remains low, especially in high-tech fields. The SPINNO program is the main source of State support to facilitate knowledge transfer between academia and the business sector. The mid-term evaluation of the program (2007) found the program to be highly relevant for the development of knowledge transfer 'infrastructure' in Estonia and the 'legal framework' for knowledge transfer within specific institutions.

5.2.3 Mobility between sectors

Concerning inter-sectoral mobility of research personnel, the general employment and working conditions legislation. Mobility of researchers and other innovation staff is encouraged through two measures: Support for the involvement of the innovation staff and the Development of collaboration and innovation in HEIs.

There are measures such as the Innovation Vouchers (budget of €2.9M for 2009–2013), product development grants (budget €77M for 2007–13) competence centres, and clusters. They are good examples of measures targeting dual, even triple, policy targets in all three policy areas – education, innovation and research. However, their cumulative effect on knowledge circulation is unclear (with exception of the Competence Centre programme) as there is no evaluation data on performance and impact available (partly due to the newness of several measures).

The Competence Centre program is the most long-standing, large-budget instrument that aims to facilitate knowledge circulation between public and private sectors. In the 2007–13, each of the eight centers can receive annually up to €1.28M, within a limit of 70% of their eligible budget budgets (for IPR related costs 50% of costs). According to a 2008 mid-term evaluation, the centers tackle efficiently intra-university barriers to industry cooperation (e.g. need for clearer strategies and improvements in administration, ability to manage IPR, boosting industrial doctoral studies) and on the industrial side, improve technology absorption and high-tech product and process development capacities.

Regarding ERA funding for the business sector, no special national measures are in place but there is an administrative support to apply for participation in international programs like the Framework Programme, as well as EUREKA and COMPERA (facilitated by Enterprise Estonia). Further measures are provided by Enterprise Estonia via funding for study visits abroad and thematic meetings (on space technology, high tech and traditional manufacturing, quality and creativity management, etc) and awareness events.

The international dimension of knowledge circulation is addressed by the specific mobility measure for HEIs, the Mobilitas program (budget of €20.3M for 2008–2015), and scholarships. Cross-border activities are eligible for funding under most of the competitive R&D and innovation support measures too (cluster development,

competence centers, development specialist). Indeed, the Estonian competence centers have visibly advanced in terms of internationalization of their activities and providing teaching and research opportunities for Master and doctoral studies.

The Involvement of Development specialist program is a targeted measure to support a fixed-term hiring (from Estonia or abroad) of researcher, engineer, and designer or marketing specialist in the business companies, to make them more competitive and raise ability to innovate.

In the context of the governance of Estonian universities the involvement of business participants in university boards is not yet common practice. However, the topic is widely discussed and University representatives participate in the governing bodies of the science and technology parks: Tartu Science Park and Tallinn Technology Park (Tehnopol). This is one of the main ways for universities to develop relations with businesses and to receive relevant feedback from the market.

5.3 Business environment

Statement to be tested (SAT 8): Framework conditions promote business investment in R&D, entrepreneurship and innovation.

Leading questions:

- Policies to promote innovation, entrepreneurship and enhance the quality of the business environment are closely interconnected.
- Favourable conditions are in place to foster a growing and robust venture capital market, especially for early stage investments.
- Consistent with the Small Business Act for Europe, the rules for starting up and running a business are simple and designed from an SME perspective. The legal framework is transparent and up-to-date. Rules are properly enforced. Markets are dynamic and competitive. Willingness to take risks is promoted. Insolvency regulations support the financial reorganisation of enterprises. There is no discrimination against entrepreneurs who may have failed the first time around.
- An efficient, affordable and effective system for the protection of intellectual property is in place, which fosters innovation and preserves investment incentives. The market for innovative products and services is kept constantly up to date by means of an efficient standard-setting system.

The OECD Economic Review[52] on Estonia 2009 concluded that Estonia can be considered to have one of the most open and competitive economies in the world. The dynamism of the business environment is reflected in high rates of firm and job creation, also relative to other European emerging market economies, as well as by large inflows of foreign direct investment (FDI). Estonia is particularly highly regarded in the area of network readiness, and also scores relatively highly (for its level of development) on measures of corporate governance and transparency. Estonia's good business environment is further supported by e-government, which is considered as the most outstanding example in central Europe, and in several aspects (such as e-governance or delivering e-services for businesses) even exceeds the standards of the OECD countries on average.

Management of IPRs remains an issue on which Estonian entrepreneurs have limited awareness, especially in SMEs. In order to remedy this situation, Enterprise Estonia and the Estonian Patent Office have arranged seminars and published materials targeting SMEs. Such seminars (occasionally in cooperation with WIPO or EPO) have been arranged annually basically since Estonian re-independence in 1991. The general trend for patent applications is rising, though. Patents at EPO increased from just above two in 1995 to being constantly between four and eight since the year 2000. Also patents at WIPO indicate an upward trend, from below 20 in the 1990s to above 20 in recent years – and 36 in 2006.34 Thus, the decline in EPO patents indicated in the data of EIS 2008 (below) is actually a matter of choosing the beginning and the end of the period of analysis. 2001 happened to be a year of extraordinary activity while the numbers stabilized below that in (most of) the subsequent years. However, the rate of patenting is far below the EU27 average, which is an indicator of insights in the field still wanting. One solution is to integrate IPR issues into other innovation policy measures, especially when the aim is to promote the emergence of new technological solutions. However, this issue can be seen in another light, too. Low patenting intensity might simply reflect the present stage of the innovation system, i.e. catching up. Also the absence of a sophisticated market for IPR will have a negative impact on the willingness to invest time and money in patenting. Therefore far reaching conclusions should be

52 OECD 2009 Economic Survey of Estonia, 2009, Policy Brief, May 2009.

However, the share of production in high tech sectors and knowledge-intensive services is still relatively low, and the share of high technology products in exports has slowed. To become a knowledge-based economy, production will need to shift towards knowledge-intensive sectors and productivity gains from innovation will need to drive growth in the future. Moreover, application of the OECD product market regulation (PMR) methodology indicated that the overall product market policies in Estonia were only slightly less restrictive than on average in the OECD countries, signaling room for further reforms to catch-up with best performers.

As discussed above, public funding in the form of grants and other instruments is generally available for Estonian enterprises. However, venture capital Estonia is not particularly well-developed. This is to some extent a consequence of the small size of the Estonian market. The Estonian Development Fund, a government-owned fund for venture capital, which became operational in 2007, has so far made only a small number of investments. However, final investment decisions take time and it is expected to make 3–4 (in addition to previous five) more investments in 2010.

According to a report from the Estonian Development Fund, other venture capital funds operating in Estonia tend to focus on companies in the expansion phase rather than start-ups and seed capital. One reason for this might be the fact that most venture capital funds operating in Estonia are based abroad. This fact also hampers coordinated actions and cooperation. Moreover, awareness of venture capital is still wanting while the number of suitable investment objects has remained low. At present the Estonian Ministry for Economic Affairs and Communications is looking how the Development Fund could be more active in seed phase additionally to start-up phase were current investments have taken place. The lack of support for enterprises in the earliest phases puts technology-intensive companies at a disadvantage in the competition with foreign-based companies in the same phase, because the field of activity is international from the start (obviously less technology-intensive early-stage companies do not usually start with an international perspective). This might even be one cause of a brain- or talent- drain from Estonia.

To summarize, despite the generally open business environment, several challenges for further development are identified:

- Barriers to competition in the electricity sector should be removed. Unbundling of Eesti Energia remains a challenge. Increasing the share of the retail markets open to consumers and creating a liberalized wholesale market should be a priority.
- The impact of limiting the corporate tax liability to distributed profits should be carefully monitored and this tax regulation reconsidered if it is established that serious distortions arise.
- The cost effectiveness of the different programs supporting business and innovation activities needs to be enhanced. Results of evaluation studies should be more rigorously implemented, including at Enterprise Estonia.
- Private-sector activities in less-developed areas of the country as a driver of growth and poverty reduction should be encouraged, in particular through facilitating a better access to credit for small and medium-sized enterprises.

OBSERVATIONS FOR PEER REVIEWERS:

- Estonia is considered to have one of the most open and competitive business environments in Europe. How can this advantage be taken stock of in the innovation policy? How can the dynamic business environment boost innovation also at the public sector?
- Business RDI is rather concentrated in Estonia, as ¾ of the BERD is performed by 58 companies. This is not unique situation in EU countries, but needs to be acknowledged in defining relevant policies.
- The patenting intensity in Estonia is far below EU27 average and may reflect the innovation activity of companies. It may also reflect the lack of awareness of IPR issues in Estonia, as well as the small 'market' for IPR. What kind of policy conclusions and suggestions should be made on this?
- The aims to increase private sector RDI are ambitious, not only in terms of financing, but equally in terms of available human resources. How should this be addressed in policy?
- Large part of the business sector RDI is financed from public sources, while collaboration between higher education institutions and enterprises is weak in Estonia. Estonian companies more often collaborate outside of Estonia. What are the suggested policies and measures to strengthen the practical PPP – collaboration within Estonia?
- What are the most effective ways of involving business leadership in RDI policy planning and implementation?
- There seems to be an inherent mismatch between the needs of business sector and the provision of knowledge from the public sector. Furthermore, there is a lack of public research organisations that would provide contract research for business sector. Should there be specific measures to this end?

6 Summary and Discussion

While the preceding sections in the document have been descriptive in nature, summarizing existing studies an relevant information of the Estonian NIS and RDI policy mix, this section contains discussion by the authors and underlines some questions for discussion.

Considering the big picture of the innovation system, the Estonian policy environment and taxation are quite enterprise friendly. What is concerning is the relatively low research intensity of the enterprises, which may be a factor of industry structure and historical factors. The key question is that how the enterprise-friendly environment can be translated to RDI activities, entrepreneurship and new value added? One answer may be to continue to work on the framework conditions for innovation in terms of RDI policy and funding, but also demand-side instruments and entrepreneurship education may be worth considering as way to lower the barriers for commercializing research.

Another key question is the apparent disparity, either between the research performing sector and the industry. HEIs are often seen as *the* source of innovation as they perform cutting edge research that supposedly has the power to transform technology and create superior value. This proposition may be (or have been) true, but commercializing research is a long and winding path and demands taking great financial risks. Further, foreseeing what research and inventions will be commercially successful and when is a task that has eluded many an expert. Despite valiant efforts to build a EU-class research and innovation system, it seems there is a slight disparity between the academia and industry, indicated by the loose coupling of enterprises and universities as well as the lack of the key industries identified in RDI policy in export statistics, albeit that the figures are form 2007 and a lot of water has flowed under the bridge since. These observations also raise the question whether the effort to build an innovation system address the indigenous structural features of the industry, instead of just trying to forcibly pull Estonia toward EU goals at any price. Thus stimulating RDI, that is D and I might be more straightforwardly achieved with demand side or market pull instruments, rather than only supply side technology push instruments that stimulate research with the credo '*ars gratia artis*'. However, given that the objectives set for ERA are geared toward scientific excellence, the policy mix should not abandon research, but to invest also more strongly in creating public-private partnerships in innovation.

Concerning building innovative capability, following recent strategic theory, innovative capability is not something that can be readily bought, but it has to be developed over time gradually[53]. This view calls for active participation in RDI and measures that stimulate learning by doing. Again here increasing attention to demand side measures and public-private partnerships, perhaps in the form of researcher mobility and innovation vouchers, present themselves as lucrative options to stimulate RDI and growth while leaving the policy maker and implementer free of the daunting task for trying to forecast e.g. the key technology areas that should be funded, and leaving the researchers and business people in charge of what they know best.

Regarding human resources in RDI, remuneration i.e. salaries and other financial perks, stuck out like a sore thumb as a major source of dissatisfaction to stay in Estonia. This probably acts as a disincentive for mobility, especially when combined with perceived lack in research infrastructures and also difficulties in dealing with immigration procedures and government due to lack of information and language barriers. While these are issues that may be overcome, if a researcher finds a sufficiently interesting position, they are not actually incentives to come to Estonia.

The Synergies expert group[54] that has studies the European RDI policy mix has come to the conclusion that the main issues to be addressed in European RDI funding are, some of which apply to national funding as well:

- The fragmentation of innovation policies at EU level;
- The sub-optimal coordination of research and innovation as well as cohesion policies at European, national and regional level, both within and between these levels;
- A lack of common strategies in accordance with the orientations of Europe 2020;
- A lack of a coherent and interacting governance structure;
- Weak complementarities and compatibilities as well as interoperability of policies and programs, particularly regarding the regional dimension in research and innovation policy and the research and innovation dimension in regional policy;
- A lack of instruments aimed at supporting the pooling of European and national funds;
- Poor communication, coordination and cooperation between actors and stakeholders at all levels.

53 See Dierickx, I. and Cool, K. 1989. Asset Stock Accumulation and Sustainability of Competitive Advantage, Management Science, 35(12), 1504–1511, developed further e.g. by Helfat, C.E., Peteraf, M.A. 2003 The Dynamic Resource-Based View: Capability Lifecycles, Strategic Management Journal, 24, 997–1000

54 Horvat, M. (Rapporteur) and Expert group on synergies between FP7, the CIP and the Cohesion Policy Funds, Synergies Expert Group (SEG) 2011 Final Report of the Synergies Expert Group

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Annex 1 | Adapted Innovation Union Self Assessment Tool

The structure of the report is based on the Self Assessment Tool (SAT) originally published in the Innovation Union Communication[55]. Original structure of the SAT is indicated in parentheses.

GOVERNANCE

Importance of research and innovation in the overall policy agenda (SAT 1)

Statement to be tested: Promoting research and innovation is considered as a key policy instrument to enhance competitiveness and job creation, address major societal challenges and improve quality of life and is communicated as such to the public

Leading questions:

- Is public action in all relevant policy areas designed and implemented in a strategic, coherent and integrated framework geared towards fostering innovation and strengthening the knowledge base and fundamental research?
- Are relevant policies and public funding increasingly oriented towards addressing major societal challenges and towards deriving competitive advantage from finding new solutions to tackle them?

Scope of innovation policy (SAT 3)

Statement to be tested: Innovation policy is pursued in a broad sense going beyond technological research and its applications

Leading questions:

- Is a broad concept of innovation – including innovation in services, improvements of processes and organizational change, business models, marketing, branding and design – actively promoted, inter alia through more interdisciplinary work involving groups of users or consumers as important constituencies of open innovation?
- Are supply and demand-side policies developed in a consistent manner, building on and increasing the absorptive capacity of the Single Market?

Governance of research and innovation (SAT 2)

Statement to be tested: Design and implementation of research and innovation policies is steered at the highest political level and based on a multi-annual strategy. Policies and instruments are targeted at exploiting current or emerging national/regional strengths within an EU context ("smart specialization")

Leading questions:

- Are the broad, multi-annual policy orientations in the field of research and innovation defined by an effective and stable centre-of-government structure, typically at the top political level? Does this structure also ensure sustained and properly coordinated implementation of the policy orientations? Is it backed up by networks involving all relevant stakeholders, such as industry, regional and local authorities, parliaments and citizens, in view of stimulating an innovation culture and building mutual trust between science and society?
- Is there a multi-annual strategy defining a limited number of priorities and providing a predictable policy and budgetary framework? Was it preceded by an international analysis of strengths and weaknesses at national and regional level and of emerging opportunities ('smart specialization') and market developments? Does the strategy duly reflects EU priorities, avoiding unnecessary duplication and fragmentation of efforts, and actively seeks to exploit opportunities for joint programming, cross-border co-operation and exploiting the leverage effects of EU instruments? Is bilateral co-operation with non-EU countries based on a clear strategy and is it co-ordinated with other EU Member States?
- Is an effective monitoring and review system in place, making full use of output indicators, international benchmarking and ex-post evaluation tools?

55 European Commission – DG Research and Innovation, Europe 2020 Flagship Initiative Innovation Union, SEC(2010) 1161

PUBLIC FUNDING

Aims of public funding (SAT 4)

Statement to be tested: There is adequate and predictable public investment in research and innovation focused in particular on stimulating private investment

Leading questions:

- Is R&D public funding oriented towards providing a high quality knowledge infrastructure and incentives for maintaining excellence in education and research (including through access to world-class research infrastructures, building regional S&T capacity and supporting innovation activity especially during periods of economic recessions). Are public investments in education, research and innovation prioritised and budgeted in the framework of multi-annual plans to ensure predictability and long term impact, drawing on the Structural Funds where appropriate?
- Is R&D public funding aimed at leveraging greater private sector investments? Are innovative financing solutions (e.g. public-private partnerships) and the use of tax incentives explored and/or adopted? Are reforms implemented to reflect changing conditions and ensure optimal returns on R&D investments?

Criteria for allocating public funding (SAT 5/1)

Statement to be tested: Excellence is a key criterion for research and education policy

Leading questions:

- Is the share of R&D public funding allocated on a competitive basis increasing while ensuring a balance between institutional and project-based funding? Are research institutions evaluated on the basis of internationally recognized criteria? Are projects selected on the basis of the quality of proposals and expected results, subject to external peer review?
- Are grants to researchers portable across borders and research institutions?
- Are the results of publicly funded research protected and published in a way that encourages their exploitation?

Means of delivering public funding (SAT 9)

Statement to be tested: Public support to research and innovation in businesses is simple, easy to access, and high quality

Leading questions:

- Is there a limited number of well targeted, clearly differentiated, and easy-to-access business support schemes consistent with support available at EU level and that address well identified market failures in the provision of private funding for innovation?
- Is public funding tailored to the needs of companies, particularly SMEs? Is the emphasis placed on outputs rather than on inputs and controls? Is bureaucracy kept to a minimum, are selection criteria straightforward and time-to-contract and to-payment as short as possible? Are funding schemes regularly evaluated and benchmarked against comparable schemes in other countries?
- Is public funding allocated through international evaluation procedures? Is trans-national cooperation encouraged? Are national rules, procedures and time-tables aligned in order to facilitate participation in EU programmes and co-operation with other Member States?
- Is there specific support to young innovative companies to help them commercialize ideas rapidly and promote their internationalization?

PUBLIC POLICIES AIMED AT THE PUBLIC SECTOR

Autonomy of research institutions (SAT 5/2)

Statement to be tested: Higher education and research institutions enjoy the necessary autonomy

Leading questions:

- Are higher education and research institutions free to organize their activities in the areas of education, research, and innovation?
- Can they apply open recruitment methods and draw on alternative sources of funding such as philanthropy?

Research careers (SAT 5/3)

Statement to be tested: Research careers are considered as attractive

Leading questions:

- Do the legal, financial and social frameworks for research careers, including doctoral studies, offer sufficiently attractive conditions to both men and women in comparison to international standards, especially those in the US?
- Are there incentives in place to attract leading international talents?

Human resources in S&T (SAT 6)

Statement to be tested: Education and training systems provide the right mix of skills

Leading questions:

- Are policies and incentives in place to ensure a sufficient supply of (post)graduates in science, technology, engineering and mathematics and an appropriate mix of skills among the population (including through strong vocational and education and training systems) in the medium-to-longer term?
- Is there sufficient focus in education and training curricula on equipping people with the capacity to learn and to develop transversal competences such as critical thinking, problem solving, creativity, teamwork, and intercultural and communication skills? Special attention is paid to address innovation skills gaps. Entrepreneurship education and training is widely available or included in curricula. Partnerships between formal education and other sectors are actively promoted to that end.

Public sector innovation (SAT 10)

Statement to be tested: The public sector itself is a driver of innovation

Leading questions:

- Is the public sector providing incentives to stimulate innovation within its organizations and in the delivery of public services?
- Is innovative public procurement being actively used to improve public services, including through dedicated budgets? Are tenders based on output-based performance specifications and contracts awarded on the basis of qualitative criteria which favor innovative solutions such as life-cycle analysis, rather than lowest price only? Is joint procurement being used?
- Are government-owned data freely available as a resource for innovation?

PUBLIC POLICIES AIMED AT THE BUSINESS SECTOR

Linkages between the public and private sectors (SAT 7)

Statement to be tested: Partnerships between higher education institutes, research centers and businesses, at regional, national and international level, are actively promoted

Leading questions:

- Where possible, research efforts are accompanied by instruments to support the commercialization of innovative ideas. Policies and instruments such as innovation/knowledge clusters, knowledge transfer platforms, and voucher systems, are in place to encourage co-operation and knowledge sharing and at creating a more favorable business environment for SMEs.
- Researchers and innovators are able to move easily between public and private institutes. There are clear rules on the ownership of intellectual property rights and sharing and support systems are in place to facilitate knowledge transfer and the creation of university spin-offs and to attract (venture) capital and business angels.
- There are no obstacles to setting up and operating transnational partnerships and collaborations.

Business environment (SAT 8)

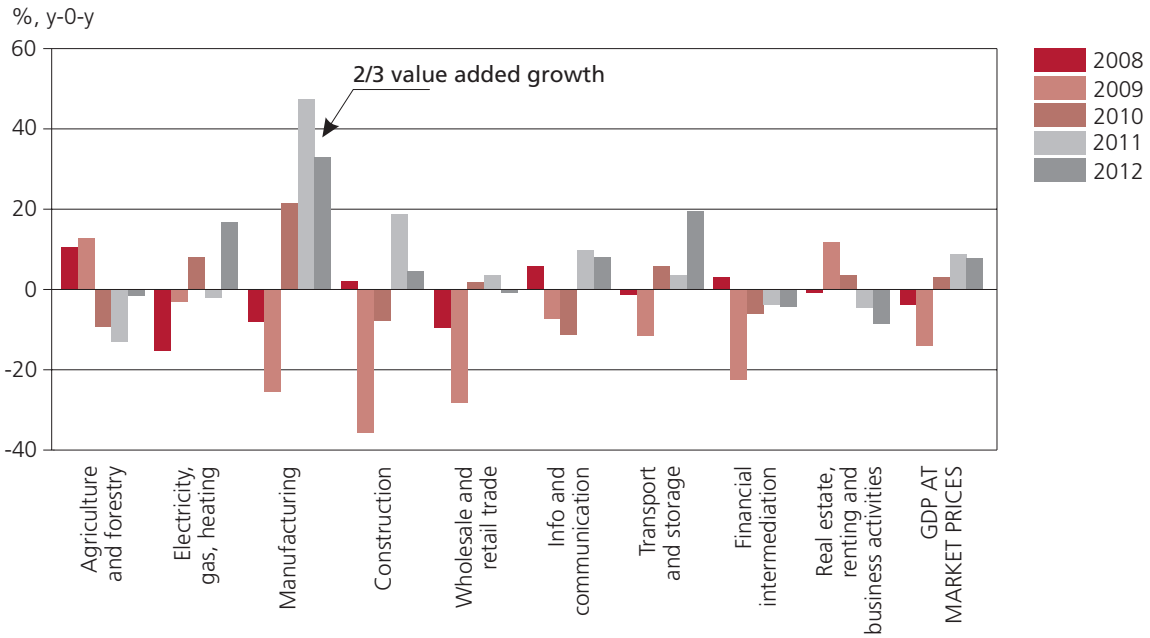
Statement to be tested: Framework conditions promote business investment in R&D, entrepreneurship and innovation

Leading questions:

- Policies to promote innovation, entrepreneurship and enhance the quality of the business environment are closely interconnected.

- Favorable conditions are in place to foster a growing and robust venture capital market, especially for early stage investments.
- Consistent with the Small Business Act for Europe, the rules for starting up and running a business are simple and designed from an SME perspective. The legal framework is transparent and up-to-date. Rules are properly enforced. Markets are dynamic and competitive. Willingness to take risks is promoted. Insolvency regulations support the financial reorganization of enterprises. There is no discrimination against entrepreneurs who may have failed the first time around.
- An efficient, affordable and effective system for the protection of intellectual property is in place, which fosters innovation and preserves investment incentives. The market for innovative products and services is kept constantly up to date by means of an efficient standard-setting system.

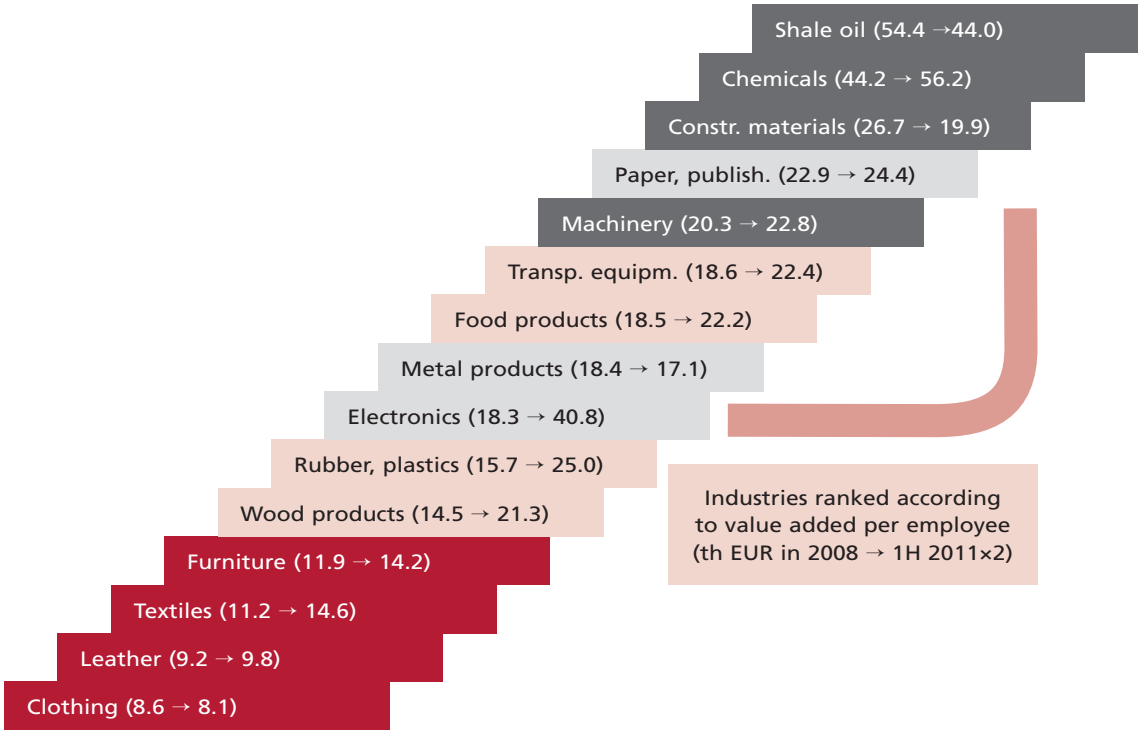
Annex 2 | Statistics on Estonian Industry sturcture and innovation performance[56]



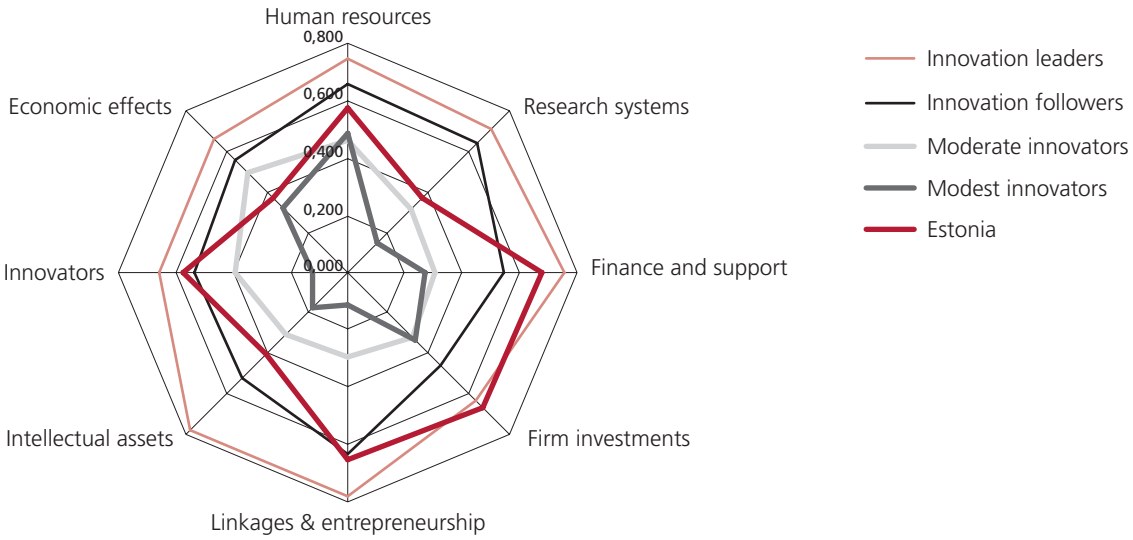
Development in sectoral GDP from 2008 to first two quarters of 2011
Source: Statistics Office of Estonia/MEAC

Development of real wages and productivity
Source: Statistical Office of Estonia/MEAC

56 Based on Eurostat and Statistics Office of Estonia (through MEAC), with contributions from Prof., Dr. Christian H.M. Ketels



"Productivity stairs" ranking Estonian manufacturing industries by value added per employee
Source: Statistics Office of Estonia/Eurostat/MEAC



Estonian profile on IUS Scoreboard 2011
Source MEAC/PRO INNO Europe

Value of Estonian Exports by industry cluster

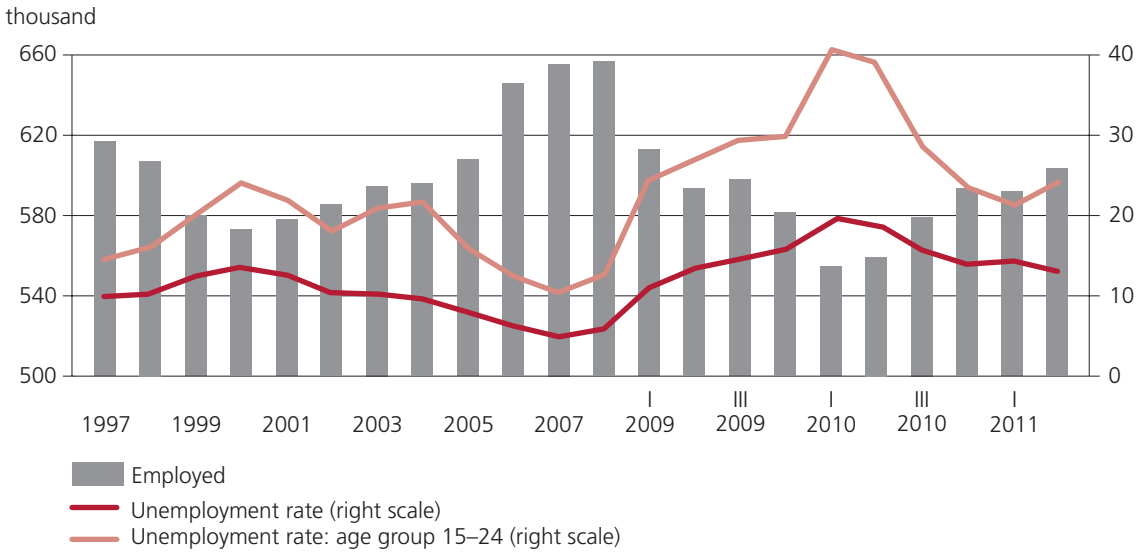
Source International Cluster Competitiveness Project/C.H.M Ketels

Exports Portfolio by Cluster, 1997–2007

Cluster	*Export Value (in EUR Thousands)*	*Share*	*Share Change*	*Begin Year*	*End Year*
Aerospace Engines	EUR 163	0.00%	0.00%	1997	2007
Tobacco	EUR 1.352	0.01%	-0.01%	1997	2007
Hospitality and Tourism	EUR 5.848	0.00%	0.00%	1997	2007
Jewelry, Precious Metals and Collectibles	EUR 7.904	0.00%	0.00%	1997	2007
Aerospace Vehicles and Defense	EUR 12.445	0.01%	0.01%	1997	2007
Biopharmaceuticals	EUR 30.925	0.01%	-0.03%	1997	2007
Entertainment and Reproduction Equipment	EUR 38.099	0.02%	-0.01%	1997	2007
Leather and Related Products	EUR 38.166	0.08%	0.02%	1997	2007
Marine Equipment	EUR 40.527	0.05%	0.03%	1997	2007
Coal and Briquettes	EUR 44.970	0.11%	0.04%	1997	2007
Footwear	EUR 45.156	0.08%	0.01%	1997	2007
Sporting, Recreational and Children's Goods	EUR 53.207	0.07%	0.03%	1997	2007
Medical Devices	EUR 59.901	0.04%	0.02%	1997	2007
Information Technology	EUR 78.368	0.01%	0.00%	1997	2007
Publishing and Printing	EUR 81.560	0.16%	0.12%	1997	2007
Fishing and Fishing Products	EUR 97.449	0.15%	-0.01%	1997	2007
Construction Materials	EUR 101.547	0.15%	0.06%	1997	2007
Financial Services	EUR 104.533	0.04%	0.02%	1997	2007
Power and Power Generation Equipment	EUR 128.795	0.18%	0.10%	1997	2007
Analytical Instruments	EUR 134.520	0.06%	0.03%	1997	2007
Chemical Products	EUR 138.737	0.03%	-0.01%	1997	2007
Construction Services	EUR 145.469	0.27%	0.12%	1997	2007
Textiles	EUR 148.870	0.08%	-0.01%	1997	2007
Heavy Machinery	EUR 157.064	0.08%	0.06%	1997	2007
Lighting and Electrical Equipment	EUR 158.324	0.10%	0.08%	1997	2007
Communications Services	EUR 195.177	0.13%	0.09%	1997	2007
Apparel	EUR 232.100	0.09%	-0.01%	1997	2007
Motor Driven Products	EUR 239.291	0.11%	0.08%	1997	2007
Production Technology	EUR 254.863	0.06%	0.04%	1997	2007
Processed Food	EUR 274.874	0.14%	-0.02%	1997	2007
Plastics	EUR 299.130	0.09%	0.04%	1997	2007
Building Fixtures and Equipment	EUR 299.187	0.20%	0.07%	1997	2007
Prefabricated Enclosures and Structures	EUR 334.318	0.44%	0.21%	1997	2007
Forest Products	EUR 344.957	0.22%	0.06%	1997	2007
Agricultural Products	EUR 398.649	0.08%	0.00%	1997	2007

Cluster	*Export Value (in EUR Thousands)*	*Share*	*Share Change*	*Begin Year*	*End Year*
Automotive	EUR 544.607	0.06%	0.02%	1997	2007
Metal Mining and Manufacturing	EUR 576.340	0.07%	0.03%	1997	2007
Communications Equipment	EUR 613.453	0.20%	0.06%	1997	2007
Business Services	EUR 640.356	0.11%	0.08%	1997	2007
Furniture	EUR 708.772	0.58%	0.34%	1997	2007
Oil and Gas Products	EUR 810.829	0.06%	0.03%	1997	2007
Transportation and Logistics	EUR 1.311.414	0.26%	0.04%	1997	2007

Source: Prof. Michael E. Porter, International Cluster Competitiveness Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Director.
Underlying data drawn from the UN Commodity Trade Statistics Database and the IMF BOP statistics.



Estonian labor market in terms of number of employed and unemployment rate
Source: Statistics Office of Estonia/Eurostat/MEAC

Global Competitiveness Index for Estonia and selected benchmark countries
Source Institute for Competitiveness and Strategy/C.H.M Ketels

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Constant Sample Start: 2010													
New Global Competitiveness Index (GCI)	**71**	**57**	**31**	**47**	**29**	**61**	**66**	**34**	**95**	**39**	**53**	**33**	**3**
Microeconomic Competitiveness (MICRO)	72	52	**32**	55	30	50	93	34	97	36	51	22	4
Macroeconomic Competitiveness (MACRO)	72	61	**30**	42	25	67	53	34	103	44	59	40	2
Social infrastructure and political institutions (SIPI)	65	56	**30**	48	28	62	63	35	101	40	66	43	2
Macroeconomic Policy (MP)	112	103	**34**	23	33	110	26	56	95	79	28	35	1
GDP per capita, ppp-adjusted (2008)	48	44	**41**	47	51	43	46	32	49	39	40	55	21
New Global Competitiveness Index (GCI)	**71**	**57**	**31**	**47**	**29**	**61**	**66**	**34**	**95**	**39**	**53**	**33**	**3**
Microeconomic Competitiveness (MICRO)	72	52	**32**	55	30	50	93	34	97	36	51	22	4
Company operations and strategy	74	43	**42**	57	36	63	100	27	91	37	54	23	6
Strategy and operational effectiveness	69	42	**44**	61	43	57	85	16	97	37	62	25	5
Firm-level technology absorption	90	52	**43**	95	40	65	97	7	118	30	56	28	11
Company spending on R&D	90	62	**41**	80	57	63	65	18	50	44	82	15	4
Nature of competitive advantage	50	47	**52**	55	73	70	62	8	95	43	99	37	5
Value chain breadth	80	33	**67**	50	44	49	108	24	106	54	59	22	8

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Capacity for innovation	55	47	**34**	54	59	41	67	7	38	39	73	23	5
Production process sophistication	70	55	**44**	56	37	57	89	22	100	35	32	31	5
Extent of marketing	71	43	**60**	61	29	51	89	31	85	36	44	28	26
Degree of customer orientation	71	32	**36**	56	49	92	94	35	131	50	96	16	18
Organizational practices	71	42	**30**	52	36	82	110	26	84	64	50	16	11
Extent of staff training	76	60	**51**	58	47	96	128	28	80	70	83	14	7
Willingness to delegate authority	78	46	**25**	43	64	112	104	30	102	77	81	18	7
Extent of incentive compensation	45	26	**20**	53	17	67	68	33	63	30	24	12	35
Reliance on professional management	80	51	**26**	66	29	64	123	21	92	73	45	22	6
Internationalization of firms	86	47	**58**	68	29	66	87	70	78	32	44	20	11
Prevalence of foreign technology licensing	84	65	**73**	97	41	56	59	57	104	15	38	30	17
Control of international distribution	94	34	**79**	72	39	93	106	62	92	61	120	12	24
Extent of regional sales	83	56	**40**	59	46	63	74	137	62	18	26	32	11
Breadth of international markets	92	44	**60**	47	9	50	123	12	51	52	34	19	13
National Business Environment	71	54	**32**	55	30	49	92	35	99	36	51	22	4
Factor (input) conditions	50	46	**27**	59	39	41	54	29	80	32	52	25	5

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Logistical infrastructure	48	40	**37**	98	31	52	49	42	83	23	63	21	6
Quality of roads	105	30	**43**	129	19	59	31	63	122	10	68	18	16
Quality of railroad infrastructure	34	28	**37**	75	84	44	57	65	30	25	24	19	8
Quality of port infrastructure	46	50	**20**	112	29	72	83	60	93	48	82	16	8
Quality of air transport infrastructure	45	115	**69**	110	31	64	70	41	103	47	128	26	17
Quality of electricity supply	51	39	**40**	61	36	38	56	37	80	28	27	43	5
Quality of domestic transport network: business													
Communications infrastructure	39	32	**19**	47	53	36	42	34	51	35	30	48	18
Quality of telephone infrastructure	58	16	**25**	69	17	14	68	6	111	24	23	65	9
Internet access in schools	31	26	**4**	49	46	29	43	37	55	23	38	35	3
Mobile telephone subscribers per 100 population	59	10	**2**	38	63	37	20	28	8	14	55	46	13
Personal computers per 100 population	34	39	**38**	48	54	37	45	41	59	46	18	42	24
Internet users per 100 population	29	35	**25**	36	68	33	44	43	53	47	21	39	9
Telephone lines per 100 population	46	57	**32**	51	62	42	24	19	39	30	68	80	49
Administrative infrastructure	51	70	**8**	81	49	32	65	86	124	39	55	27	6
(Low) Burden of customs procedures	69	36	**13**	60	7	59	68	90	129	30	66	35	4
(Low) Burden of government regulation	92	113	**10**	122	43	134	139	95	127	126	118	18	6

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Ease of starting a new business	74	104	**4**	78	90	35	34	107	127	85	32	15	8
(Low) Number of procedures required to start a business	23	57	**23**	34	88	14	57	23	88	34	34	88	6
(Low) Time required to start a business	61	84	**21**	98	86	6	75	102	93	13	61	39	52
Doing Business, Paying Taxes (Low) Payments number (WB)	8	34	**27**	97	27	39	50	83	32	12	77	34	12
Capital market infrastructure	95	83	**40**	52	31	65	92	20	116	37	69	12	5
Regulation of securities exchanges	99	50	**43**	32	88	48	83	21	106	24	95	15	3
Financial market sophistication	83	77	**33**	61	19	42	76	20	94	21	62	29	10
Soundness of banks	116	86	**79**	66	5	74	67	2	124	72	35	32	7
Ease of access to loans	126	110	**51**	70	22	89	94	54	99	55	59	10	3
Venture capital availability	105	111	**28**	80	35	114	108	10	90	46	81	9	2
Financing through local equity market	121	79	**61**	69	26	110	103	36	99	67	123	12	46
Protection of minority shareholders' interests	104	83	**58**	67	36	79	128	33	127	54	89	26	1
Doing Business, Getting Credit Legal rights index (WB)	6	75	**60**	6	86	39	60	6	103	103	6	1	39
Domestic credit to private sector	30	54	**29**	72	37	53	46	36	74	12	69	24	41
Innovation infrastructure	60	42	**31**	54	44	37	62	22	53	41	78	26	2
Quality of scientific research institutions	62	41	**25**	47	56	14	49	2	58	29	93	30	16
University-industry research collaboration	73	34	**37**	57	45	33	79	17	65	27	98	21	4

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Quality of the educational system													
Quality of math and science education	61	23	**24**	58	120	35	21	99	42	103	68	27	3
Quality of management schools	80	73	**43**	77	19	78	85	45	84	25	104	34	18
Availability of scientists and engineers	100	45	**54**	68	33	47	84	17	59	40	66	34	1
(Low) Brain drain													
Tertiary enrollment	18	11	**24**	21	40	22	48	28	12	34	38	73	2
Utility patents per million population	42	57	**40**	62	55	33	36	4	53	50	46	30	7
Demand conditions	75	51	**26**	63	33	56	87	46	78	29	68	28	5
Government procurement of advanced technology products	113	110	**32**	86	41	90	122	33	74	23	133	8	4
Government success in ICT promotion	84	30	**10**	85	29	79	93	44	96	16	100	21	26
Laws relating to ICT	82	37	**4**	85	33	55	76	54	84	11	72	28	3
Buyer sophistication	87	108	**79**	61	25	110	121	113	49	54	114	28	18
Presence of demanding regulatory standards	52	44	**30**	42	43	27	64	55	81	36	22	37	7
Stringency of environmental regulations	57	36	**23**	45	48	41	54	32	95	26	29	40	5

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Supporting and related industries and clusters	89	69	**61**	58	35	65	84	47	92	46	54	16	6
Availability of latest technologies	65	35	**33**	89	31	46	57	6	113	16	41	39	4
Local supplier quantity	132	37	**98**	18	60	68	103	25	96	39	29	21	85
Local supplier quality	53	40	**43**	45	29	62	79	21	110	48	49	32	19
Local availability of process machinery	77	78	**56**	30	36	51	72	55	59	45	71	16	6
Local availability of specialized research and training services	70	38	**32**	24	33	60	63	29	67	41	42	26	8
State of cluster development	101	114	**98**	109	37	102	105	91	83	58	57	16	7
Extent of collaboration in clusters	86	121	**80**	117	36	85	107	106	81	63	59	18	3
Extent of cluster policy													
Context for strategy and rivalry	69	66	**27**	49	19	40	121	30	119	56	37	29	12
Cooperation in labor-employer relations	86	70	**41**	97	40	76	134	19	120	107	73	16	14
Pay and productivity	37	18	**5**	55	46	56	98	19	52	106	17	7	64
FDI and technology transfer	91	39	**43**	44	22	15	109	60	124	14	6	19	95
Quality of competition in the ISP sector	33	67	**112**	11	94	77	45	117	53	92	106	29	132
(Low) Impact of taxation on incentives to work and invest	126	128	**32**	104	16	138	139	37	88	127	33	21	96
(Low) Distortive effect of taxes and subsidies on competition	77	100	**32**	60	6	117	133	62	114	106	131	67	21

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Intellectual property protection	63	70	**32**	60	61	47	65	49	114	39	58	34	1
Restrictions on capital flows	65	56	**16**	83	17	23	90	47	119	19	51	74	2
Strength of auditing and reporting standards	75	50	**34**	44	21	33	80	30	110	48	61	31	5
Prevalence of trade barriers	35	63	**22**	48	6	12	80	16	122	15	25	87	7
Prevalence of foreign ownership	70	94	**39**	99	9	14	105	46	127	75	4	55	30
Business impact of rules on FDI	104	117	**28**	101	11	48	136	68	120	58	26	32	31
Intensity of local competition	83	65	**31**	33	25	36	121	10	113	50	35	29	64
Effectiveness of antitrust policy	87	102	**46**	57	20	71	104	30	100	51	86	31	3
(Low) Extent of market dominance (by business groups)	82	108	**34**	41	81	57	120	117	83	106	52	25	27
Efficacy of corporate boards	80	55	**65**	84	28	83	133	61	110	99	41	17	7
Low market disruption from state-owned enterprises	98	57	**34**	39	26	41	132	16	119	122	105	59	2
Strength of investor protection	45	77	**45**	33	33	99	109	5	77	33	93	4	45
(Low) Rigidity of employment	110	90	**123**	64	42	58	121	37	90	110	58	18	104
Regulatory quality	33	34	**17**	36	14	29	52	30	110	32	28	64	6
(Low) Tariff rate	8	8	**8**	8	7	8	40	36	82	8	8	71	8
Social Infrastructure and Political Institutions (SIPI)	65	56	**30**	48	28	62	63	35	101	40	66	43	2

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Human development	54	49	**37**	48	52	43	39	24	70	27	40	46	6
Quality of primary education	49	40	**17**	46	116	57	39	78	63	62	58	25	1
Quality of healthcare services	75	72	**40**	114	66	79	57	25	110	39	69	28	7
Accessibility of healthcare services	82	59	**48**	90	86	42	44	31	91	30	39	34	5
Health expenditure	72	69	**92**	63	68	49	45	42	91	13	44	110	36
Life expectancy	78	83	**61**	47	31	61	42	10	99	27	52	53	23
(Low) Malaria incidence	1	1	**1**	1	1	1	1	1	1	1	1	85	1
(Low) Tuberculosis incidence	70	78	**60**	53	29	37	54	14	89	57	30	87	23
(Low) Infant mortality	44	37	**29**	36	42	35	32	20	60	11	38	39	7
Primary enrollment	88	77	**64**	51	62	94	87	35	85	12	78	44	45
Secondary enrollment	31	26	**25**	24	56	32	49	59	78	1	52	98	1
Political institutions	100	72	**28**	52	21	89	101	44	106	60	114	39	2
Effectiveness of law-making bodies	117	104	**39**	71	42	84	95	29	78	64	108	21	6
Public trust of politicians	121	114	**45**	76	28	132	90	39	67	66	133	35	12
(Low) Wastefulness of government spending	120	110	**40**	70	25	121	128	53	76	122	124	26	13
(Low) Favoritism in decisions of government officials	90	53	**31**	55	15	99	96	27	98	73	139	38	9

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Government effectiveness in reducing poverty and inequality	127	116	**65**	83	31	115	101	107	114	68	111	22	2
Transparency of government policymaking	85	49	**16**	93	12	89	79	120	104	74	99	39	7
Decentralization of economic policymaking	40	34	**10**	13	89	71	111	22	69	108	46	26	14
Freedom of the press	79	58	**35**	46	12	59	93	16	126	54	76	108	5
Voice and Accountability (WB)	40	36	**23**	29	34	30	46	43	114	18	37	99	7
Rule of law	64	55	**30**	50	24	66	75	34	122	43	82	48	2
Reliability of police services	76	77	**33**	62	5	69	58	91	128	39	93	51	1
(Low) Business costs of crime and violence	48	29	**38**	37	77	64	44	55	106	26	51	80	13
(Low impact of) Organized crime	45	29	**20**	46	62	66	77	58	118	26	86	72	13
Judicial independence	77	81	**28**	56	21	62	94	4	111	57	124	50	8
Efficiency of legal framework	125	81	**37**	92	22	99	127	51	113	120	138	27	3
Property rights	79	64	**34**	58	43	62	87	65	128	39	77	40	1
(Low occurrence of) Diversion of public funds	79	75	**36**	47	32	111	85	25	101	49	121	45	4
(Low occurrence of) Irregular payments by firms	79	49	**33**	41	26	59	77	13	103	36	75	51	4
(Low) Business costs of corruption	92	96	**32**	49	24	118	79	29	116	48	58	54	7
Ethical behavior of firms	93	71	**34**	58	19	116	78	23	112	50	107	42	4

	Latvia	*Lithuania*	**Estonia**	*Poland*	*Chile*	*Hungary*	*Croatia*	*Israel*	*Russian Federation*	*Portugal*	*Slovak Republic*	*Malaysia*	*Finland*
	LVA	*LTU*	**EST**	*POL*	*CHL*	*HUN*	*HRV*	*ISR*	*RUS*	*PRT*	*SVK*	*MYS*	*FIN*
	2010	*2010*	**2010**	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*	*2010*
Control of Corruption (WB)	48	51	**30**	42	21	44	61	35	131	26	47	62	5
Rule of Law (WB)	36	40	**26**	43	23	37	57	35	113	28	44	49	1
Macroeconomic Policy (MP)	112	103	**34**	23	33	110	26	56	95	79	28	35	1
Government surplus/deficit	117	116	**1**	1	1	97	1	79	1	122	99	112	1
Government debt	1	1	**1**	1	1	117	1	121	1	118	1	1	1
Inflation	99	89	**54**	45	53	72	48	41	123	1	1	1	1

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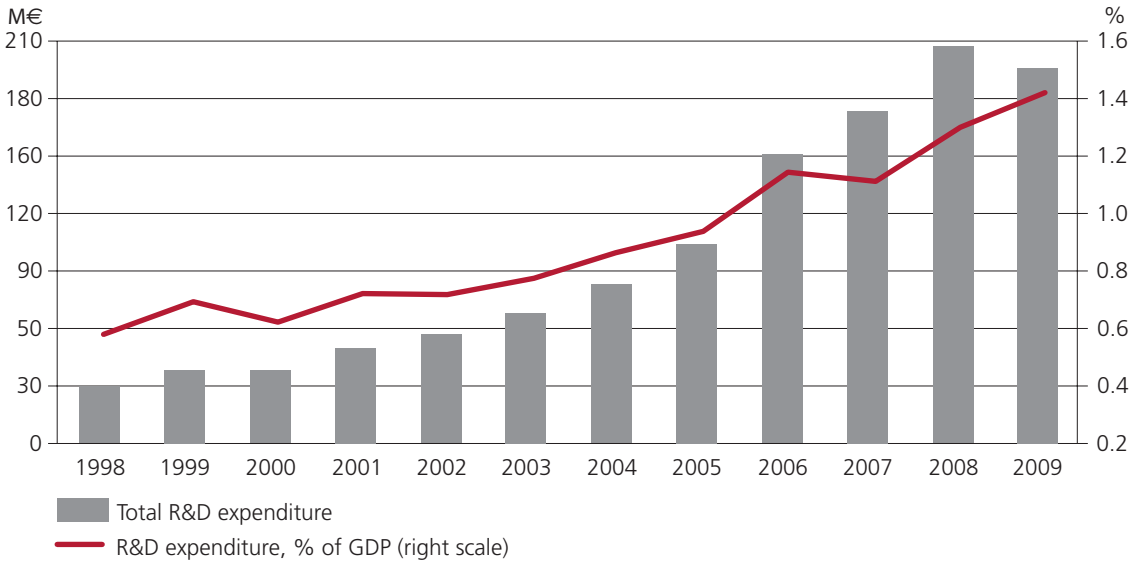
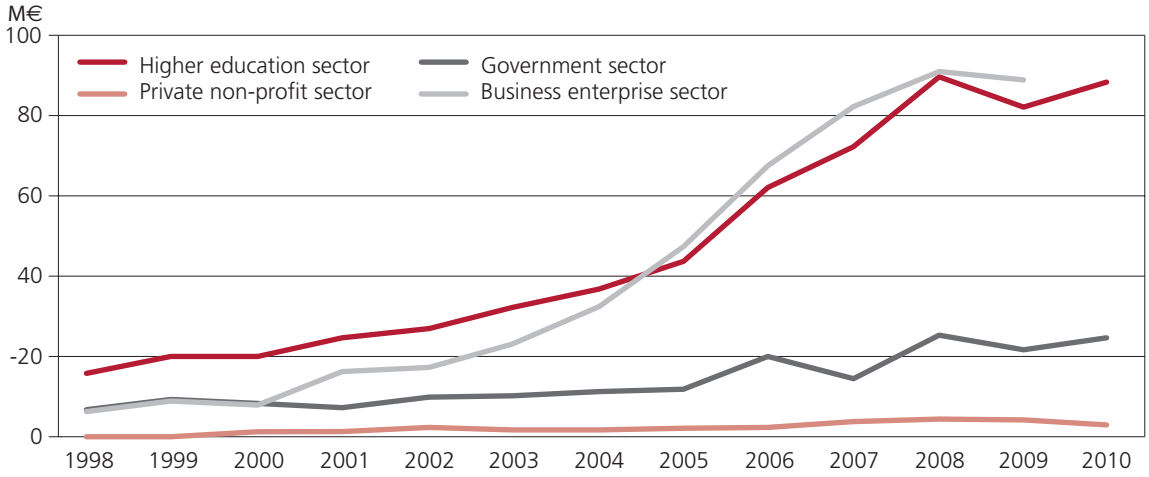
Annex 3 | 2011 Government budget allocations for RDI

RDI costs in state budget (Figures in M)
Source: Statistical Office of Estonia/MEAC

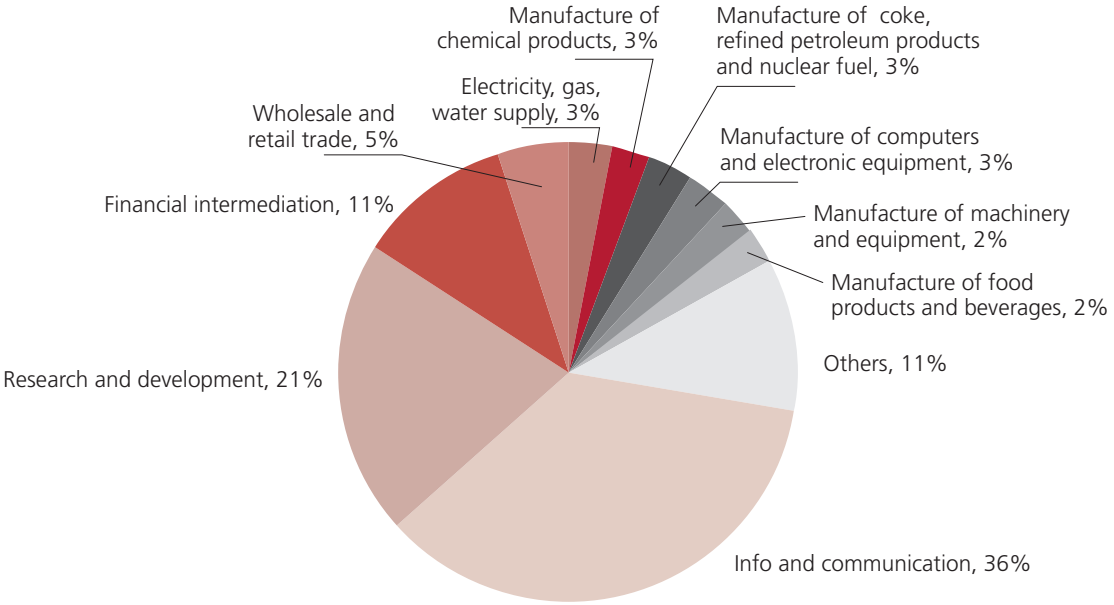
	2011	*2012*	*Change M€*	*Change %*
MER	134.9	135.5	0.6	0.4
MEAC	20.4	19.3	-1.0	-5.1
Other ministries	7.6	8.2	0.6	7.5
TOTAL	**162.8**	**163.0**	**0.1**	**0.1**
EU Structural funds	104.5	104.8	0.3	0.3
% of SF in total R&D	64.2	64.3		
GDP (Billions of €)	16.0	17.0		
RDI costs as % of GDP	1.0	1.0		



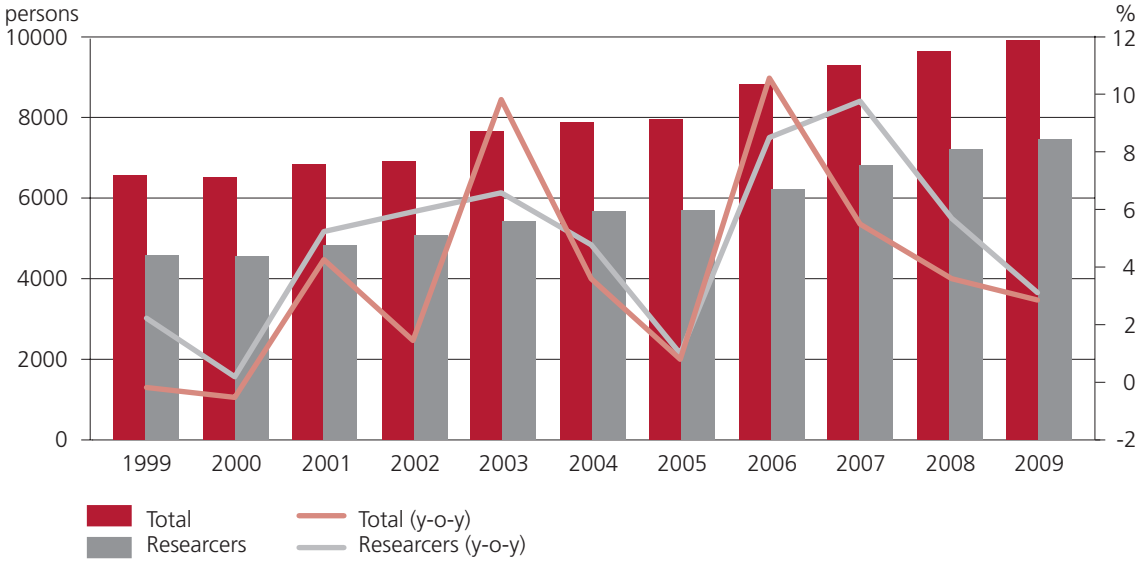
RDI Expenditure in Estonia in millions of Euros and as a fragment of GDP
Source: Statistical Office of Estonia/MEAC



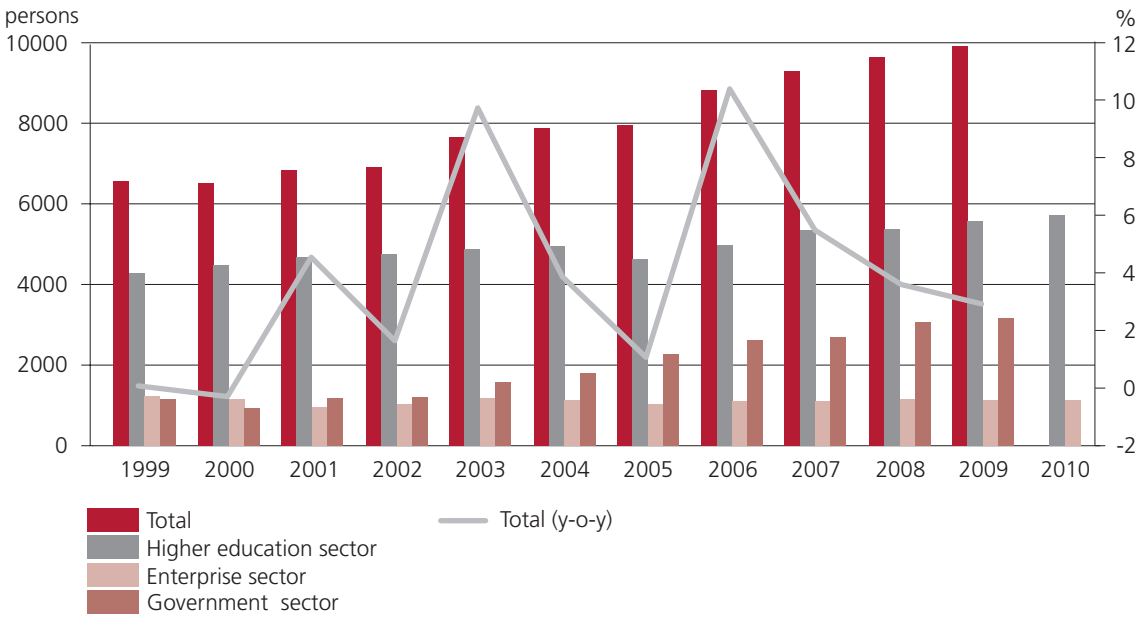
RDI Expenditure in Estonia in millions of Euros by sector
Source: Statistical Office of Estonia/MEAC



Fractions of intramural RDI expenses in business sector by activity
Source: Statistical Office of Estonia/MEAC



Number of employed RDI personnel and their share of the total workforce
Source: Statistical Office of Estonia/MEAC



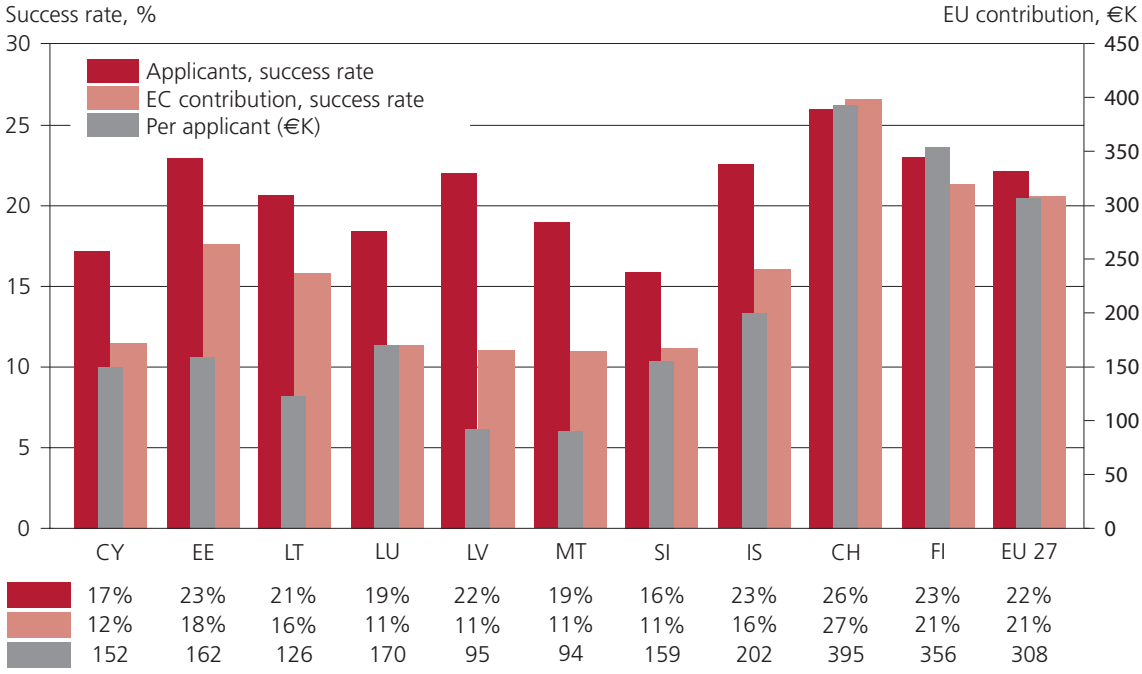
Number of employed RDI personnel by sectors and their share of the total workforce
Source: Statistical Office of Estonia/MEAC

Annex 4 | Estonian participation in EU Framework Programmes[57]

FP performance- impact on national R&D funding framework –mirroring of priorities?

Estonia is successfully participating in Framework programmes, having success rates over average and being one of the bests among new member states. In FP6 Estonia had the highest retour[58], exceeding twice the input. The **EC contribution per applicant** has been growing from programme to programme, but in FP7 it still remains at the level of ca 150 k€ (as the other NMS: CY, CZ, PL, HU, LT, EE, RO, BG, SK, SI, MT, LV +LU & IE) while for the best rewarded countries the EC contribution per applicant is at the level of 350–450 k€. The size of grant is also connected to the role of partner in project and the type of project.

	Contracts	*EU funding (MEEK)*	*Applications*	*Success rate*	*MEUR*
FP4 (1994–1998)	86	60.8	316	27%	3.9
FP5 (1998–2002)	216	300	809	26.80%	19.1
FP6 (2002–2006)	381	529	> 1150	(not available)	33.8
FP7 (2007–2010)	305	777	644	22.8% > EU27 21.8%) Financial 17.7%	50

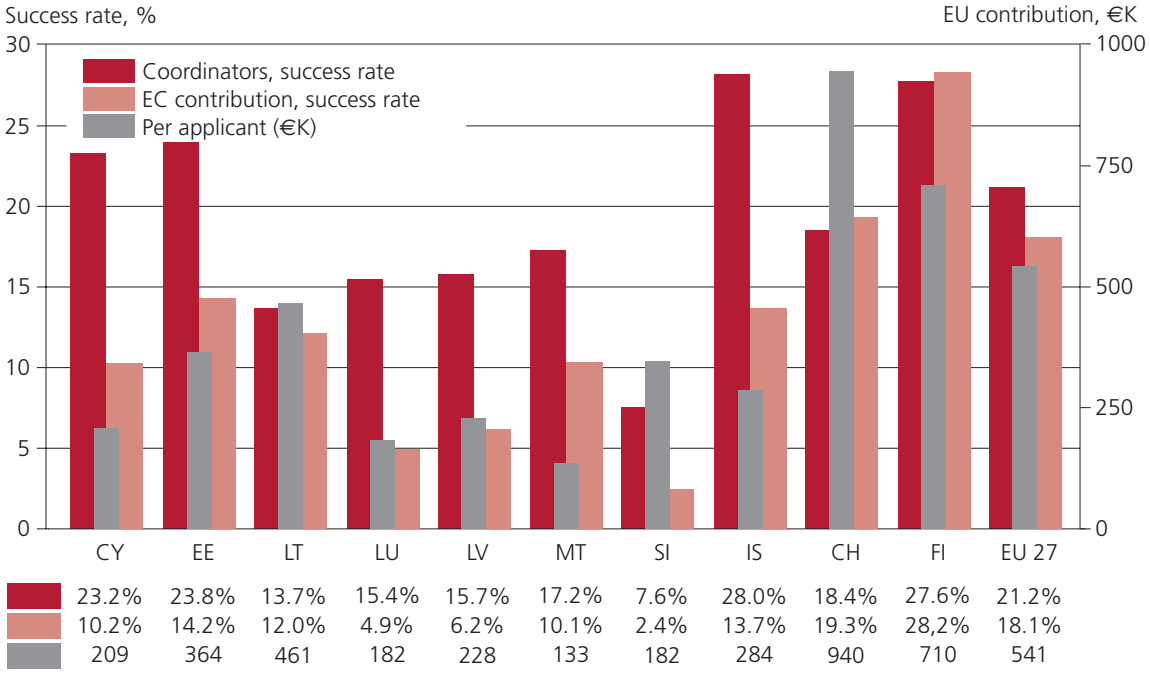


FP7 success rates and EU contribution 2007–2010

Source: European Commission (2011): Fourth FP7 Monitoring Report, MONITORING REPORT 2010, 4 August 2011

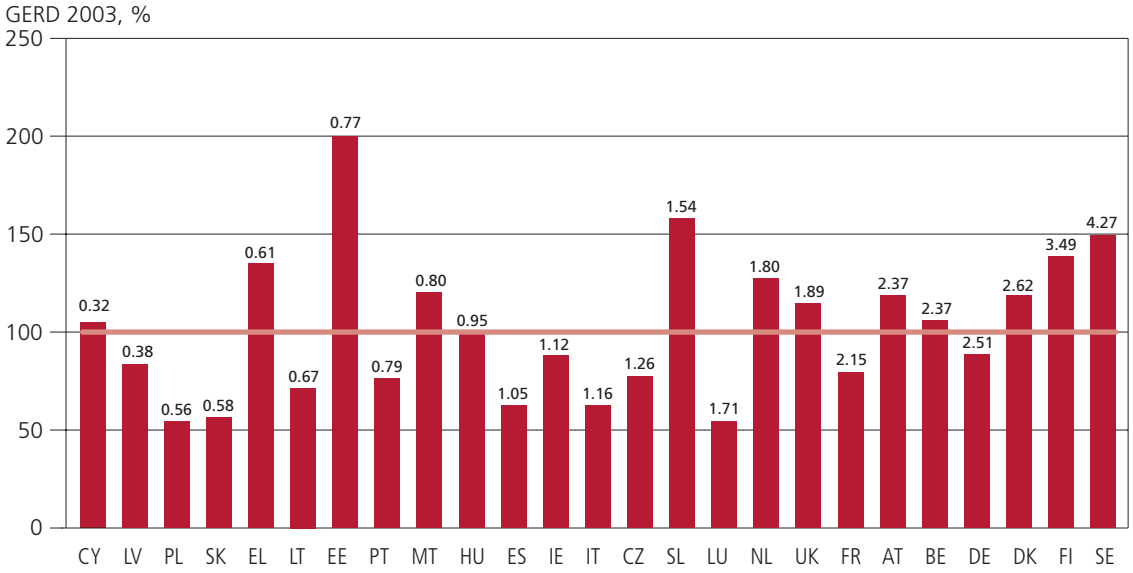
57 Source: Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group, November 2010, DG Research, European Commission/MER

58 Ex-post Evaluation of the Sixth Framework Programmes, Report of the Expert Group, fig. 6

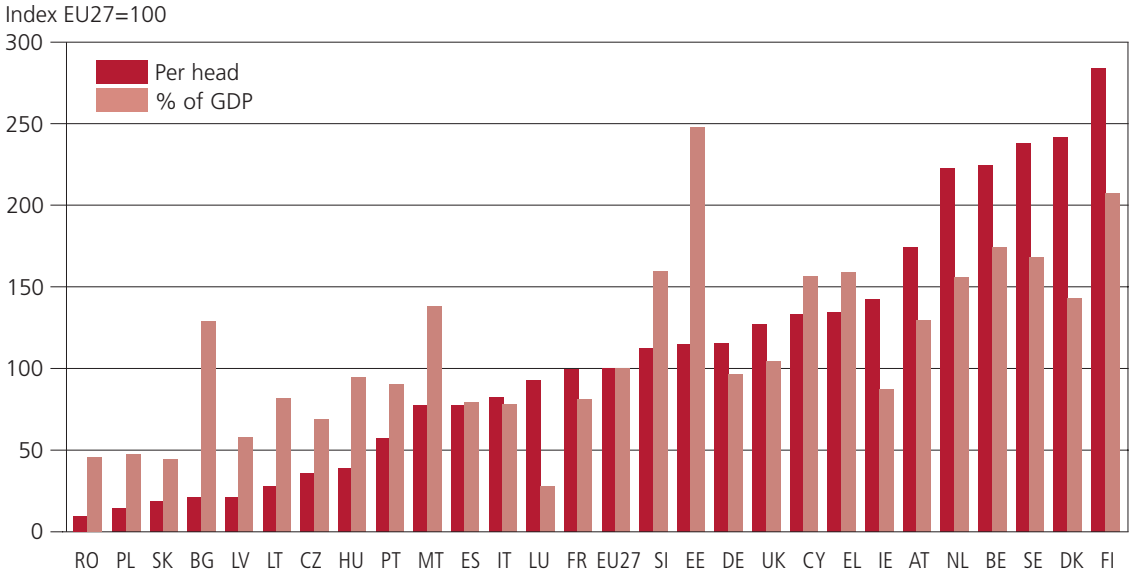


FP7 success rates and EU contribution in coordinated projects 2007–2010
Source: e-Corda, April 2011

Estonia has the highest rate of EC funding contribution to the retained projects in FP7 measured as a percentage of the national GDP and in FP6 measured as a ratio of % FP6 participation to the contribution to EU GDP (Figures bellow).



Retour in FP (ratio of % FP participation to % contribution to EU GDP) vs increasing Member State GERD level
Source: DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008



EU contribution to retained FP7 projects per head and as % of GDP, average 2007–2009 (EU27=100%)

Source: Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group, November 2010, DG Research, European Commission

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