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Innovation studies

Evaluation of Estonian RTDI Policy Mix

Toetab Euroopa Liit

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Eesti Riiklik Arengukava

10 | 2007

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Results of OMC Peer Review Report 2007
Country Report for Estonia

Reviewers:

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Foreword

The main objective of the Policy Mix Expert Group in the third cycle of the Open Method of Coordination (OMC) was to conduct a **peer review process** capable of acting as an instrument of **mutual learning**. The specific aim of the process was to help countries better understand the policy mixes needed to raise R&D intensity by improving overall innovation system performance.

The six countries volunteering to be reviewed during the third cycle were **Belgium**, **Estonia**, **France**, **Lithuania**, the **Netherlands** and the **UK**. The reviews were conducted by six teams, each composed of representatives from at least three 'examiner' countries, the European Commission and an independent consultant acting as moderator and rapporteur.

The six consultants involved were responsible for preparing **Background Reports** as an input to the review teams and, eventually, **Country Reports** reflecting the results of the peer review teams' discussions with senior policymakers and stakeholders in the review countries. These were then discussed in a series of meetings open to all members of the Policy Mix Expert Group in an effort to maximise mutual learning.

Finally, a separate **Synthesis Report** was prepared by another independent consultant (Ken Guy from Wise Guys Ltd) and presented to CREST.

Here is the country report for **Estonia** which summarizes the reflections of the experts who have reviewed Estonia in the context of the CREST Open Method of Coordination (OMC) Policy Mix exercise. The review was carried out from 11 to 12 June 2007 in Tallinn, organised by the Estonian Ministry of Economic Affairs and Communications.

This review report aims to provide a view on the achievements and challenges for Estonian RTDI policy against the background of the Lisbon 3% target and the ways to achieve it by improving the mix and coherence of RTDI policies and its articulation against each other. It provides a synthesis of the observations of the experts and – on the basis of a critical discussion of the current state – puts forward some recommendations for Estonian RTDI policy.

Estonian Ministry of Economic Affairs and Communications would like to express its gratitude to the examiners, independent consultant and EC observer for their time and effort participating in this exercise.

Division of Technology and Innovation
Estonian Ministry of Economic Affairs and Communications

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Kokkuvõte

OMC CREST-i näol on tegemist Euroopa Komisjoni poolt 2000. a. käivitatud algatusega. OMC (ehk *open method of coordination*) tähistab avatud koordinatsioonimeetodit, mida kasutatakse liikmesriikide poliitika vabatahtlikkuse alusel koordineerimiseks valdkondades, kus Euroopa Liidul puudub seadusandlik pädevus. Eesmärgiks on muuhulgas kaasa aidata liikmesriikide jõupingutustele Lissaboni reformikavade elluviimisel ning neis sätestatud eesmärkide saavutamisel (sh 3% liikmesriikide SKP-st teadus- ja arendustegevuse toetamiseks).

2007. a juunis osales Majandus- ja Kommunikatsiooniministeeriumi algatusel Eesti vabatahtlikult liikmesriikide teadus- ja arendustegevuse ning innovatsiooni (TA&I) poliitika ekspertide vahelises *peer review* protsessis, mille käigus viidi läbi Eesti TA&I poliitika analüüs ning tehti soovitused selle strateegilise suunitluse ja püstitatud eesmärkide parema saavutamise osas.

Eesti TA&I poliitika hindamises osalesid järgmised eksperdid:
- Wolfgang Polt, Joanneumi Tehnoloogia ja Regionaalpoliitika Instituut, Austria (ekspertgrupi juht)
- Per Koch, Norra Research Council
- Boris Pukl, Sloveenia Research Council
- Arjan M. Wolters, Hollandi Majandusministeerium
- Marta Truco, Euroopa Komisjoni DG Research (vaatlejana)

Uurimise keskmes olid järgmised teemad:
- Eesti TA&I süsteemi strateegiline suunitlus, sh eesmärgi "3% SKP-st TA-le" saavutatavus;
- Eesti TA süsteem ja selle koostöövõime ettevõtlussektoriga;
- Eesti ettevõtlussektori innovatsioonivõimekuse tõstmise võimalused;
- Eesti TA&I süsteemi juhtimine ja *policy learning*;
- Ekspertide järeldused ja ettepanekud.

Ekspertide peamised järeldused ja soovitused TA&I poliitika strateegiline suunitluse osas olid:
- Mitte keskenduda kitsalt 3% eesmärgi saavutamisele iga hinna eest – ettevõtete ja ka avaliku sektori poolne nõudlus ja rakendamissuutlikkus ei pruugi TA rahastamise sedavõrd hüppelise tõusuga toime tulla;
- Peamine eesmärk nõudluse suurendamine kvaliteetse TA järele.

TA ja ettevõtlussektori koostöö osas täheldati järgmist:
- Rohkem toetust ettevõtetepoolse TA&I suutlikkuse tõstmiseks (teadus- ja haridussüsteemi võtmeroll tööjõu koolitamisel), eriti traditsioonilistes sektorites.

Eesti TA&I süsteemi juhtimise ja *policy learning*'u osas olid jõuti järgmiste ettepanekuteni:
- Rakendussuutlikkus võib saada otsustavaks kavandatud poliitikameetmete õnnestumisel, eksisteerib arvestatav *policy failure* oht;
- Täheldatav on märkimisväärne vastuolu Eesti TA&I valdkonna eesmärkide ja reaalse institutsionaalse suutlikkuse vahel sätestatud eesmärkide saavutamiseks vajalikke tegevusi ette valmistada ja ellu viia;
- Soovitatakse loobuda ka analüüsi autorite endi poolt tehtud poliitikasoovitustest, kui riiklikult ei leita võimalusi olemasoleva TAI poliitikaga seotud inimressursi suurendamiseks.

1 Introduction

This report summarizes the reflections of the experts who have reviewed Estonia in the context of the CREST Open Method of Coordination (OMC) Policy Mix exercise. The expert review was conducted by the following experts:

Wolfgang Polt	Joanneum Research Ltd, Austria
Per Koch	Norwegian Research Council
Boris Pukl	Slovenian Research Agency
Arjan Wolters	Ministry of Economic Affairs, The Netherlands
Marta Truco	EC observer, DG Research

The review was carried out from 11 to 12 June 2007 in Tallinn, organised by the Estonian Ministry of Economic Affairs and Communications. In preparation of this meeting, an OMC Policy Review Background report (see Annex A) on the main features of the Estonian Research and Development and Innovation (RD&I) System was produced which provided information about the Science Base, Business RD&I, Economic and Market Developments, Human resources, the research, technology development and innovation (RTDI) policy system and its governance.

The review was carried out in the form of 3 Focus Groups, bringing together policy makers from different ministries and policy experts, people responsible for the implementation of policy from agencies, and addressees of policy from the business and academic communities. The first Focus Group was held jointly for a project on science, technology and innovation (STI) governance in Estonia carried out by Dr Katrin Männik from Technopolis Group. The participants of the Focus Groups and the Issue Papers drafted in preparation are documented in Annex B and C respectively.

In addition, a number of individual interviews with Estonian experts was carried out either face to face or via phone (see Annex D for a list of interviewees).

This review report aims to provide a view on the achievements and challenges for Estonian RTDI policy against the background of the 3% target and the ways to achieve it by improving the mix and coherence of RTDI policies and its articulation against each other. It provides a synthesis of the observations of the experts and – on the basis of a critical discussion of the current state – puts forward some recommendations for Estonian RTDI policy.

2 The Estonian R&D and Innovation System

Estonia is a small open economy with a population of some 1.3m people. Following independence in 1991, it has rapidly increased its GDP per capita. Growth rates have been consistently higher than the EU25 average (7.5% vs. 2.3% between 1995 and 2006). In most recent years, Estonia experienced the highest growth rates in Europe, exceeding 11% in 2006, thus mirroring those of some Asian countries.[1]

In this phase of rapid catching-up, differences in income and productivity levels with the EU average have shrunk, but are still considerable to date (39% of EU25 average). Estonia's state budget accrues a surplus and its unemployment levels are currently among the lowest in EU. The main forces behind the rapid catching-up the country has experienced in recent years are the establishment of a liberal market regime, the country's openness to international links and its business-friendly framework conditions (such as corporate tax regime, regulations etc.). These conditions have enabled a rapid re-structuring of the enterprise sector in the transformation period and have attracted considerable amounts of FDI (notably from neighbouring countries like Sweden and Finland, with which Estonia has cultural ties), which are among the highest in the industrialised world.

So far, the catching-up path of the Estonian economy is primarily based on the favourable business environment and low labour costs. Hence, the industrial structure of Estonia is to a large extent dominated by SMEs and sectors with low R&D intensity. Some of these sectors are well intertwined with their respective cluster-counterparts in Sweden and Finland (e.g. in wood/forestry and electronics clusters). In these clusters, the Estonian enterprises occupy the lower end of the value chain. This pattern is not going to change overnight nor can it be said to have reached its limits already. Examples of countries which have pursued a similar strategy for decades in the past (or at present) include Ireland and Austria. The difference between Estonia and these predecessors is probably in the time for which this development path is a viable one. In Estonia's case, we expect the period in which a further transition to a more knowledge-based (i.e. skill-intensive, R&D intensive, more innovative) economy should happen to be somewhat shorter, and sustained efforts in this direction are thus very timely and appropriate.

The (small) size of the country was more than once brought up in the discussions as a potential problem and obstacle for development, e.g. in the problems of creating critical mass, reaping the benefits of larger markets, etc. In our opinion, small size can also be an advantage: smaller economies also have smaller inertia and they can react faster to changes as well as adapt to the changing environments and new framework conditions. On the other hand, size might indeed be a problem, e.g. when it comes to the question of priority setting and policy design: while one would assume that the smaller the country, the more important it is to set priorities in order to reach critical mass, such policies might also be unnecessarily exclusive with regard to some parts of the innovation system. It might be reasonable for the RTDI policy – especially in view of the small size of the country – to employ mostly generic policy measures to ensure a general increase in RD&I capacities throughout the innovation system. This is especially true given the rapid structural change in industry which makes it hard to 'pick winners' or industrial sectors that should be favoured. The new national technology programmes especially should be reviewed in this light and not be confined to too narrowly defined technology areas. Rather, they should be linked much more with cluster initiatives and have significant non-R&D components.

As the competitiveness of Estonian enterprises today is mainly based on cost advantages and proximity to the neighbours, they occupy only the lower parts in the value-added chain. The industrial structure is very much geared towards sectors with comparatively low R&D intensity.

Through foreign direct investment and trade, Estonia is well linked to highly developed European economies and has come some way in restructuring its trade relations away from the countries of the former Soviet Union. Nevertheless, some of the legacies of this period still remain evident today and have an impact on the development of the Estonian innovation system, e.g. concerning energy supply.

While the transition process has been very successful, there are some imbalances in the growth trajectory which pose challenges for future development. These include the current account balance which is highly negative, labour market and skill shortages which lead to rapid increases in wages and erode the current basis for cost competitiveness.

[1] *See the Background Paper in Annex A for a more detailed account of the Estonian development.*

Estonia is classified in the European Innovation Scoreboard in the 'innovation trailing' group and only in the 'followers group' in the Global Innovation Scoreboard and has very low rankings and performance in terms of BERD, patents, life-long learning and other indicators.

In the years since independence, Estonia has successfully developed a number of institutions and instruments of RTDI policy through:

- the formulation of strategies for RTDI policy for the periods 2002–2006 and 2007–2013 respectively
- the rapid set-up of an RTDI policy system and related policy instruments which is modelled after European best practice examples (with Finland and Sweden being role models in many instances)
- the substantial increase in RD&I expenditures in absolute terms during recent years
- the successful implementation of e-government strategy which has brought Estonia to the top of the respective rankings of development of the information society.

The developments of Estonian RTDI policy have to be assessed quite favourably: Estonian RTDI policy has definitely been aimed at establishing a system based on international best practice examples. This process was supported by active policy learning from other countries and participation in EU policy discussions. A major role for policy formulation – as in other new member countries – was played by the Structural Funds, but was accompanied in Estonia (unlike the other countries) by the country's formulation of own relevant strategies.

Budgets for the RTDI policy that started out small have been growing rapidly in absolute terms. In terms of the share of R&D in GDP, the growth has been less then anticipated because Estonia's GDP also grew very rapidly. While publicc expenditures for HERD match the EU average, both GOVERD and BERD are well below this mark. This imbalance between the different R&D performing sectors was – and still is – a major concern for Estonian RTDI policy, which has tried to establish links between academia and industry through various measures in recent years.

These budget increases as well as the need to link to EU policy have put the Estonian RTDI policy system under considerable strain in terms of its capacity for policy formulation, policy coordination and policy implementation. Especially for policy implementation, some new institutions have been created. In these circumstances it is natural that policy governance is an issue.

At this moment, most of the institutions and instruments cannot be comprehensively assessed and evaluated because they have been created too recently. Where there are some evaluations (e.g. for the technology and knowledge transfer programme called SPINNO) the results were taken into account in this report. Otherwise, assessments given here are based on the experts' judgement and their individual backgrounds.

This report is organised along the lines of the major topics that came up during the review, the interviews and the discussions among the review team. They reflect in our opinion the major questions and challenges for Estonian RTDI policy in the coming years:

- **Strategic orientation** of Estonian RTDI policy: here our topics for discussion include the 3% target against the background of structural characteristics of the Estonian economy and whether Estonian RTDI policy should have an explicit high-tech orientation.
- The role of the **Science System and Industry-Science relations**: considerable attention and effort has been devoted to improving relations between industry and science in Estonia. Here we give a critical appraisal of these measures.
- Raising the **Innovation capacities in the enterprise sector**. Here we discuss how different barriers to innovation for Estonian firms (awareness, cooperation with research institutions, human resources, funding of RD&I can be tackled.
- **Governance and Policy learning** in Estonia: In times of rapid change (also institutional change), governance of the RTDI policy is a major issue. Here, we discuss how the setting for Estonian RTDI policy could be improved and greater policy coherence could be achieved.
- And finally, we propose some **adjustments and further developments in the policy mix** of Estonian RTDI policy and try to draw some **main conclusions**.

3 Commentary by the review team

3.1 Strategic Orientation of Estonian RTDI Policy

The 3% target
In its endeavours to achieve the Lisbon and Barcelona targets, the Estonian government has set ambitious targets for itself. E.g. the national RD&I strategy document '*Knowledge-based Estonia*' for the years of 2007–2013 asserts that the "target of 3% of GDP expenditures on R&D, as agreed in the Lisbon strategy, is planned to be achieved by 2014" (p. 15). However, the strategy is less clear on why a 3% objective makes sense in an Estonian context, or how Estonia is supposed to reach such a goal.

Given
- the experience of the previous period of the "Knowledge-Based Estonia" strategy (for the years of 2002–06) where the target could not be met despite a rather well-articulated STI policy,
- the current phase of rapid economic growth which renders any target of a quota/ratio doubtful and
- the current structures of industry with its dominance of less R&D intensive sectors, which are not likely to change overnight,

reaching the 3% target would imply a rather drastic structural change in the manufacturing industry, which, given today's situation, is not very likely to take place to the extent needed to arrive at a 'high-tech' industrial structure. Hence, the targets put forward in the strategy seem somewhat overambitious and should not be pursued at all costs. While it is certainly necessary to have ambitious targets and to further raise R&D and knowledge intensity substantially in the years to come with a view of fostering change of industrial structures in a more knowledge-based, skill-intensive and high-tech direction, it has to be remembered that this is an input (or cost) target. If not accompanied by sensible policy measures, there exists the risk of spending monies unwisely, i.e. not to the benefit of the Estonian innovation system.

In our view, Estonia would seem well on track towards a Knowledge-Based Economy (KBE) if the increases in R&D expenditure in absolute terms are sustained in the coming years. Moreover, we think that further increases in R&D funding, though a necessary ingredient in a comprehensive overall KBE strategy, are not the main obstacle for the current growth trajectory of Estonia nor the further development of the innovation system. More pressing and pertinent challenges for the near future seem to be in raising the innovation capabilities of enterprises in a broader way: encouraging SMEs to engage in innovation, raising the level of innovation in enterprises from predominantly incremental towards more strategic innovation on a broad basis, i.e. throughout all the branches of the economy.

High-tech orientation of RTDI policy
There is no optimal R&D investment rate that applies to all countries and all industries. The R&D investment needed in an industry is dependent on the competence needs of the companies found in that industry.

A skill-intensive, innovative company in a traditional sector can be just as good a contributor to a country's economic growth as a high-tech company, and will probably also contribute more to overall employment (both examples can be seen in the recent development in Estonia but also in other countries like Austria, Slovenia, Slovakia, etc). Given that Estonian industry is dominated by SME-s (which invest little in R&D in any country) which operate mainly in the so-called low-tech branches, one cannot benchmark Estonia against countries like Sweden or Finland. Sweden and Finland have several large high-tech companies (Nokia, Ericsson, etc.) which Estonia lacks. These companies provide a significant part of the national R&D investments of these countries.

As far as we can see, there is a need for a coherent discussion on the relationship between the future development of Estonian industry and the needs for R&D within industry and in the knowledge institutions. This discussion should not be misled by the dichotomy between high-tech and low-tech industries. The term "high-tech" denotes a company that invests more than 4% of its turn-over in R&D. It is essentially an R&D indicator. Given that companies can be knowledge-based, innovative and profitable without these levels of R&D investments, the development of high-tech industries cannot be put up as a political goal in its own right.

Relevant Estonian business areas that could benefit from such incremental and knowledge-intensive innovation could for instance be food production, textile production, building materials, pulp and paper, furniture, manufacturing and electronics. The strong growth of the Estonian service sector indicates a need for a more systematic approach towards this heterogeneous part of the economy, including tourism (which is the only sector where there is an explicit sectoral policy), health and social work and financial services.

If Estonia decides (like Finland before it) to focus on the development of high-tech companies, that decision should be based on a thorough analysis of the competences available in today's companies and the challenges Estonian industry will face in the future. If there is reason to believe that some of the present industries have no viable future due to comparative advantages of other countries, it would make sense to see if the competences found in those industries can be used for new activities, including high-tech industries.

Estonian policy makers do, for obvious reasons, like to compare their country to their Nordic neighbours. If they find that the present industrial structure is not sustainable, it would make sense to take a closer look at the paths followed by Ireland and Singapore and try to attract or develop more high-tech companies. These companies can, under the right circumstances, become economic and technological "locomotives", pulling the rest of the economy behind them – just like the US has done for Canada, Germany has done for Austria and UK has done for Ireland for quite some time in post-war history. In this context the 3% objective makes sense.

Societal goals and RTDI policy

Though the necessity to link R&D policy to industrial policy cannot be overemphasised in the Estonian case, RTDI policy is not tantamount to these policy areas. Societal goals are expressed in other policy arenas and need to be articulated with RTDI policy. From our review we gathered the impression that articulation of this kind is still very weak in Estonia and policy coordination between the relevant ministries is underdeveloped.

Several examples of societal needs that require specific R&D approaches have been given:[2]

- Research and education in the field of health care and social needs can lead to the improved well-being of Estonian citizens and increase the capability of the population to remain in productive employment for a longer period of time as a solution for mitigating Estonia's demographic processes.
- Energy resources are another area where research is required to safeguard future interests of the society. In Estonia, the resources for oil-shale energy production are being gradually exhausted.
- Finally, in an uncertain global environment, Estonia has to maintain a capacity to protect its citizens and interests within the common security policy of the EU (p. 30).

None of these priorities are industrial priorities only, but all of them can be integrated with policies for developing specific clusters.

3.2 The role of the science system and science-industry relations

With respect to its public science system, Estonia faces problems that many small transition economies have faced or are still facing: a relatively large university system that (also as a part of the legacy of the former system) is quite disconnected from the enterprise sector.

Thus, it should not come as a surprise that it has been often stated that one of the main challenges if not THE main challenge of the Estonian innovation system is to bridge the gap between academia and business, or the science system and the system of industrial production.

Currently, cooperation between universities and the business sector in innovation is at a low level, as is the share of academic science in industry. In part, this might reflect the heritage of the old academic system and earlier prevailing attitudes (the former Academy of Science Institutes having been incorporated into the universities in the 1990-s). While the Estonian system of higher education is undergoing rapid changes (e.g. in the speedy introduction of the Bologna principles), there remain problems in aligning the university and educational system with other parts of the innovation system.

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2 *Evaluation of the design and implementation of Estonian RTDI policy: implications for policy planning:* Ministry of Economic Affairs and Communications of the Republic of Estiona/Technopolis Consulting Group Belgium, Tallinn 2006.

Though we recognize that this is indeed a major problem in Estonia (as in almost any catching-up economy), we would warn against too high expectations with respect to the scope and impacts such policies can have given the background of the current industrial structure and the stage of economic development: companies are still relatively young and their competitive advantages build on areas other than high quality or R&D (e.g. they'll need to employ qualified engineers and researchers before starting any in-house or collaborative R&D).

In our discussions we found greatly varying views and opinions and certainly not a common view among Estonian RTDI policy makers regarding the role the science system can play. While some are advocating an orientation of the science system towards ties to international science and focusing purely on excellence, others are seeking possibilities for stronger connections between the science system and the system of industrial production. Apparently the specialisation patterns of Estonian science and enterprises do not match easily. Size is a problem here, as demonstrated by the fact that Estonia can only have a limited number of competent research groups (the country has a total of some 4000 researchers), as is the specialisation of Estonian industry.

We heard some Estonian policy makers argue that given the lack of R&D absorbing capacity in firms and the lack of conformity between industrial structure and university orientation, universities should focus on the needs of the global society instead. This argument must be based on the idea that R&D is an objective in and for itself and not the means for achieving a goal. Although we do understand the need for all countries to contribute to the solution of global problems, we would argue that Estonia has not reached a stage where it can afford to fund extensive public research that does not focus on Estonia's own needs, be they social, cultural, environmental, industrial or economical. A typology of objectives of this sort is provided in the new RD&I strategy. We consider it of paramount importance to make sure that the university sector works in cooperation with the rest of society in these areas.

Initiatives in this vein could be:

- An increased focus on the development of competences needed in industry in existing university units. This should be done by increasing the number of new students and graduates, but should not limit the scope of the number of major competence areas which the universities follow and develop.
- The establishment of independent, non-profit research institutes targeting the relevant section of industry might be an option for the future, depending and based on the current Competence Centre Programme out of which such institutions might emerge. The advantage of such institutions is that they tend to be more market oriented and more sensitive to the practical short term needs of industry.
- A stronger orientation of public R&D programs towards industry needs. A preference should be given to the re-orientation and bolstering of existing programmes over establishing new ones. At the moment there are not many companies that can take part in (or contribute funding to) such R&D projects
- but that will change over time as the competition in the market and mergers and acquisition probably bring in larger companies with more "R&D clout."
- The role of research as a learning tool for students is probably just as important as its capacity to generate new ideas and inventions to be used by industry today. Given that Estonian industry demonstrates only a limited ability to make use of university research at the moment, it is probably wiser to use the university system to develop human resources needed in the future.
- However, there is also room for improvement of the quality of the Estonian university and college education which should be research-based, as a good supply of R&D trained candidates will increase the R&D absorbing capacities of Estonian firms in the future. There is a need for specific measures to support small R&D groups and the development of human resources and to stimulate and attract prominent Estonian scientists from abroad to return. The first measures have been taken (human mobility programme is about to be implemented), but do not seem sufficient and in general it might be said that there is still a lack of synergy between science and industry policy.

On the basis of our discussions it is safe to conclude that there is still a huge gap between the science and business sectors and it is likely to persist for a number of years. If there are new policy measures to be introduced to further decrease this gap, they should primarily address the entry barrier of most enterprises to engage in such collaborations and especially the capacities of SME-s to engage in R&D (such as vouchers for SME-s, human mobility programmes, etc.).

3.3 Raising the innovative capacity of Estonian firms

Estonian enterprises, mostly SME-s, belong to traditional sectors and industries. There is a small number of R&D performing enterprises in Estonia and correspondingly the percentage of high-tech companies in the value added sector and exports in traditional sector is also low. On the other hand, the share of innovative SME-s is quite high, especially in the service sector, even in international comparison. The growth rate of the export of innovative companies is 20–25%. In general, high-tech exports are also growing rapidly (albeit starting from a very low level). Only a small number of companies perform R&D activities, but it seems that the number of such companies is increasing fast. The number of patents issued for industry is small. The low availability of skilled labour is certainly a problem, as there is a lack of qualified labour at all levels. Currently this labour shortage is caused by the very rapid growth of the Estonian economy, but the shortage in supply of high quality labour is not likely to disappear even with lower growth rates given the fact that a relatively small percentage of students obtaining higher education enrol in science and engineering studies.

Generally, there is wide-spread agreement that raising the innovative capacity of enterprises should be a prime policy concern of Estonian RTDI policy. Yet from what we see in the figures (e.g. from the most recent EU Community Innovation Survey), there seems to be very little public support for private innovation. Public funding seems to be still very much geared towards R&D (and the science system). In our view, it is definitely necessary to better tailor the policy measures to this end. We will now propose a few measures which we consider especially pertinent to the Estonian situation.

Given the present challenges for Estonian industry and services, we think that government should focus on the following dimensions in the coming years:

Human capital and entrepreneurial qualities
Human capital is an important bottleneck for creating a knowledge based economy in Estonia. The problem seems to be manifold:

- the number of science and engineering graduates is low and the age pyramid of researchers is strongly skewed towards the older cohorts, and
- the quality level of graduates is threatened by the fact that students quite often start working before finishing their studies, while
- life long learning is at a very low level, i.e. there are few measures for promoting vocational training in place.

We doubt whether there are sufficient policy measures in place as of yet. The human mobility programme to be launched in 2008 is a step in the right direction, but it will only cover a smallish number of people. In our view, these arrangements have to be accompanied by measures that make it financially attractive for both employers and employees to invest in education. It is certain that during the period of fast economic growth and labour shortage firms will not be very willing to let people spend time on education. Fiscal measures to promote life long learning might be a way to address the issue. We would strongly encourage a discussion on this subject to be initiated in Estonia, despite the obstacles and difficulties of such a measure given the current (simple and low) overall tax regime in Estonia.

Creating innovation awareness and stakeholder involvement
Well educated staff is a necessary precondition (but not one sufficient in itself) for companies to be aware of the need to innovate. More definitely needs to be done in this field. The **Dutch Syntens** may be an example on how to create awareness, although this organisation is increasingly concentrating its efforts on SME-s already willing to innovate (i.e. already aware of the need to innovate). Syntens operates from a number of regional offices, offering technological services (problem identification, partnersearch) to SME-s to a maximum of two days a year per SME. Its focus is mainly technological and Syntens mostly employs engineers. For Estonia it might be worth considering applying a similar measure with a specific emphasis on SME-s in the service sector.

Currently, business enterprises and trade associations are much more concerned with other questions, e.g. with labour markets and environmental regulation, etc. The Ministry of Economic Affairs and Communications is well aware of the problem and is preparing various initiatives to support and stimulate the dialogue between different stakeholders, including good practice initiatives and guidelines for stakeholder involvement. For the time being, however, there seems to be little responsiveness from the side of the business and sector level associations. We consider this to be probably a transitory problem: once there are more R&D intensive and innovative enterprises, this will be reflected in the stance of the trade associations. Yet, sector-based trade associations should be ascribed an important role, especially in cluster related policies.

Increasing the accessibility of research institutes and universities
A number of programmes already exist in Estonia for increasing interaction between the public research system and the enterprise sector, e.g. the Competence Centre Programme and the SPINNO programme. The total funding of the programmes has been about 13 million Euros over the past three years, which is a considerable sum in the Estonian context. The impact of SPINNO has been evaluated quite favourably, but it is too early to evaluate the success of the Competence Centre Programme.

However, neither measure would reach SME-s that have not already built up a critical mass of R&D capacities or do not engage regularly in innovation. To reach out towards the majority of SME-s, additional measures might be needed to create more demand for research among companies and to stimulate R&D institutions to address these demands. One way to create such a demand is a voucher system similar to the one used in the Netherlands over the past three years and either under implementation or discussion in a number of other countries (e.g. Austria, Ireland). The voucher addresses both issues: it stimulates SME-s to approach research institutes and it gives research institutes a financial interest in performing R&D on behalf of SME-s.

The Dutch voucher system was introduced in three stages. First there were three pilot projects before the system was introduced on a large scale in 2006. Over the years, changes have been made in the structure of the voucher system.

The pilots were extensively – and favourably – evaluated. Additionality with regard to collaboration with universities and research organisations could be demonstrated. However, there were no signs that this collaboration went on afterwards (without the voucher system) once the original research question was addressed. The number of vouchers issued but not capitalized grew as the numbers of vouchers available increased. Whether the voucher system changed the attitude of universities and research institutes towards SME-s is not yet clear. A new evaluation is planned for the end of this year.

We strongly recommend establishment of such a system, taking into account the experiences of other countries (notable the Netherlands, but also other countries which are implementing variations of the system) in Estonia as a means to address SME-s hitherto not being reached by the policy measures for fostering interaction between industry and science.

Stimulating private R&D on a broad basis
Currently, the public funding for private R&D (18.4 million Euros in five years) is provided by direct support. Estonia has no tax credit scheme to stimulate R&D by companies. Although seemingly at odds with the simple and transparent Estonian tax system, such a scheme might be considered as an option for the future. **The Dutch WBSO** might serve as a successful example, but other countries have also used similar schemes (France, Norway). The Promotion of Research and Development Act in the Netherlands (WBSO) took effect in 1994. The WBSO provides for a fiscal facility that reduces wage costs for R&D employees by reducing wage tax and social insurance contributions [3]. The condition is that these employees should work on technological R&D activities aimed at the development of products, processes and software that are new to the company. The WBSO also provides for extra incentives for high-tech start-ups to conduct R&D. One of the main advantages WBSO over a R&D subsidy is its simplicity. Implementation costs of WBSO are about half of those for subsidy schemes, while at the same time a tax reduction targeted towards R&D is more efficient in promoting R&D than a general tax cut for firms. The WBSO has been thoroughly evaluated. It has proven to be effective while every Euro of tax reduction results in an increase of expenditures of more than 1 Euro.

Another example of this type is the **Norwegian Scheme 'SkatteFunn'**, which is a measure that gives tax allowances for investments in R&D. 20% of expenses for R&D projects in SMEs, and 18% in large companies, can be deducted. The basis for deduction is R&D expenses of up to NOK 4m (approximately EUR 530,000) for internal projects, and another NOK 4m for co-operative projects (or NOK 8m for co-operative projects alone). The R&D projects should aim at generating new knowledge, information or experience which is of value to the development of new products, services or production processes. This measure has become a successful one among Norwegian companies. The results from an evaluation are expected by the end of the year.

[3] The scheme also applies to the self-employed persons involved in R&D-activities, in which case the settlement takes place via income tax. The analyses presented in this study relate only to companies, and not to the self-employed.

Given that the RD&I strategy „Knowledge-Based Estonia" suggests the introduction of such a measure, we encourage policy makers in Estonia to open a discussion on the issue to explore the feasibility – based on the growing experiences of other countries. One of the advantages of this kind of public support to private R&D would be that there is no administrative effort involved and it would put no further strain on the Estonian RTDI policy system.

Cluster oriented policy
We would recommend that a plan be devised for the development of the knowledge bases for industries of special importance to the Estonian economy. We are not advocating subsidizing individual companies, but rather creating strategies for strengthening the development of industrial clusters (networks of companies, suppliers, customers, service providers and knowledge institutions involved in the same value chain of production). In this regard we are in accord with the 2006 EU Trend Chart Report on Estonia, where Erik Terk and Andres Viia list "Lack of focus of innovation policy in terms of clusters and high-potential (key) areas on the implementation level" as a major weakness in their innovation governance SWOT review. [4]

Such a set of priorities would not necessarily conflict with Estonia's current prioritization of ICT, biotechnology and materials, as these are generic knowledge areas that might be of use to many of the existing industries. There might be conflicts though, if technology areas for the the technology programmes were defined too narrowly and only with a view to technology.

One way of identifying such clusters and their competence needs would be to arrange a national foresight study involving policy makers, researchers and experts and industry representatives, but with a broader remit than just looking into the future avenues of scientific and technological development with the aim of defining R&D priorities. Rather, such strategies must take into consideration all of the various types of knowledge. Alternatively, thought should be given to industry roadmaps under the planned cluster programme.

3.4 Governance and policy learning

The RTDI policy system in Estonia has had a remarkably positive effect in recent years (compared to problems and challenges faced in other countries) and has deservedly been assessed quite favourably in international comparison. Having read relevant background documents and discussed innovation policy concepts with Estonian civil servants and policy makers, it is clear to this group that Estonian policy competences in this area are among the most advanced in Europe. Estonian policy makers have taken the 'systemic approach' to RTDI policy as the main frame of reference in a much more concise way than those of many old member states.

On the other hand, we think that many measures still start from the R&D end of the policy spectrum, although the national strategy documents for 2002–06 and 2007–13 had/have a broader view of innovation. We suspect that this problem has been partly caused by the fact that the process of policy learning was based on examples from the most advanced concepts of RTDI policy systems.

As evaluations have demonstrated and as was also stated by many people concerned with RTDI policy in Estonia, it seems that the institutional setting is (still) not ready for the new strategy. This implies that the Estonian government will have to rethink and re-examine the role of individual institutions, in particular the ministries and governmental agencies, as well as various bodies and committees in the governance of national innovation system.

On the other hand, "third generation" broad-based and holistic innovation policy initiatives have not been implemented elsewhere in Europe. Thus, the situation in Estonia is not better or worse than in most other countries. Though policy coordination definitely is an issue, it might be more important for Estonia to further develop and improve its "second generation" policies than venture into extremely time consuming policy processes, attempting to coordinate the activities of a large number of ministries.

Having said that, we still see room for improvement of the Estonian RTDI policy system in following areas:
- The improvement of articulation between (higher) education, science, technology and enterprise policies.
- The policy system is under strain in terms of implementation capacity: one of the main reasons for the establishment of technology and/or cluster programmes.

[4] European Trend Chart *Innovation Annual Innovation Policy Trends and Appraisal Report Estonia 2006*, p. 22, www.trendchart.org.

With regard to the issue of governance, the coordination between individual stakeholders, in particular between ministries, seems to be the main problem. This problem was partly tackled with the introduction and implementation of the Structural Funds. In the opinion of some of the participants in the panel, it seems that there are improvements with regard to the communication between ministries. It appears that cooperation between the two most important ministries with regard to the implementation of the activities, the Ministry of Education and Research and the Ministry of Economic Affairs and Communications is improving. However, the problem of how to engage other ministries and secure their more active involvement in the governance of the national innovation system in Estonia, remains.

In this vein, the governance vehicle of the Estonian R&D Council does not seem to fulfil the expectations concerning it. One reason for this could be that the main part of policy formulation is still carried out in the two separate sub-committees for R&D policy and innovation policy respectively. Another reason is definitely to be found in the under-staffing of the Council. Similar institutions in other countries enjoy greater capacity and are hence more capable of pro-active formulation of policies.

- An attempt to re-invigorate the R&D Council as a true instrument of policy co-ordination and governance might include both a significant increase in the capacities of the secretariat as well as a dissolution/merger of the two sub-committees.

It is also important to decide how other ministries can be included in the process of design and implementation of the RD&I strategy. Creating demand for research and innovation support services and creating favourable environments is certainly very important. Defining public demand for R&D (mission, societal objectives) and increasing the capacities of ministries to this end could be steps in this direction.

In this respect, it might be worthwhile to consider the formulation of the topics of the national technology programmes not with respect to technological areas only, but rather to seek topics with a broader societal remit and then address these challenges with mission oriented programmes that encompass R&D, but go well beyond R&D and include diffusion and innovation-oriented measures, etc.

It is equally important to address the problem of insufficient institutional capacities in the responsible ministries and implementation agencies. While the budget for key activities has increased manifold during recent years and the number of policy measures and instruments has risen considerably, the number of civil servants to administrate and manage these increased funds and policy initiatives has remained practically unchanged.

4 Major lessons for Estonian RTDI policy

Strategic orientation of RTDI policy

Estonia has rapidly increased its R&D spending in recent years and has set very high targets for the mid-term future. On the other hand, R&D intensity has only been slowly increasing and Estonia still trails in many innovation-related indicators. While we think that Estonian RTDI policy makers should carefully watch the developments of these indicators, we do not consider this a major cause for concern for Estonia, given the flaws of the synthetic indicator SII which is especially bad in reflecting the developments of catching-up economies and the overall development of the Estonian innovation system. Generally, we think that some of the problems Estonia is currently facing are quite typical for a country undergoing a rapid catching-up process.

Thus, though we think that the strategy 'Knowledge-based Estonia' rightly puts an emphasis on the need to increase R&D spending substantially also in the coming years, we think that the main preoccupation of Estonian RTDI policy should not be to reach the 3% target at any cost, but instead to raise the innovation capacity of enterprises in a broader sense (including, but spanning beyond R&D) and also to address a number of important societal problems.

This might be a problem if the 'demand' side for R&D is not well developed, as is the case in Estonia. Also, we think that a broader innovation strategy has to include the more 'traditional' sectors which (in all countries) have a lower R&D intensity. Here, policy measures like cluster-oriented policies of the type that are implemented mostly on the regional level (e.g. in Austria) would probably be more appropriate than pure R&D support measures.

In general, there should be more emphasis on raising the innovation capacities of SMEs by means such as the voucher system. The goal would be to trigger innovation in a broad sense, including non-technological innovation.

Science System and Science-Industry relations

While this has been and remains an issue receiving much attention in Estonian RTDI policy, we would argue that there should be a stronger emphasis on measures for raising the innovation and research capabilities of enterprises. For the science system, we still see room for improvement in a more determined orientation towards the needs of the Estonian economy and society. The role of the science and education system in the supply of skilled labour should be strengthened.

In our view, there are some imbalances in the system, some of which merit policy actions, some of which do not (but are likely to be transitory in nature). The most debated issue is the imbalance between the science and the enterprise sector in the innovation system. Partly, we consider this a transitory problem on which RTDI policy has only a limited effect: closer connections between education, technology and enterprise policies are required, as are some years of development before the enterprise sector can grow into a significant funder and user of R&D performed in public research institutions. It has to be noted that there are hardly any public research capacities outside the universities. In other countries like Norway (Sintef), Finland (VTT), the Netherlands (TNO), Germany (FhG) and Austria (ARC, Joanneum Research), such RTO-s are an important part of the innovation system and can serve as a link to research for the business sector. We suggest looking into the possibility of launching Public-Private Partnership (PPP) research institutes in Estonia as well.

Raising innovation capacities of companies

We think that this is the area where the focus of the RTDI policy for the following years should predominantly be. We consider it especially important that any strategy of this kind include the traditional sectors, address SMEs and have a broad view of innovation that is not confined solely to R&D. We propose a number of policy actions ranging from voucher systems to cluster oriented policies and also encourage a discussion about tax related support measures, specifically targeted to different types of innovation expenditures (R&D, training, personnel, etc.). In our view, it is time to strengthen the "demand side" of R&D.

Governance and policy learning

It is our opinion that the conceptual basis for RTDI policy in Estonia is very well developed, but we also think that there exist both a "coordination gap" as well as an "implementation gap" (resulting from the limited capacity of policy making institutions (ministries, the Council, agencies) and the considerable amount of policy measures and initiatives). The solutions to these problems would comprise a more active inclusion and participation of other sectoral ministries in RTDI policy design and implementation and a significant increase in institution capacity. Without this increase, there is a danger of policy failure. Unless the design of new policy measures is matched by an increased capacity for implementation, we would even advocate NOT applying the measures, including the ones we propose in this report.

We specifically stress the need to think about new arrangements for the Estonian R&D Council as a tool for policy coordination and see an urgent need to strengthen the capacities of both the ministries as well as in the implementation agencies. Otherwise, there is the danger that many good concepts and policy initiatives might not be implemented well.

Annex A | Background Report

Estonia
Prepared for the Review mission 11–12 June, Tallinn

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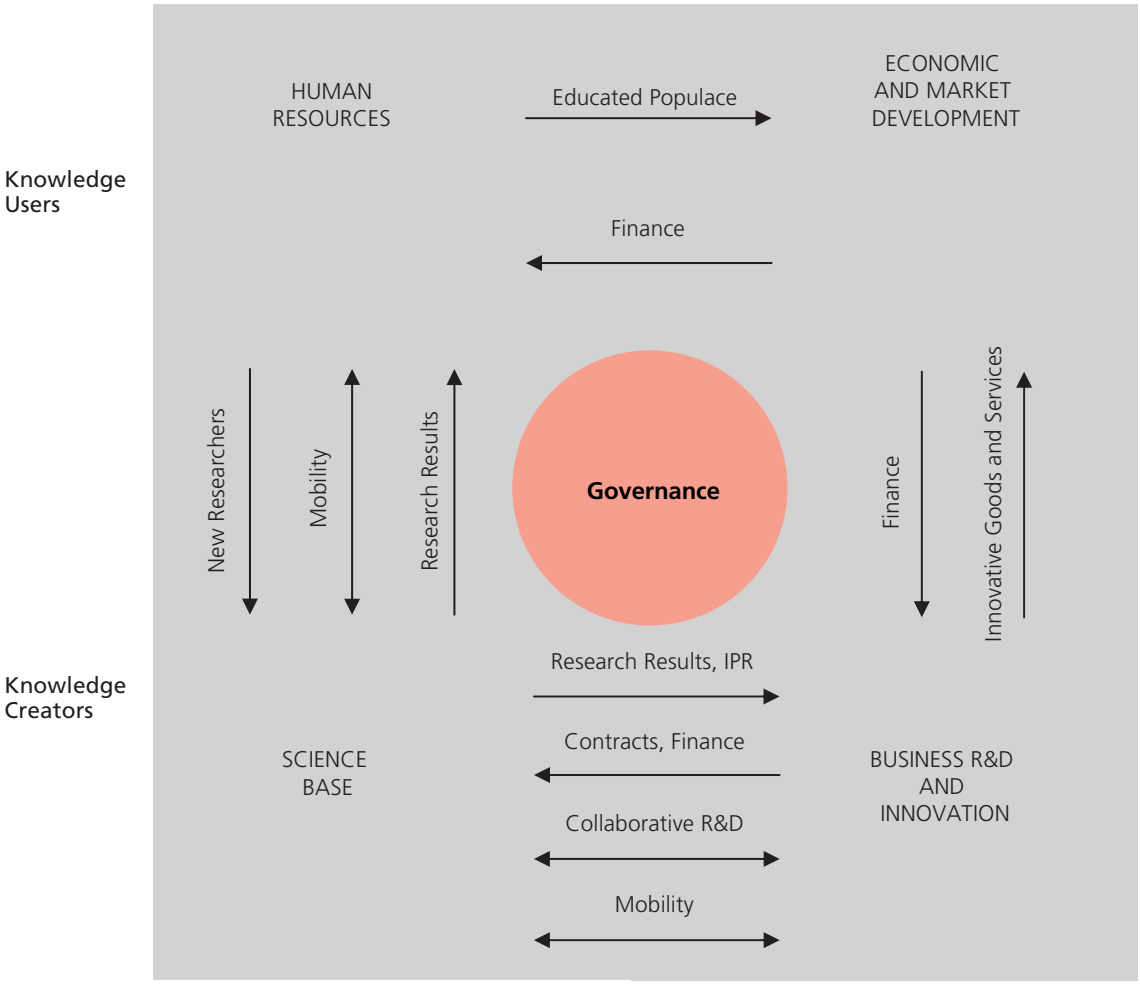
May 2007

Content

1 Introduction

1.1 Background

This background report is based on the template used in the pilot exercise in the second OMC cycle. It derives from a fairly simple model of an innovation system, specifically one that considers four basic domains within an overall innovation system and the links and flows between them. The diagram below depicts these domains and just some of the more important links and flows between them.



Although innovation systems are typically much more complex than depicted here, this simple model provides a convenient way of visualising some of the more important domains within an innovation system and the relationships between them. It also provides a useful framework within which to ask questions relating to:

- The relative scale of the challenges nations confront both within each of the four innovation system domains and across them;
- The range of policy responses to these challenges and their 'location' within the innovation system, e.g. 'reinforcement' policies to strengthen particular domains such as the science base or business R&D and innovation, or 'bridging' policies designed to improve the links or flows between domains, e.g. policies to enhance university-industry interactions or to improve the flow of capital from capital markets to innovative high-tech firms and start-ups;
- The match between problems and policy responses within and across domains;
- The conflicts and synergies between policies within and across domains;
- The governance of policies within and across domains.

This framework has been used to structure each country report into six main sections corresponding to a general introduction, four separate sections dealing with challenges and policy responses in each of the four separate innovation system domains (with policies dealing with the interface between domains treated just once to avoid duplication, but cross referenced in other relevant sections), and a final section dealing with the innovation system as a whole and focusing on challenges and responses, conflicts and synergies, policy orchestration and lessons relevant to the Lisbon agenda.

The data sources used for compiling and constructing each of these sections include material contained in the ERAWATCH baseload, Trend chart reports, National Reform Programme reports, OECD reports and documents made available by the CREST national contact points for the Policy Mix exercise.

The basic aim of these reports is to interpret available evidence and provide commentary that will suggest lines of enquiry during the subsequent visits to the countries under review, and to provoke discussion in the eventual peer review meeting later in the year.

1.2 Basic facts about Estonia

With a population of 1.3m, a GDP of €10,540m (2005) and an employment of approximately 600,000 (2004) (Eurostat 2007a), Estonia is a small economy that has enjoyed a fairly successful catching-up process since its independence in 1991. Gross national income per capita almost tripled from 3,060 US$ in 1991 to 9,060 US$ in 2005[5] (Worldbank 2007). Based on constant market prices GDP grew on average by 7.5% p.a. between 1995 and 2006 by far exceeding EU-25 GDP growth (2.3%). However, GDP per capita (9,700€ in 2006 at current prices) is still only 39% of the EU-25 average (Eurostat 2007b).

The Estonian policy framework for this growth trajectory is a liberal economic policy with respect to trade, foreign direct investment and business regulation. Multinational corporations, mainly from northern Europe (and here especially from Sweden and Finland) have contributed substantially to economic growth and catching-up both by outsourcing parts of the value chain (low value added work) to Estonia and by substantial foreign direct investment. Of the new member states Estonia has the highest share of foreign direct investment (stock) to GDP in 2005 (96%; UNCTAD 2007). Exports of goods and services (current prices) reached 80% of GDP in 2006 (EU25: 40%) and grew strongly in the previous decade (on average almost 12% p.a. between 1995 and 2006; EU-25 = 6.2%; constant prices) (Eurostat 2007b). This has been especially driven by integration into the EU in 2004, which has fostered strong trade and business linkages, especially with its Northern 'neighbours' – Sweden and Finland.

On the other hand, Estonia still struggles with problems typically encountered by a catching-up economy, namely a low labour productivity[6] of currently 59% of the EU-25 average in 2005 (albeit considerably up from 32% of EU-25 average in 1995) and a structure of manufacturing industries which is mostly geared to low- and low-medium-tech sectors (e.g. forest sector, food, textiles) (see Tiits, Katter, Kalvet 2006).

While expenditure on R&D (as a percentage of GDP) is still quite low (0.9% in 2004) and widely seen as insufficient in terms of the goal of creating a "Knowledge based Estonia" (see Estonia 2002 and 2006, two major strategy documents covering Estonian RTDI policy), the country nevertheless has an ICT policy (especially its e-Government initiative) that is widely admired as a role model for new Member States.

Against this background, it seems fair to conclude that Estonia has made significant progress in terms of catching-up, though it still has to tackle a number of structural weaknesses and imbalances, including some in the area of RTDI policy[7].

5 *based on current prices, Worldbank's Atlas method*
6 *Labour productivity per person employed – GDP in PPS per person employed relative to EU-25*
7 *E.g. a recent study comes to the conclusion that "the Estonian national innovation system seems to be still too weak for a transition from an investment-based strategy of development to an innovation-based one" (Technopolis 2006b: 5)*

2 Science Base (R&D Capacity)

2.1 Indicators and Challenges

In recent years, R&D expenditure in Estonia has expanded considerably in absolute terms, though this growth has almost been outstripped by the rapid growth of GDP. Thus, as a share of GDP, R&D expenditure grew, but it is still below 1% of GDP, somewhat behind the target set in the strategy for the period from 2002–2006 (see Figure 1).

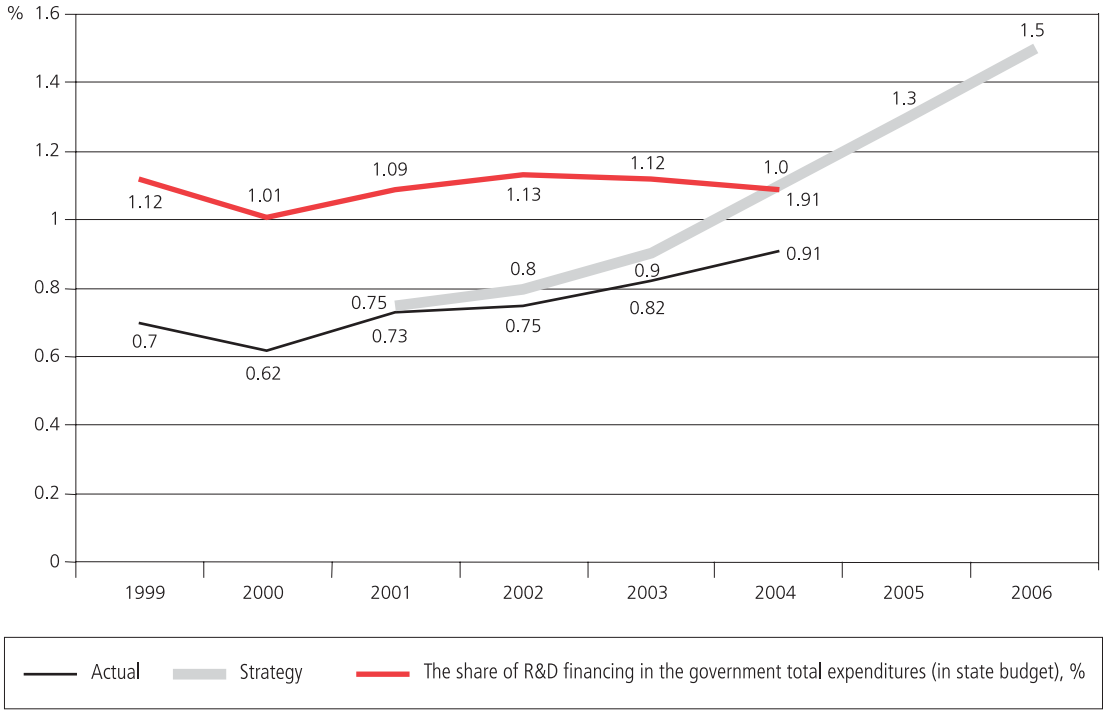


Figure 1. R&D expenditures as share of GDP and of the public sector gross expenditures
Government of Estonia 2006: 41

While Estonia's overall R&D intensity is low by international comparison, the public sector science base compares favourably with the EU-25 average, with R&D performed in the higher education sector accounting for about the same share of GDP as the EU-25 average. The share of researchers as a percentage of the working population is even slightly higher than in the EU as a whole. In stark contrast, R&D in the government sector is only half of the EU-25 average and business sector R&D is less than one third of the average (Table 1).

Similarly, the situation in the public sectors in terms of personnel is comparable (GOV) or even clearly better (HES) than in the European average, while the figures for the business sector displays a significant gap compared to the EU-25.

Funding in the higher education sector is mostly oriented to basic (49%) and applied research (39%), while the government sector is even more concentrated on basic research (67%) and allocates fewer resources to applied research (26%) (Eurostat 2007b).

A weakness of the science base is the comparatively low output both in terms of publications and patents even though this output has been growing recently. Also, output of the higher education sector regarding science and engineering (S&E) graduates is relatively low as is the share of scientists and engineers at the active population. Though the share of S&T graduates at the working population is (still) above EU-25 average, there is a problem with the age structure, as the share of older scientists is quite large.

Table 1. Indicative Indicators for the Science Base (2004)

Indicator	*Estonia*	*EU-25*
R&D intensity (GERD as a % of GDP**)	0.91	1.86
GOVRD**	0.12	0.24
HERD**	0.42	0.41
BERD**	0.36	1.20
Public R&D expenditures (% of GDP)*	0.5	0.7
Share of GERD going to….		
Basic Research***	32.2	NA
Applied Research***	25.1	NA
Experimental Development***	42.7	NA
Researchers as a percentage of the working population***	0.86	0.83
GOV***	0.10	0.09
HES***	0.58	0.41
BES***	0.17	0.33
New S&E graduates per 1000 population aged 20–29*	8.9	12.7
Share of S&E graduates of all graduates from tertiary education**	16.9	23.0
S&T graduates as a % of working population aged 25–64***	34.4	26.3
Scientists and Engineers as a % of active population (2005)**	3.5	4.6
Number of peer reviewed papers per million inhabitants (articles and notes)****	~500	~680
Patent Application at EPO (Priority year) per million inhabitants (2003)***	15.5	136.1
Patents Granted at USPTO (Priority year) per million inhabitants (2000)***	0.7	52.5

** EIS 2006; ** Eurostat 2007a (pocketbook); *** Eurostat 2007b (online database); **** Erawatch 2006*

The main public research organisations are the three large Estonian research **universities** in Tartu (the country's largest university) and Tallinn, and **affiliated public research institutes** (most of them former institutes of the Academy of Sciences). In recent years, five **Competence Centres** have been established, as R&D organisations operated in collaboration between universities and companies performing applied research with the aim of fostering industry-science relations. Furthermore, ten **Centres of Scientific Excellence** were founded, with a focus on doctoral studies and bringing together "high level" research groups and individual researchers from different organisations. The main purpose of these centres is raising the quality of research and education and thereby attracting excellent researchers and students against the background of 'brain drain'.

Some mayor challenges for the research system were identified in the new government strategy for RTDI policy "**Knowledge-Based Estonia – Research and Development Strategy 2007–2013"** (Government of Estonia 2006: 14) as:

- "to ensure a sufficient number of researchers and engineers;
- to upgrade the outdated R&D infrastructure in order to provide an international competitive research environment;
- to resolve problems in relation to state budget financing of applied research;
- to increase public sector R&D investment to 1.05% of GDP by 2010;
- to focus primarily on research fields that are important for Estonia."

2.2 Governance

The role of parliament in R&D policy is mainly to approve the national budget for RTD policies and the R&D strategy. It is advised in matters of RTDI policy by the **Research and Development Council** (including four ministers, four academics and four business persons). In practical terms, two ministries are responsible for RTDI policy: the Ministry of Education and Research and the Ministry of Economic Affairs and Communications. Both report to and discuss with the council. Basically, Estonia has a fairly strict division between research policy targeting basic research especially in universities, and innovation policy supporting private sector innovation activities. The main body responsible for (public) research policy is the **Ministry of Education and Research**. The ministry is advised by two committees, namely a) the **Science Policy Committee** (named R&D Policy Commission in Figure 2) and b) the **Science Competence Council**. Both committees include stakeholders (experts from the respective sectors) that advise on strategy (a), on funding, evaluation of research organisations and research infrastructure support (b). An important member of the Science Policy Committee and an actor in its own right is the **Estonian Academy of Science**, an association of distinguished scientists. While some funding is distributed directly by the ministry, the grant funding of the ministry is implemented by the **Estonian Science Foundation**. Moreover, the ministry has links to the **Archimedes Foundation** which is the central contact point for all EU programmes and projects and coordinates the evaluation of scientific research activities.

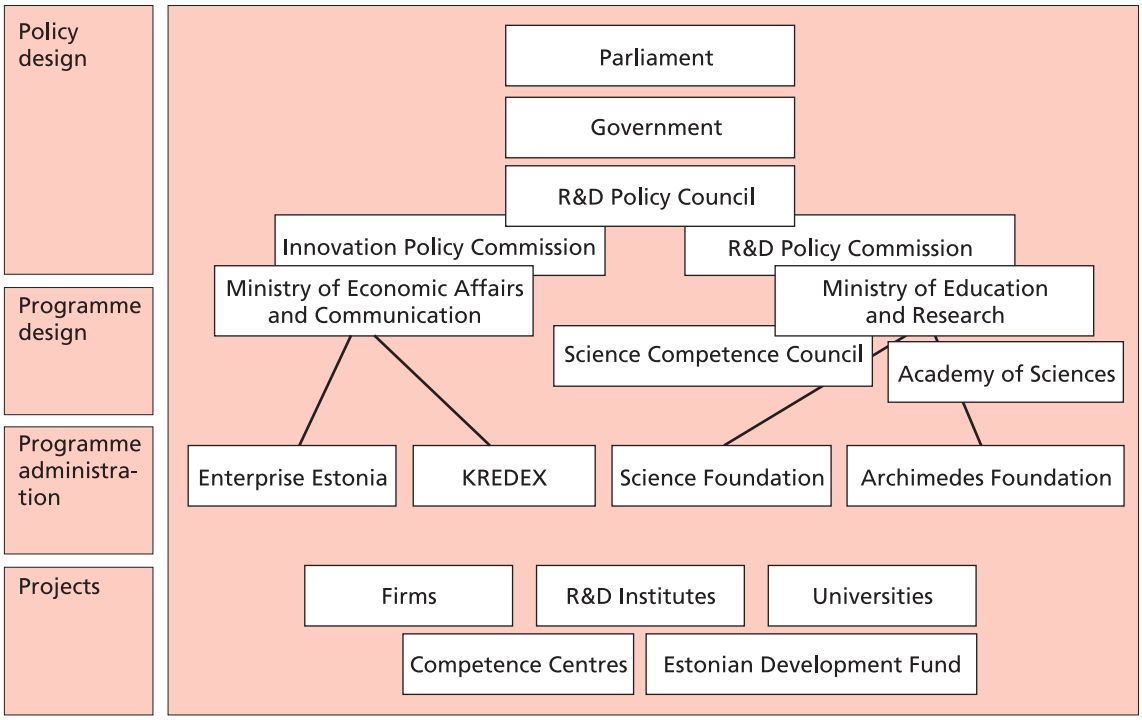


Figure 2. Institutional Framework
Trendchart 2006

Main policy documents outlining the governance structure of Estonian RTDI policy are the **Organisation of Research and Development Act** which regulates the organisation of R&D in Estonia and **Knowledge-based Estonia: Estonian Research and Development Strategy (I and II respectively)**. The first strategy covered the period from 2002 to 2006, at the beginning of 2007 the new strategy for 2007–2013 was launched.

Policy formulation and design is informed by a considerable number of policy studies and evaluations[8] (which also touch upon issues of governance), as well as through active policy learning from other countries experiences[9] (e.g. in the case of the competence centre programme).

[8] *such as "Evaluation of Estonian Innovation System" (Hernesniemi 2000), "Technology Policy of Estonia: System Planning and Development of Implementing Agency" (Romanainen 2001), "Assessment of Estonian Research Development Technology and Innovation Funding System" (Nedeva, Georghiou 2003), "Evaluation of the design and implementation of Estonian RTDI policy: implications for policy planning" (Technopolis 2006a)*

[9] *With Finland and other small open economies regularly being referred to.*

2.3 Policy Objectives

Estonian research policy is in a process of transition and restructuring of the system after its independence from the former Soviet Union. While the main objective of the previous **Knowledge-Based Estonia – Research and Development Strategy 2002–2006** in terms or research policy was "updating the pool of knowledge" (Erawatch 2006:4), the new **R&D Strategy for 2007–2013** states three main objectives of which one is directly related to the science base, namely "competitive quality and increased intensity of research and development" (Government of Estonia 2006: 4). Furthermore, the strategy mentions the objectives of increasing the intensity of research while ensuring its quality; increasing the number and quality of RDI employees by supporting activities of higher education organisations; and providing state-of-the-art conditions (infrastructure). In addition, the strategy sets the following targets for 2013, which also cover other domains of the innovation system (business R&D and human resources):

- "an increase in the proportion of employees engaged in research and development to 8 researchers and engineers per 1000 employees (5.0 in 2004; EU25 average 5.5);
- the proportion of upgraded and new RD&I infrastructures 80% (less than 20% in 2004);
- total investments in research and development 3% of GDP by 2014 (0.88% of GDP in 2004; EU25 corresponding indicator 1.90% of GDP), of which the public sector share is 1.4% of GDP (0.54% of GDP in 2004; EU25 corresponding indicator 0.68%);
- the number of high quality publications, according to internationally recognised bibliometric database, 1200 (796 in 2004, according to the ISI Web of Science);
- the number of European Patent Office patents per million inhabitants will grow 5 times (8.9 in 2002; EU25 corresponding indicator 133.6);
- an efficient eLibrary (a common system of integrated electronic collections and services) and a digital research information system
- a growing number of foreign researchers and students coming to Estonia"

(Government of Estonia 2006: pp. 20).

[10] *That is, with out specifically targeting fields of science, technologies or sectors.*

2.4 Policy Instruments

Estonia's research policy so far has had a strong focus on the public research base. The main instruments for research policy in this field are **funding** schemes for **R&D projects** and **R&D infrastructure**.

Important **channels for funding R&D** are (see Figure 3):

- research project funding (so called "targeted" funding, 2005: €14.7m),
- basic funding for research organisations (base-line funding; €4.1m) and
- grants for researchers (research grants, €5.8m).

In addition, Estonia set up several 'generic'[10] **national programmes**, of which the **Centres for Excellence programme** (€6.4m over the period from 2005–2006 for the funding of research groups), and the **Research and Development Infrastructure Programme** (€14.7m over the period from 2004–2006 for funding infrastructure, equipment and labour costs) are the most important ones. The latter one is financed by the Ministry of Economic Affairs and Communications and implemented by Enterprise Estonia, even though it is targeted at universities, non-profit research organisations, and technology and innovation centres (i.e. target groups of the Ministry of Research and Education). Both basic funding and centres of excellence have been established just recently. While the latter follows the European trend to foster 'excellence' in scientific research and education, the aim of basic funding is to provide 'flexible' money, especially for universities e.g. in order to allow matching EU-programme funds. Several instruments were significantly co-funded by the European Regional Development Fund (see Government of Estonia 2005). EU funding continues to play an important role as a source of funding of R&D.

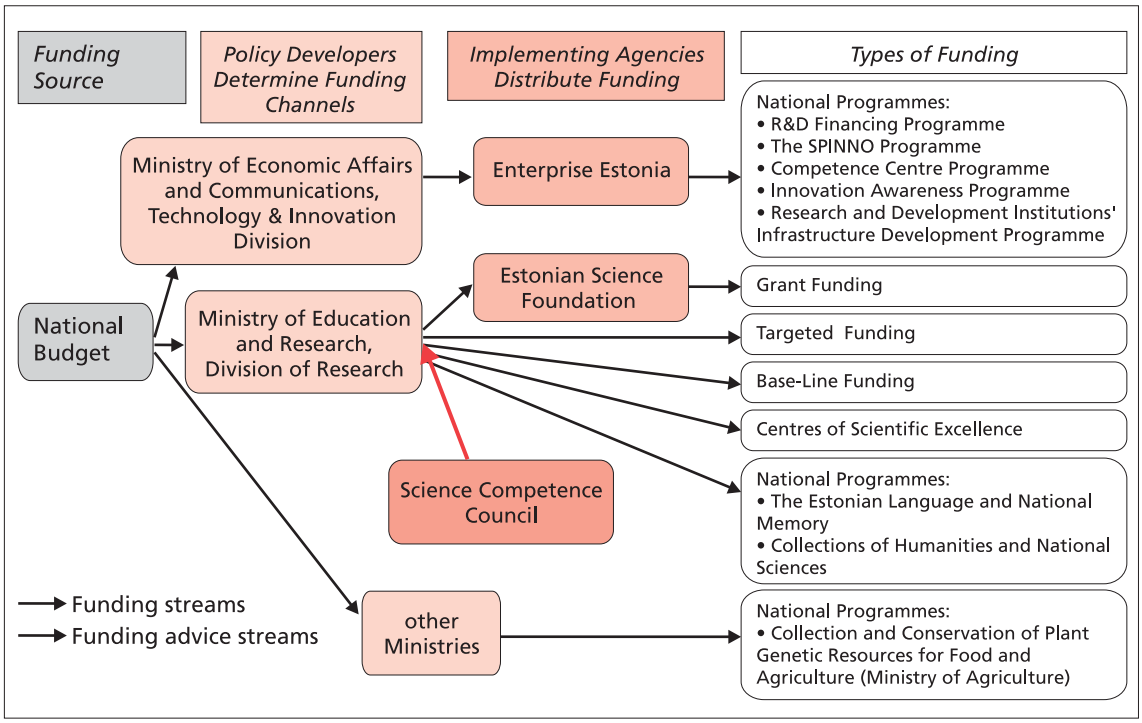


Figure 3: Estonian National R&D Funding System
Erawatch 2006

2.5 Policy Effectiveness

As with other RTDI policy measures, those addressing the research system are mostly too recent to arrive at a final assessment. Nevertheless, a number of studies scrutinising parts of the system allow some critical issues for RTDI policy to be highlighted:

According to two recent evaluations of the Estonian research policy (Technopolis 2006a, Nedeva and Georghiou 2003) the most critical **challenge** facing the Estonian innovation system is the need to substantially **increase R&D investment** in the public as well as in the private sector. The targets set in the strategy for 2002–2006 have not yet been achieved.

Table 2 provides an overview of policy achievements and challenges and summarises a number of other issues concerning the public RDI system and related policies that have been highlighted in recent analyses.

Table 2: SWOT Analysis of the public RDI system and policies

Strengths	*Weaknesses*
■ Relatively high resource commitment (funds/ researchers) to higher education sector ■ Strong research potential in certain technology fields ■ Existence of a national RDI strategy ■ R&D and innovation vision at the level of Government	■ Underdeveloped (although gradually improving) R&D infrastructure ■ Low level of R&D (particularly private) and education investments ■ IPR regulated differently by universities ■ Additionality of EU funds is not always secured ■ Deficit of skilled labour ■ Low commercialisation level of R&D results ■ Governance of the public sector ■ Limited cooperation between ministries other than Min. of Economic Affairs and Min. of Education and Research ■ Absence of knowledge and skills of innovation and human resource management in both private and public sector ■ Knowledge infrastructure not attractive enough to attract strategic foreign investments
Opportunities	*Threats*
■ Increased financial support for national R&D infrastructure ■ International knowledge transfer ■ Cross-border R&D cooperation ■ Cross-border public programmes	■ Aging research community and brain drain of young researchers ■ Opposition from the academic sector against more demand-oriented innovation policy developments ■ Lack of co-ordination with other policy areas due to the predominant role of two sectoral ministries in innovation policy making; split of the system into two (academic research vs. industry innovation). ■ R&D and innovation policy not coherent with socio-economic needs ■ Lack of interest and awareness from the private sector

author's compilation, based on Männik 2007: 13, Trendchart 2006: 22; Nedeva and Georghiou 2003

Some difficulties have been observed in the past in the effective co-ordination of RTDI policies between the main responsible ministries (main responsibilities lie with the Ministry of Education and Research and Ministry of Economic Affairs and Communications, some relate to the Ministry of Finance and Ministry of Agriculture). Moreover, the R&D Policy Council which is supposed to act as a negotiator in RTDI strategic questions has, according to recent assessments "not performed this role sufficiently" (e.g. in respect to the elaboration of the R&D strategy 2002–2006) (Technopolis 2006b: ii).

Scrutinising the Estonian funding system for R&D, Nedeva and Georghiou (2003) found the institutional set-up well structured and logical, but saw some major problems causing a lack of effectiveness and efficiency of policy:

- Overall insufficient funding for RDTI;
- lack of base-line funding for research institutions (which has been corrected for in the meantime),
- fragmentation of the RDTI funding system, displayed by a mismatch between research capacity and research users, and the duality of the system (Ministry of Research and Education vs. Ministry of Economic Affairs and Communications), and
- problems associated with the image/vision of research, i.e. lack of public and political appreciation.

While some of these problems have been tackled by recent policy initiatives (e.g. base-line funding), some are still on the policy agenda.

On a more operational level, in its evaluation of the effectiveness of current RTDI policy measures, a recent study points to the fact that the **"R&D infrastructure development programme"** and the **Centres of Excellence Programme** are likely to be oversubscribed (or under funded), which might limit the effects of the programmes (Technopolis 2006a: 22).

3 Business R&D & Innovation

3.1 Indicators and Challenges

The Estonian economy is predominately comprised of low-technology small and medium sized enterprises (Government of Estonia 2006), which is reflected by a low share of high-tech employment and exports, a very low business enterprise expenditure on R&D (BERD is only one fourth of the EU-25 average), and a low share of researchers in the business sector (about half of EU-25 average) (see Table 3). The largest share of BERD is spent on the following sectors which account for about 50% of total BERD: manufacture of motor vehicles, IT services, R&D services, business services and telecom (see Figure 4), while in terms of value added, 'traditional' economic sectors (wood and furniture, food, textiles) still account for a significant share of overall economic activity. Thus, the gap in BERD is largely a problem of industry structure.

The output of R&D measured in terms of patents is very low compared to overall European levels, probably indicating a large share of 'incremental' innovation stemming from the R&D efforts of enterprises.

Table 3: Indicative Indicators for Business R&D & Innovation (2004)

Indicator	*Estonia*	*EU-25*
High-Tech		
Employment in high-tech services (% of total workforce) (2005)*	2.8	3.4
Employment in medium-high and high-tech manufacturing (% of total workforce) (2005)*	4.8	6.7
Exports of high technology products as a share of total exports*	10.1	18.4
Business R&D expenditures		
Business R&D expenditures (% of GDP)*	0.3	1.2
Share of Business R&D expenditure financed by…		
Business Sector**	85.3	NA
Government Sector**	4.1	NA
Abroad$	10.5	NA
Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)*	NA	NA
Researchers in the business sector		
Researchers in the business sector as a % of the working population**	0.17	0.33
Business enterprise researcher by economic activity (FTE) (in% of total business enterprise researchers)		
Manufacturing	47.5	NA
Food products; beverages and tobacco	2.1	NA
Textiles and textile products; manufacture of leather and leather products	0.8	NA

Indicator	*Estonia*	*EU-25*
Wood and wood products, manufacture of pulp, paper and paper products	0.9	NA
Coke, refined petroleum products; chemicals, chemical products, plastic	10.1	NA
Other non-metallic mineral products	c	NA
Basic metals	0.0	NA
Fabricated metal products, except machinery	2.4	NA
Machinery and equipment n.e.c.	4.2	NA
Office machinery and computers	0.9	NA
Electrical machinery and apparatus n.e.c.	3.3	NA
Radio, television and communication equipment	10.6	NA
Medical, precision and optical instruments, watches	7.1	NA
Motor vehicles, trailers and semi-trailers	2.9	NA
Other transport equipment	c	NA
Furniture; manufacturing n.e.c.	c	NA
Recycling	c	NA
Electricity, gas and water supply	2.6	NA
Construction	c	NA
Services	49.5	NA
Wholesale and retail trade; repair of motor vehicles, etc.	2.4	NA
Hotels and restaurants	0.0	NA
Land, water, air transport; post and telecommunications	2.1	NA
Financial intermediation	5.7	NA
Real estate, renting and business activities	37.8	NA
Public administration and defence, social security; education; health	1.4	NA
Innovation		
Innovation expenditures (% of turnover)*	1.6	NA
Sales of new-to-market products (% of turnover)*	4.4	NA
Sales of new-to-firm not new-to-market products (% of turnover)*	7.6	NA
Share of enterprises receiving public funding for innovation*	0.3	NA
SMEs innovating in-house (% of SMEs)*	NA	NA
Innovative SMEs co-operating with others (% of SMEs)*	16.0	NA
SMEs using organisational innovation (% of SMEs)*	39.2	NA
Patents		
New EPO patents per million population (2003)*	15.5	136.7
New USPTO patents per million population (2003)*	1.2	60.2
Venture Capital		
Early-stage venture capital (% of GDP)*	NA	0.0

** EIS 2006; ** Eurostat 2007b (online database); *** Erawatch 2006; c – confidential*

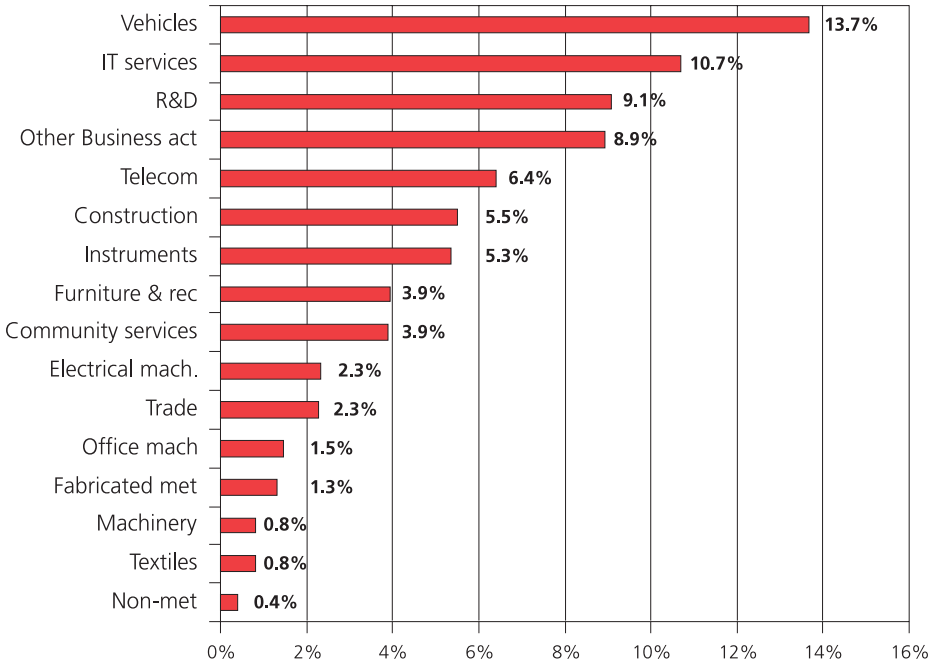


Figure 4. Business enterprise intramural expenditure on R&D by industrial sector. (31 sectors. Shares of total. 2003).

Source: Joanneum Research et al 2006, based on Eurostat Database, S & T Data, 2005,

The latest *Community Innovation Survey* (see Celikel-Esser et al. 2007; Schiefer 2007) highlights the following main characteristics of innovation performance and innovation activities of the Estonian business sector:

- 49% of all Estonian firms have carried out innovation activities. This is well above the EU average (42% for EU 27; Eurostat 2007c);[11]
- This is most pronounced in the service sector, where the share (50.7%) is in EU-Top 5. In contrast with other EU countries, Estonian service firms are even slightly more innovative (51%) than manufacturing enterprises (48%). The most innovative sectors are financial intermediaries (73%) and trade (63%);
- Also, in Estonia a relatively high share of enterprises are active in both process and product innovation.

Thus, the Estonian enterprise sector is characterised by low R&D, but high innovation intensity. The character of these innovation activities, however, is of some concern to policymakers:

- Although Estonian enterprises co-operate quite intensely in innovation with other actors, their linkages to universities are amongst the lowest in the countries covered by the CIS;
- The share of turnover accruing from products that were new to the market was well below other countries, while the respective share of products 'new to the enterprise' was quite high in comparison. This indicates a 'catching-up' with developments in more advanced markets, but not yet a strong indigenous capacity for more 'strategic', 'radical' or 'break-through' innovation (Schiefer 2007:396);
- Other "notable weaknesses of the country are the indicators of intellectual property – only 6% of the total innovative enterprises have applied for a patent and 2% have registered a trademark" (Celikel-Esser et al. 2007: 29);
- Another concern is that, according to the CIS, only a very small number of Estonian enterprises (less than 1%, as compared to 5.4% in Lithuania; 8.4% in Finland; and 9.3% in Austria) have received any form of public support – despite the fact that lack of funds from both internal and external sources rank as prominent barriers to innovation amongst both Estonian enterprises and those in other catching-up countries (Schiefer 2007:396 and 400).

[11] *Viia et al. assess: "Estonia has improved its indicators nearly all over the scale. The share of innovative enterprises among all surveyed Estonian enterprises amounted to 49%, which is a very good result, much higher than the EU average four years ago (44%) and according to preliminary data not lower than the EU countries average in 2002–2004. Compared to the results of the previous survey there has been a 13-percentage points growth" (2007: 9). It has to be kept in mind, though, that CIS3 and CIS4 are not strictly comparable due to changes in surveying methodology and questions.*

Foreign firms are very important for the development of an innovative enterprise sector in Estonia: foreign firms operating in Estonia are both more innovative and more productive. Also, foreign direct investment (FDI) – especially from Sweden and Finland, which account for the lion's share of FDI in Estonia – links Estonian industries to the successful Swedish and Finnish Clusters (wood, electronics/ICT) thereby offering an opportunity for Cluster-development in Estonia as well. So far, the place in the value-chain occupied by Estonian firms in these linkages is mostly on the low-tech, lower value added end (see Tiits et al 2006).

Against this background, the major challenge for Estonian innovation policy with regard to the business sector is to "increase the competitiveness of traditional industries through technology change" and at the same time to "increase the creation of new high technology firms" and foster structural change towards more knowledge intensive sectors (Trendchart Report 2006).

3.2 Governance

The main actor in business oriented research and innovation policy is the **Ministry of Economic Affairs and Communications** (see Figure 2). Within the ministry, the **Technology and Innovation Division** is responsible for planning technology and innovation policy, managing technology development, and supervising Enterprise Estonia. The ministry receives advice on its policy strategy from the **Innovation Policy Committee**. All national programmes of the ministry are implemented by **Enterprise Estonia**, the national one-stop-shop business promotion agency (budget 2006: ~€94m)**.** Another agency under the ministry is **KredEx**, the national Credit and Export Guarantee Fund.

In order to assure/ increase the quality of innovation policies and its implementation, the ministry has commissioned several evaluations[12] and provided training for stakeholders of the NIS.

3.3 Policy Objectives

The **National Development Plan** (Government of Estonia 2005) includes, under Measure 2.3 – promotion of Research, Technology Development and Innovation, the following broad objectives for the development of the business sector's RTDI activities:

- "To create a new knowledge and a critical RD&I mass in a number of technological fields vital to existing industry, and to set up new technology intensive sectors of activity;
- To increase the co-operation between the science and business sectors in applied research of strategic importance for the Estonian economy and to reinforce the capacities of R&D institutions to co-operate with businesses and to manage the innovation process;
- To stimulate an increased involvement of Estonian businesses in funding and undertaking on a regular basis in research and development, technology transfer and development and innovation;
- To establish financially sustainable technology and innovation infrastructures and support services able support Estonian businesses in their innovation activities;
- To generate a wide awareness of innovation as a key driver of economic growth and to strengthen the RD&I capacity and competence of the businesses and R&D institutions."

(Government of Estonia 2005: 66).

The main strategy document for RTDI policy "**Knowledge-Based Estonia – Research and Development Strategy"** further elaborates these general objectives: While the main objective of the previous **R&D Strategy 2002–2006** in terms of innovation policy was "to increase the competitiveness of enterprises" (Erawatch 2006: 4), the new **R&D Strategy 2007–2013** states three main objectives, of which one is directly related to the business sector, namely "innovative enterprises creating new value in the global economy" (Government of Estonia 2006: 4). Further objectives are to facilitate the growth of economic added value by supporting innovation activities in new and traditional sectors, and to encourage the creation and growth of new innovative enterprises and the renewal of old business models. Moreover, the strategy aims to create a legal and business environment that is conducive to R&D; increase awareness of the importance of RDI for economic growth; and underlines the role of public procurement in initiating RDI and ambitious development projects (Government of Estonia 2006). More concretely, the strategy sets the following targets for the period until 2013 for the business sector's RTDI:

[12] *E.g. Hernesniemi 2000, Romanainen 2001, de Jager et al. 2002, Reid 2002, Monck 2002, Nedeva, Georghiou 2003[*

- "growth of enterprises' R&D investments to 1.6% of GDP by 2014 (0.34% in 2004; EU25 average 1.22% of GDP in 2003);
- growth of enterprises' innovation investments (intramural and extramural research and development, purchase of machinery and equipment, attaining knowledge) to 2.5% of turnover (1.6% in 2004; EU25 average 2.15% of turnover in 2000);
- growth of sales revenues of new products and services to 15% of the enterprise gross turnover (7.6% in 2004; EU15 average 16.8% in 2000);
- a growing number of enterprises participating in international RD&I cooperation programmes and networks;
- a growing number and increasing importance of foreign investors who consider Estonia to be a good location for innovative activities;
- a significantly higher position of Estonia in the European Union "Innovation Scoreboard" (13th position in 2006, 5th–10th position in 2013)" (Government of Estonia 2006: pp. 20).

3.4 Policy Instruments

Innovation policy in Estonia focuses on **triggering R&D investment** in the private sector, fostering **science-industry linkages** and **facilitating innovative entrepreneurship.** This focus is reflected both in the priorities set in the R&D Strategy 2007–2013 as well as in concrete policy measures.

Examples in case are:

- The **R&D Financing programme** (€18.4m in 5 years) offers funding for feasibility studies, applied research and product development for Estonian enterprises and R&D organisations.
- In 2003 the **Competence Centre programme** (€9.1m for 3 years) was initiated, in order to increase strategic cooperation between the research and enterprise sector.
- In 2004 the second phase of the **SPINNO programme** (€4.2m 2004–2006) started, which targets universities and research institutes in order to strengthen their business orientation, entrepreneurial spirit, technology transfer activities and collaborations with domestic and foreign enterprises.
- Furthermore, **technology parks** (e.g. Tallinn Technology Park and Tartu Science Park) and **incubation centres** were set up in order to promote technology oriented start-ups and spin-offs.
- In addition, the parliament adopted an act to establish the **Estonian Development Fund** in December 2006. The Fund is supposed to start operating in late 2007 with an expected investment capital of €32m. It has the objective of providing (venture) capital and management know-how for start-up enterprises as well as (technology) foresight and monitoring on behalf of the respective ministries.

It is noteworthy that many instruments are not financed solely from national sources, but receive substantial additional funding from the European Regional Development Fund (Government of Estonia 2005).

3.5 Policy Effectiveness

While Estonian innovation policy is regarded as one of the most developed amongst the New EU Member States and has been described as being well-structured and advanced in terms of the use of different instruments[13], several reports[14] also point to room for improvement in terms of the composition of the mix and the general implementation of RTDI policy. Table 4 provides an overview of some of the main issues concerning the business sectors R&D and innovation performance and related policies.

[13] *European TrendChart http://www.cordis.lu*

[14] *Reid, A. (2003) Optimising the Design and delivery of Innovation Policy in Estonia. Tallinn Technopolis Consulting Group (2005) Evaluation of the design and implementation of Estonian RTDI policy: implications for policy planning. Tallinn Technopolis, MERIT, Logotech, ISMERI, LACAVE&ass (2006) Strategic Evaluation on Innovation and the Knowledge Based Economy in relation to the Structural and Cohesion Funds for the programming period 2007-2013 Nedeva, M. Georghiou, L. (2003) Assessment of the Estonian research development Technology and Innovation Funding System. Manchester.*

Table 4: SWOT Analysis of private RDI-system and related policies

Strengths	*Weaknesses*
■ High share of employees with tertiary education ■ High level of ICT expenditures and diffusion in provision of public services ■ Widespread performance of innovation among SMEs ■ Widespread performance of innovation in service sector ■ Experience in policy evaluation as a learning tool ■ Existence of a national RDI strategy ■ Operating support schemes and programmes for promoting innovation in companies and fostering industry – academy co-operation ■ Comprehensive enterprise support agency, offering broad range of support measures, including innovation support ■ An established network of innovation support structures (business incubators, technology/ science parks, technology transfer offices at universities) ■ Strong research potential in certain technology fields ■ R&D and innovation vision at the level of Government	■ Low level of R&D (particularly private) and education investments ■ Deficit of skilled labour ■ Low commercialisation level of R&D results ■ Unattractive knowledge infrastructure for strategic foreign investments ■ Lack of measures addressing medium and low-technology companies ■ Lack of focus of innovation policy in terms of clusters or high-potential (key) areas on the implementation level (Programmes for key technology areas in the national R&D strategy have not yet materialised) ■ Passive cooperation between ministries other than Min. of Econ. Affairs and Min. of Educ. and Research ■ Lack of policy capacity in ministries and agencies ■ Lack of pre-seed and seed capital ■ Insufficient coordination between different financing and other partnering institutions involved in NIS ■ Difficulties in implementation of planned innovation policy measures ■ Limited capabilities for technology foresights ■ Underdeveloped (although gradually improving) R&D infrastructure ■ Additionality of EU funds is not always assured
Opportunities	*Threats*
■ Launch of the state venture capital fund ■ Increased financial support for national R&D infrastructure ■ Increasing competition encourages enterprises to develop more strategic plans and implement more risky activities ■ International knowledge transfer ■ Creation of new technology based enterprises ■ Developing intermediaries for technology diffusion and using them more actively at regional level ■ Cross-border R&D cooperation ■ Cross-border public programmes ■ Opportunities related to Structural Funds (in 2007–2013)	■ Lack of interest by the private sector ■ Not gaining higher mandates within the value chain of international production (concerns multinational subsidiaries) ■ Lack of policy coordination between different institutions ■ Lack of commitment of entrepreneurial associations to innovation policy making ■ Lack of co-ordination with other policy areas due to the predominant role of two sectoral ministries in innovation policy making. ■ R&D and innovation policy not coherent with socio-economic needs ■ Lack of the coordination body for horizontally deal with innovation across different policy areas

Own compilation, mainly based on Männik 2007: 13, Trendchart 2006: 22, Erawatch 2007

As has been remarked in some evaluations, for most instruments it is too early to assess their impact. Issues for policy discussions might rather be the comprehensiveness of the set of policy instruments and whether there are gaps and omissions.

An exception from this rule is a recent evaluation of the **SPINNO programme** (SQW 2007). This evaluation concludes that the programme is achieving its targets. It records a growth and above target output for R&D contracts with businesses, income from consultancy and training as well as licenses granted. In contrast, the number of spin-offs established and existing after more than three years, patents and income from the realisation of IP as well as from analysis and testing services have been rising but have stayed below target. It has to be noted that most outputs are low in absolute terms. With regard to soft measures, the study emphasises that the programme has raised the profile of knowledge transfer among the staff of the scientific organisations and has resulted in the establishment of regulations and procedures for technology transfer.

Consequently, it is seen as an important measure to increase the capability and enthusiasm for business collaboration within the science sector. However, the potential of such science-industry linkages and technology transfer are considered limited due to the (still) low demand by Estonian enterprises and the relatively unattractive financial rewards for these type of activities.

In some cases, effectiveness of policy measures seems to be hampered by bottlenecks in implementation and lack of implementation capabilities. e.g., some studies saw a major shortcoming (and hence future challenge) in the failure to elaborate **national technology programmes in the key sectors** identified by the R&D Strategy 2002–2006 (Nesveda/Georghiou 2003, Technopolis: 2006a). In the meantime, the launch of such programmes is being prepared. Currently, the issue is which sectors/technologies should be addressed and how priority areas should be defined.

Other examples in this vein can be taken from the assessment of the effectiveness of current RTDI policy measures (Technopolis 2006a). This assessment finds that:

- **Enterprise Estonia** is overly bureaucratic, "which significantly impedes the communication with clients" (Technopolis 2006b: ii);
- The **R&D financing programme** has experienced a significant leap in demand for financing from enterprises and universities and might be under-funded;
- The **Competence Centres programme** is also experiencing difficulties with bureaucracy and financial rules in its implementation;
- **The infrastructure development programme for science and technology parks** has lacked finance due to the fact that only small amounts of funding were committed within the Single Programming Document (SPD) at the time of the evaluation (Technopolis 2006a: 22).

Thus, strengthening the implementation capacity of RTDI policy seems to be an important issue in Estonia. In this vein, e.g. **Enterprising Estonia** has been assigned the following priorities for action (see Ratso 2005):

- The development of human resources;
- Improved access to finance;
- The development of business support structure;
- The enhanced distribution of information;
- Reduction of administrative burdens.

4 Economic and Market Development (Absorptive Capacity)

4.1 Indicators and Challenges

Absorptive capacity and demand for new technologies currently are limited by the overall level of development and the industrial structure of the country: Estonia's GDP per capita is still significantly lower than in the EU-25, its domestic economy is dominated by small to medium, low- to medium-technology enterprises, business expenditure on R&D is very low and economic growth is primarily driven by exports from traditional economical sectors. In the same vein, the figures for low labour productivity (Table 5) points towards the necessity of upgrading production processes. Results from the *Community Innovation Survey* suggest that currently this happens mainly through the acquisition of foreign technology and machinery (see chapter 3.1), rather than via indigenous innovation.

On the other hand, Estonia is a country increasingly linked to more advanced markets (especially those of its northern neighbours). It also has a high share of innovative enterprises (especially in services), above average ICT expenditure, relatively high broadband penetration and well-established e-society and e-government initiatives. This suggests substantial absorption capacities on the part of private households and public administrations with regard to new technologies, and these expectations now underpin Estonian RTDI strategy (see Ministry of Economic Affairs and Communications 2006).

In addition, the very dynamic, open and liberal business environment with high GDP growth rates, low level of corruption and high macroeconomic stability should be conductive for innovation activities also in the business sector in the mid- and long-term (see Table 5 for a general assessment of the business environment).

Table 5: Indicative Indicators for Economic and Market Development (2004)

Indicator	*Estonia*	*EU-25*
GDP per capita in PPS (relative to EU-25) (2005)***	59.8	100.0
Real GDP Growth Rate (2005)***	10.5	1.7
Labour productivity per person employed (relative to EU-25) (2005)***	58.5	100.0
Labour productivity per hour worked (relative to EU-15)***	41.1	91.5
Employment in medium-high and high-tech manufacturing (% of total workforce) (2005)*	4.8	6.7
Exports of high technology products as a share of total exports*	10.1	18.4
ICT expenditure as a percentage of GDP (2005)*	9.8	6.4
Level of internet access (%) (2006)***	46.0	51.0
Broadband penetration rate (number of broadband lines per 100 population) (2005)*	11.1	10.6
Percentage of enterprises using computers (2006)		
SMEs	94.0	97.0
Large Enterprises	100.0	100.0
for additional statistics see Table 3		

** EIS 2006, ** Eurostat 2007a (pocketbook) *** Eurostat 2007b (online database) **** Erawatch 2006*

4.2 Governance

Main ministries responsible for economic and market development are the **Ministry of Economic Affairs and Communication** with **Enterprise Estonia** as its agency and the **Ministry of Finance.** The national **Bank of Estonia** (Eesti Pank) participates in the national economic policy through the implementation of an independent monetary policy, consultancy to the government, and international cooperation (see http://www.eestipank.info).

4.3 Policy Objectives

A number of policy documents set out some very ambitious development targets, many of which have a strong bearing on RTDI policy:

At present, the main macroeconomic policy document is the **Action Plan for Growth and Jobs 2005–2007** (Republic of Estonia 2005) which states three main macroeconomic objectives: a) ensuring a stable macroeconomic environment, b) ensuring the long-term sustainability of fiscal policy and c) direction of fiscal policy to improve economic growth and employment".

The **Enterprising Estonia** document brings together the national policy for the development of small and medium-sized enterprises in Estonia for 2002–2006. Main objectives are: a) promotion of enterprising spirit, b) creation of new jobs, and c) increase of competitiveness of Estonian businesses. The draft of a new policy document states the vision that "by the year 2013 Estonia will be the best place in the world for entrepreneurship (or business activities)". The four main objectives are: a) strong entrepreneurial culture, b) legal environment favourable for entrepreneurship; c) access to capital, d) growth and international success of businesses (Kuura 2006, Ratso 2005).

Success Estonia 2014 is the Estonian competitiveness strategy which takes on the principles of the Lisbon strategy. Its main aim is to double the living standard in Estonia by 2014. Targets are a) labour productivity growth, b) increased employment, c) birth rate increase, d) reduced inequalities in society, and e) reduced pollution load (Ratso 2005).

In addition to objectives stated in section the **Knowledge based Estonia – R&D-Strategy 2007–2013** underlines the need to support the internationalisation of domestic enterprises, their struggle to extend export markets and to attract foreign direct investment developing innovative products and services rather than exploiting cost advantages. Explicitly, the strategy aims at achieving the following targets in the period up until 2013:

- "growth of employment in high-technology and medium-high-technology industry and service sectors to 11% of total employment (7.53% in 2004; EU25 average 9.8%);
- growth in enterprise productivity per employee to 80% of the EU25 average (57% in 2005)
- an increasing inflow of knowledge and technology intensive foreign investments;
- a growing number of internationally known Estonian brands and trademarks;
- a continuously high position in e-State ranking lists"

(Government of Estonia 2006: pp. 20).

4.4 Policy Instruments

On the level of macroeconomic policy, fiscal and monetary policies are primarily oriented towards fulfilling the criteria for EU monetary union. In order to achieve the objectives stated in the **Action Plan for Growth and Jobs 2005–2007** (Republic of Estonia 2005 – see chapter) the government envisaged the following orientation of macroeconomic activities (see Sepp 2005):

- In order to ensure macroeconomic stability, the government has mainly focused on the **mid-term balance of the state finances** by securing at least an even annual state budget and by controlling the financial situation of the local authorities. Moreover, the government has prepared for **joining the European Monetary Union** by harmonising national laws to EMU regulations, preparing the currency changeover, and focusing economic policies on the compliance with the Maastricht convergence criteria. A third highlight is **risk control** with regard to the rising current account deficit and increasing personal credits;
- In order to ensure the sustainability of fiscal policy, the government is aiming to **reform the national pension scheme and health care system**;
- In order to foster economic growth and employment by means of fiscal policy, the government is aiming at maintaining a relative **low tax burden** and **optimising the tax income structure**. Instruments include tax relief on labour, increases in indirect consumer and environment taxes, and streamlining the tax system via the abolition of tax shelters.

Sepp (2005) points out that current Estonian policy does not yet use **competition policies** to foster entrepreneurship and innovation.

In terms of governance, the Action plan asks for better coordination of the different regulation authorities.

4.5 Policy Effectiveness

Economic policy has succeeded in providing a stable monetary and fiscal environment, but still has to cope with some imbalances like current account deficits and increasing foreign debts (though this is commonplace in rapidly catching-up economies). Also, the establishment of open trade regimes is likely to foster structural change and technology diffusion.

So far, the articulation between general economic policy and RTDI policy has not been an explicit one. There are links to some sectoral policies (notably with respect to information society policies), though these links could be improved considerably. A recognised challenge for the period from 2007 to 2013 is to better identify and link the needs of society with RTDI policy and translate these into policy priorities and programmes (see Government of Estonia 2006).

Table 6 summarizes some of the observations made on the SWOTs of Estonian Economic Development and Policy.

Table 6: SWOT Analysis of Economic and Market Development related policies

Strengths	*Weaknesses*
■ Monetary stability ■ Openness to foreign trade and investments ■ High level of economic dynamics (GDP growth) ■ Low tax rates ■ Decreasing unemployment rate ■ Low level of corruption ■ Simple and cheap arrangement of trading across borders, dealing with licenses, enforcing contracts, registering property, paying taxes ■ High regulatory quality ■ Government effectiveness	■ High inflation rate ■ Productive capacity with existing labour, capital, and technology unable to keep pace with growing demand ■ Increasing foreign debt ratio ■ High current account deficit ■ Increasing labour costs ■ Ineffective public health system ■ High energy intensity of the economy ■ Rigidity of labour market
Opportunities	*Threats*
■ Stronger integration with the Nordic production networks via competence-building and clustering ■ Attracting strategic investors and innovators	■ Economic development and innovation led by other countries than Estonia ■ Sensitive to external financial, economic or political shocks ■ High dependence on main export partners, particularly financing sector, machinery and electronic equipment, textiles, wood

Männik 2007: 13; Tiits at al 2006

5 Human Resources (Human and Social Capacity)

5.1 Indicators and Challenges

Due to rapid economic growth and a low unemployment rate, Estonia is confronted with shortages of skilled labour. As described in the chapters on the science system and business innovation, there is a high share of scientists and people with tertiary education in the workforce, but with an unfavourable age structure. These cohorts of the labour force will have to be replaced in the near future. Enterprises already report the lack of skilled labour as one of the most important barriers to innovation.

Consequently, Estonia currently invests above EU-25 average in education (although slightly less than EU average in tertiary education). In the same vein, it has a high educational attainment among the age group 20–24 (see Table 7).

However, the attractiveness of science and engineering education paths is well below the EU-25 average, as is participation in life long learning. There seems to be a policy issue in further raising the quality and attractiveness of tertiary education (some measures in this vein have been described in the chapter on the research system), as the systems attracts considerably less students from abroad than Estonian students moving abroad. This can be a benefit for future development as Estonian students (and scientists) abroad might establish valuable international links to the Estonian research scene, but might as well be a substantial cost to the system in the form of brain drain.

Table 7: Indicative Indicators for Human Resources (2004)

Indicator	*Estonia*	*EU-25*
Expenditure on education as % of GDP or public expenditure (2003)		
Total public expenditure as % of GDP, all levels of education***	5.43	5.20
Total public expenditure as % of GDP, at tertiary level of education***	1.05	1.15
Share of Science and Engineering Students at all tertiary students***	22.0	25.3
Share of Science and Engineering Graduates at all tertiary graduates***	16.9	23.0
Youth education attainment level (% of population aged 20–24 having completed at least upper secondary education) (2005)*	80.9	76.9
Participation in life-long learning per 100 population aged 25–64 (2005)*	5.9	11.0
Population with tertiary education per 100 population aged 25–64 (2005)*	33.3	22.8
Students (ISCED 5–6) studying in another EU-27, EEA or Candidate country – as % of all students***	3.5	2.1
Inflow of students (ISCED 5–6) from EU-27, EEA and Candidate countries – as % of all students in the country***	0.9	2.6

** EIS 2006, ** Eurostat 2007a (pocketbook) *** Eurostat 2007b (online database) **** Erawatch 2006; for additional statistics see Table 1*

The main challenges facing the education system, according to **The Estonian Higher Education Strategy for 2006–2015**, are as follows:

- "The number of higher education institutions is unnecessarily large, the studies available do not sufficiently take into account the needs of the labour market.
- The quality of higher education is uneven, both on the level of the institutions and the fields of study.
- The output of Doctoral studies does not match the needs of Estonian society.
- International cooperation and academic mobility are insufficient.
- The level of higher education funding is inadequate, and has not managed to keep up with the increase in the numbers of students and study programmes, and the increase in the cost of living.
- The organisation of higher education has become confused and nebulous, the objectives and roles of the levels of study and educational institutions are not clearly defined.
- There is no consistent higher education policy, resulting in dissatisfaction with the current situation".

(Estonian Ministry of Research and Education 2005)

5.2 Governance

Responsibility for education lies with the **Ministry of Education and Research**, which is advised by the **Academy of Sciences** and the **Science Competence Council** (Figure 2). The **Archimedes Foundation** coordinates the evaluation of higher education curricula, while **Foundation Innove** was established to promote initiatives and activities of lifelong learning through Estonian and EU programmes in the area of human resources development.

5.3 Policy Objectives

Human resources are a constant concern for Estonia's R&D and innovation policy (see Erawatch 2006). In consequence, this has resulted in several strategies concerning human resources and education.

The **Estonian Higher Education Strategy for 2006–2015** sets the following objectives:

- "Guarantee a volume of higher education study that is applicable to the demand for higher education, bringing the preferences of students closer to the needs of society.
- Assure the quality of higher education on a level comparable to the Nordic countries and the European Union.
- Participate as an equal partner in regional and Europe-wide academic cooperation.
- Satisfy the needs of Estonian society for a highly qualified workforce, taking into account the integration of the Estonian economy into the Nordic countries' economy, with preferential development of studies in the natural and exact sciences and in technology.

- Ensure the continuation and development of Estonian-medium higher education in the European open education space.
- Ensure a level of funding close to the OECD average per student, simultaneously preserving an access to higher education comparable to OECD countries."

(Estonian Ministry of Research and Education 2005a)

These objectives are supposed to be achieved with the following four activity lines, which will be measured using the indicators in brackets:

- Linking higher education with labour market demand (indicators: proportion of people in society with higher education, unemployment rate amongst people with tertiary education, proportion of 25–64 year olds participating in lifelong learning, proportion of people dropping out of studies);
- Linking higher education with research and development activity and the innovation system (Indicators: number of doctoral theses defended per year, proportion of foreign students in Doctoral and Master's study in areas preferred by the state, increasing the number of graduates from the areas of natural and exact sciences and technology);
- Assuring the quality of higher education (indicator: Assessment of Estonian higher education institutions and the quality of their study programmes by agencies registered with the European Higher Education Quality Assurance Register);
- Funding higher education (Indicators: level of funding per student, number of higher education institutions with internationally competitive study environments, access to modern research and information systems).

The **Life Long Learning Strategy 2005–2008** states that one objective is to "raise the opportunities and motivation of Estonian population to participate in formal, non-formal and informal training with the purpose of improving one's knowledge and skills in accordance with one's own needs and that of the citizenship, society and labour market" (Estonian Ministry of Research and Education 2005b). This will be measured by the share of participants in education and training among people aged 25–64, which should reach the level of 10% by the year 2008**.**

Similarly, the **Development Plan for Estonian Vocational Education and Training System 2005–2008** states the need to orient vocational education to the needs of the Estonian economy, improve the quality of the education, increase the number of vocational students, guarantee access to the vocational system and foster cooperation to other types of education (Estonian Ministry of Research and Education 2005c).

5.4 Policy Instruments

In general, measures co-financed by the European Social Fund (ESF) seem to be important. The **National Development Plan** (Government of Estonia 2003/ 2005) includes the priority "Human Resource Development", which aims to increase labour force potential and effective use. Four measures are implemented:

- Measure 1.1: Educational System Supporting the Flexibility and Employability of the Labour Force and Providing Opportunities of Lifelong Learning for all;
- Measure 1.2: Human Resource Development Increasing the Competitiveness of Enterprises;
- Measure 1.3: Inclusive Labour Market;
- Measure 1.4: Enhancing Administrative Capacity Policy Effectiveness.

In terms of higher education the government uses several instruments to attract more young people to RTDI related job opportunities: scholarships for PhD students, funding for short-term international studies (masters, PhD) and research visits, including PhD students in the Centres of Excellence, research rewards etc.

Moreover, it initiated an **Innovation Awareness Raising programme** to popularise S&T among pupils and contemplates relaxed immigration laws to facilitate the inflow of skilled labour.

Another measure aims to increase Estonian school education quality by utilizing modern information and communication technology. **The Tiger Leap programme** is a national specific programme funded by the Ministry of Education and Research. The first stage (1997–2000) of the programme was meant to modernise the ICT infrastructure of educational establishments. The second stage highlighted ICT competency-supporting e-learning initiatives within schools, universities and other institutions. The focus of the current stage (2006–2009) is mainly on e-learning and related content service development, in order to increase curriculum quality and the effectiveness of ICT utilisation.

5.5 Policy Effectiveness

In Table 8, we provide an overview of the main strengths, weaknesses, opportunities, and threats for Human Resource development and related policies.

Table 8: SWOT Analysis of Human Resources (policy)

Strengths	*Weaknesses*
■ High share of employees with tertiary education ■ Relatively high share of students studying temporarily abroad	■ Low level of (tertiary) education investments ■ Low level of lifelong learning ■ Low level of foreign students ■ Deficit of skilled labour ■ Absence of knowledge and skills of innovation and human resource management in both private and public sector
Opportunities	*Threats*
■ Clear strategy for Higher Education, life-long learning and vocational training	■ Brain Drain

own compilation based on Männik 2007: 13

Some specific measures have been launched to increase the attractiveness of the educational system, especially in tertiary education – namely the **Centres of Excellence Programme**. Yet, apart from early observations on implementation (see again Technopolis 2006) it is too early to see the effects of the programme on the system. In the same vein, according to Technopolis (2006a: 22), the **innovation awareness programme** received a "good response to first calls from a range of beneficiaries".

6 Overall Innovation System

6.1 Challenges and Responses

The development of the Estonian Innovation system poses several challenges which have been described in the previous chapters. Here, a brief re-iteration of the main issues is presented:

The Estonian Innovation System is in a phase of rapid catching-up. In this phase it faces some problems typical of catching-up countries, especially those making the transition from the soviet system. Liberal economic policies and low corporate taxes have provided quite favourable framework conditions for business. Both local and foreign enterprises have capitalized on these conditions, linking the Estonian Innovation system increasingly to the advanced markets of its northern neighbours (especially Finland and Sweden) and Europe generally (both by foreign trade, which is a major driver of growth as well as by foreign direct investment), thereby making it less vulnerable to inherited economic ties.

The enterprise sector has been improving productivity and almost halving the gap towards the EU average, but still has to close a considerable gap. Enterprises in Estonia have been very active in innovation, but much less so in R&D. New to market innovations and innovations resulting from collaboration with universities have also been less frequent than in many other EU countries. Barriers to the financing of R&D and innovation remain high, as enterprises report infrequent use of public money to support their efforts in this sphere.

Other weak spots of the system and hence areas of concern for RTDI policy are firstly the availability of skilled labour, which has to be set against the background of low unemployment, rising wages and hence a loss of competitiveness in traditional sectors of the economy; and secondly the quality of the science system and of tertiary education, which attracts too few S&E students and students from abroad and could potentially lead to a Brain Drain.

The existence of these weaknesses does not imply that Estonian RTDI policy has reacted weakly to the challenges confronted by its Innovation System. On the contrary, national policy has risen to the level of good international practice in a very short time, especially in terms of strategy formulation, design of policy instruments and policy learning activities (including evaluation). Policymakers have actively sought to learn from other countries' experiences and to apply them to their own contexts. This is epitomised by programmes like

the Competence Centre Programme, the Centres of Excellence Programme, the new Development Fund (notwithstanding some difficulties in implementation) and a range of other policy measures.

Having recently completed a cycle of strategy formulation, the challenges for the RTDI policy system today are predominantly to:

- Improve the governance of RTDI policy;
- Improve the capacity for policy implementation and the mix of policies;
- Find the right balances when addressing the problems of different stakeholder groups in the innovation system.

6.2 Conflicts and Synergies

There are a number of different (potentially conflicting) policy targets and hence challenges for the RTDI policy system. These are:

- The need to strike the right balance between support to excellence in scientific research and research addressing the needs of enterprises and society
- The need to resolve the conflict between (the funding of) academic research and commercially oriented R&D, and to foster collaboration between academia and business given that in the past it has been described as 'dislocated';
- The need to support the innovation capacities of enterprises in a wider sense (i.e. beyond the stage of R&D), while at the same time increasing the R&D intensity of existing enterprises and fostering structural change towards knowledge-, skill- and R&D-intensive sectors
- The need to focus resources and prioritise them (e.g. via the use of national programmes focusing on these priorities), reflecting both the needs of the business sector as well as of society at large (e.g. reflecting environmental, cultural etc. goals)
- The need to strike the right balance between new technologies, sectors and enterprises and traditional ones, so that new high-tech business start-ups can be fostered in parallel with efforts to improve productivity, technology diffusion and innovative activity in traditional economic sectors and the service sector.

6.3 Policy Orchestration

While Estonian R&D and innovation policy is regarded as one of the most developed amongst the New EU Member States[15], the governance of RTDI policy and the need for further 'policy learning' are mentioned in a number of documents and studies[16,17,18,19,20,21] as important issues if Estonia is to improve its RTDI policy system. For example, "The inadequacy of the coordination of innovation policy between the ministries (of Education and Research and of Economic Affairs and Communications) and the small number of actively involved ministerial departments is an old problem" (Trendchart 2006:4). But the challenges for governance stretch well beyond the coordination between the two main ministries responsible for RTDI, as little explicit articulation of RTDI policy with other policy areas (e.g. macroeconomic policy) seems to have occurred in the past. Thus policy orchestration has to address the following challenges in the future:

- The nature of co-ordination practices within the STI governance system of the country and the strength of linkages between different actors in the economy (particularly between policy makers and industry)
- The way that different policy actors interact with each other both horizontally (e.g. between different Ministries) and vertically (between different levels of STI governance e.g. regional and national)
- The related need for extensive interactions between policy makers in different policy domains (human resources, science base, economic and market development, business R&D and innovation) if technological development and economic growth objectives related to the Lisbon agenda and the National Reform Programme (NRP) are to be attained

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15 *European TrendChart http://www.cordis.lu*
16 *IMPLORE Report on Estonia (2007). [IMPLORE is a project under the aegis of DG Enterprise]. Unpublished Mimeo.*
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20 *European Innovation Progress Report 2006. Trendchart. European Commission.*
21 *Hakkaja, K. ERAWATCH Research Inventory Report for Estonia. See: http://cordis.europa.eu/erawatch (2006)*

6.4 Towards Lisbon

Estonia has formulated development strategies and RTDI policies very much in line with the Lisbon targets. In these strategies, very ambitious targets are formulated. If they are to be reached, the capacities of the RTDI policy system have to be increased, the governance of the RTDI policy system must seek improvements and the policy mix has to be adjusted to balance the needs of the different parts of the innovation system. Not least, sufficient monies have to support these strategies.

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Annex B | Participants and Issue papers

Estonia
Focus Groups
Prepared for the review mission 11–12 June, Tallinn

Focus Group 1:

The Estonian RTDI Policy Mix from Governance and Policy Learning Perspective[22]
(June 11, 9.30–12.00)

KEY TOPICS AND QUESTIONS FOR THE PANELLISTS[23]
Examiners:

- Mr Boris Pukl, Slovenian Research Agency
- Mr Per Koch, Research Council of Norway
- Drs A. M. Wolters (Arjan), Directorate General for Enterprise & Innovation, Strategy, Research and International Affairs Department, Ministry of Economic Affairs for Netherlands
- Ms Marta Truco, DG Research, European Commission

Consultants:

- Dr Wolfgang Polt, Head of Vienna Office of Joanneum Research Institute for Technology and Regional Policy
- Dr Katrin Männik, Consultant, Representative Baltic States, Technopolis Group Belgium

Estonian participants:

- Mr Indrek Reimand, Head of the Research Department, Ministry of Education and Research for Estonia (*Research Secretary of the State Chancellery's Research and Development Council's Research Policy sub-committee*)
- Ms Tea Danilov, Head of the Economic Development Department, Ministry of Economic Affairs and Communications for Estonia (*member of the State Chancellery's Research and Development Council's Innovation Policy and Research Policy subcommittees*)
- Ms Kitty Kubo, Head of Technology and Innovation Policy Unit, Economic Development Department, Ministry of Economic Affairs and Communications for Estonia
- Mr Lauri Tammiste, Head of the Division of Economic Analysis, Ministry of Economic Affairs and Communications for Estonia
- Ms Anna Laido, Counsellor, Research and Development Council Secretariat, State Chancellery
- Mr Madis Võõras, Director for Technology Development, Enterprise Estonia

[22] *This focus group meeting is held within the framework of two exercises: firstly the Commission's OMC-CREST initative and its RTDI policy peer review mission to Estonia; and secondly the Commission's assignment on 'The role of Science and Technology for Catching-up Economies'. These studies are being executed respectively by Dr Wolfgang Polt, Head of Vienna Office of Joanneum Research Institute for Technology and Regional Policy, and Dr Katrin Männik, Consultant, Representative Baltic States, Technopolis Group Belgium.*

[23] *The Ministry of Economic Affairs is also providing the preliminary reports of these projects as background information for the round table meeting.*

Observations

While Estonian R&D and innovation policy is regarded as one of the most developed amongst the New EU Member States[24], the governance of RTDI policy and the need for further 'policy learning' are mentioned in a number of documents and studies[25,26,27,28,29,30] as important issues if Estonia is to improve its RTDI policy system. In particular, the following topics deserve attention:

- **The impact of the socio-economic environment and institutional context** of the country on the nature of the STI governance system and policy making
- **The existence and nature of co-ordination practices** within the STI governance system of the country and the strength of linkages between different actors in the economy (particularly between policy makers and industry)
- **The way that different policy actors interact** with each other both horizontally (e.g. between different Ministries) and vertically (between different levels of STI governance e.g. regional and national)
- **The related need for extensive interactions between policy makers in different policy domains** (human resources, science base, economic and market development, business R&D and innovation) if technological development and economic growth objectives related to the Lisbon agenda and the National Reform Programme (NRP) are to be attained
- **The capacity of different stakeholders and the country in general to benefit from 'policy learning'**, the barriers to such learning and the opportunities available to do so, e.g. via policy reviews, benchmarking, monitoring and evaluation etc.

Questions to the panellists

- What have been the most important developments since the early 1990s (in terms of changes in the socio-economic environment and institutional context) to affect the economic and technological growth of the country? How have various positive and negative factors influenced the STI governance system and policy-making in Estonia? Could you point to significant differences between the three Baltic countries – Estonia, Latvia, and Lithuania? What changes are needed to stimulate further improvements?
- Do you share/agree with the observation that governance is an important issue for Estonian RTDI policy? Please give your view on the existence and nature of co-ordination practices within the STI governance system of the country and the strength of linkages between different actors.
- Can you identify a need for a strong lead institution with responsibility for the RTDI field and with good coordination links with all other relevant policy actors? Which aspects of governance in the Estonian RTDI policy system need to be improved? Can you recommend any good practices from abroad that would be appropriate for Estonia?
- How do interactions between different policy actors occur, i.e. what mechanisms are in place to facilitate interactions? How do these interactions contribute to ´catching-up´? What proposals would you make to improve the interaction between ministries and other related policy actors? Also, how can RTDI policy be better articulated with policies in other areas (environment, education, ICT, social affairs, etc.)? Can you recommend any good practices from abroad that would be appropriate for Estonia?
- Is there space for innovation initiatives to be undertaken at the level of local or regional authorities in the context of regional development policy? Or should STI policymaking be completely concentrated at the level of the central government? If not, how should the various policy levels (national and regional) be integrated?
- How does communication take place between policy-makers and different stakeholders, e.g. industrial representatives from different sectors, academics in different fields, technology users as well as developers etc? Does either industry or academia play a role in policy making? Can you recommend any good practices from abroad that would be appropriate for Estonia?
- Do you consider the strategic framework for the development of RTDI in Estonia to be clear and realistic, and its implementation to be transparent to stakeholders in the RTDI field? Please mention the most important measures/instruments that you could consider will contribute significantly to the economic development of Estonia during 2007–2013?

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24 *European TrendChart http://www.cordis.lu*

25 *IMPLORE Report on Estonia (2007). [IMPLORE is a project under the aegis of DG Enterprise]. Unpublished Mimeo.*

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29 *European Innovation Progress Report 2006. Trendchart. European Commission.*

30 *Hakkaja, K. ERAWATCH Research Inventory Report for Estonia. See: http://cordis.europa.eu/erawatch (2006)*

- Do you support the efforts of national policy makers to shape developments in the RTDI field, even if some of these efforts are out of alignment with EU policy and/or the wishes of some Estonian companies and multinational corporations? Can you point to any innovation champions in the Estonian economy?
- To what extent are evaluations, monitoring practices and foresight studies integrated into policymaking? How are each of these embedded in the policy making system? What feedback mechanisms are in place to ensure that the results of these endeavours influence the formulation and implementation of future policies?
- What are the most important opportunities and threats affecting the STI governance system and policymaking in Estonia, taking into account its location in the Baltic area next to both Russia and Northern Europe?

Focus Group 2:

The Estonian RTDI Policy Mix: Instruments and their Implementation[31]
(June 11, 13.30–16.00)

Examiners:
- Mr Boris Pukl, Slovenian Research Agency
- Mr Per Koch, Research Council of Norway
- Drs A. M. Wolters (Arjan), Directorate General for Enterprise & Innovation, Strategy, Research and International Affairs Department, Ministry of Economic Affairs for Netherlands
- Ms Marta Truco, DG Research, European Commission

Consultants:
- Dr Wolfgang Polt, Head of Vienna Office of Joanneum Research Institute for Technology and Regional Policy

Estonian participants:
- Ms Tea Danilov, Head of the Economic Development Department, Ministry of Economic Affairs and Communications for Estonia (*member of the State Chancellery's Research and Development Council's Innovation Policy and Research Policy subcommittees*)
- Ms Kitty Kubo, Head of Technology and Innovation Policy Unit, Economic Development Department, Ministry of Economic Affairs and Communications for Estonia
- Mr Rein Vaikmäe, Vice Rector for Research, Tallinn University of Technology (*member of the State Chancellery's Research and Development Council's Research Policy subcommittee*)
- Mr Siim Sikkut, Head of Development Unit, State Budget Department, Ministry of Financial Affairs for Estonia
- Mr Madis Võõras, Director for Technology Development, Enterprise Estonia
- Mr Meelis Sirendi, Member of the Board, Estonian Science Foundation
- Mr Madis Saluveer, Head of Office, Estonian Research Competency Council
- *Dr Katrin Männik, Consultant, Representative Baltic States, Technopolis Group Belgium (observer)*

The adequacy of the mix of policy instruments used to support RDTI (programmes, funding schemes, fiscal measures, institutional support schemes etc.) and how well these instruments are implemented are core concerns of the CREST policy mix reviews. The underlying assumption is that, in order to reach the Lisbon and Barcelona targets, such a mix of policy instruments should correctly address the main challenges of the innovation system; should have no or few gaps or overlaps in terms of the spectrum of instruments deployed; and should be implemented within the context of a well-structured institutional setting. This Focus Group, therefore, will concern itself with these core issues.

[31] *The focus group meeting is held within the framework of the Commission's OMC-CREST initative and its RTDI policy peer review mission to Estonia. It is moderated by Dr Wolfgang Polt, Head of the Vienna Office of Joanneum Research Institute for Technology and Regional Policy.*

KEY TOPICS AND QUESTIONS FOR THE PANELLISTS

Observations

While Estonian R&D and innovation policy is regarded as one of the most developed amongst the New EU Member States and has been described as being well structured and advanced in terms of the use of different instruments[32], several reports[33], also point to room for improvement in terms of the composition of the mix and the general implementation of RTDI policy.

Some issues are potentially of great importance in terms of improving the Estonian RTDI policy mix. These include:

- The need to strike the right balance between **support to excellence in scientific research and research addressing the needs of enterprises and society**
- **The link between (the funding of) academic research and commercially oriented R&D** which has been described as being 'dislocated' in the past
- The need to support the **innovation capacities of enterprises** in a wider sense (i.e. beyond the stage of R&D),
- The need to **focus resources and prioritise** them (e.g. via the use of national programmes focusing on these priorities)
- The need to strike the right **balance between new technologies / sectors / enterprises and traditional ones.**

These issues give rise to a number of questions for the panellists to consider:

Questions to the panellists

- How have the recommendations of past evaluations of RTDI policy instruments been taken up? What changes have been introduced as a consequence of these evaluations in terms of the range of instruments deployed and the ways in which they are implemented? How should the system be further changed?
- What were in your opinion the most important recent changes in the instruments supporting RTDI? Do you consider the currently available policy instruments as being appropriate and sufficient to meet the challenges being faced by enterprises? Where do you see gaps in the mix of instruments? Where do you see potential overlaps?
- In the current state of the development of the Estonian Innovation System, what would in your opinion be the right balance between academic and commercially oriented R&D? Is the link between basic and applied research sufficiently established? Should there be further measures to improve the situation or just better co-ordination of existing ones? If new measures are needed, what are they?
- How much emphasis should be put on support for innovation rather than for R&D. What should be the correct balance?
- What have been the first experiences with sector / technology / cluster-specific measures? Should they be prioritised?
- Though the 'tool-box' of policy instruments in use in Estonia seems to be quite comprehensive, there is currently no specific tax treatment of R&D/innovation expenditure. The RTDI strategy for 2007–2013 foresees the discussion of such an instrument. Do you think that such a measure should be introduced? Why/why not? If so, how should it be concretely designed to have the best effect?
- What can be improved in terms of the delivery of the different instruments, and if so what would you suggest? How would you judge the comparative performance of the institutions responsible for the implementation of these instruments?

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[32] *European TrendChart http://www.cordis.lu*

[33] *Reid, A. (2003) Optimising the Design and delivery of Innovation Policy in Estonia. Tallinn Technopolis Consulting Group (2005) Evaluation of the design and implementation of Estonian RTDI policy: implications for policy planning. Tallinn Technopolis, MERIT, Logotech, ISMERI, LACAVE&ass (2006) Strategic Evaluation on Innovation and the Knowledge Based Economy in relation to the Structural and Cohesion Funds for the programming period 2007-2013 Nedeva, M. Georghiou, L. (2003) Assessment of the Estonian research development Technology and Innovation Funding System. Manchester*

Focus Group 3:

The Estonian RTDI Policy Mix from a Business and Industry Perspective[34]
(June 12, 9.30–12.00)

KEY TOPICS AND QUESTIONS FOR THE PANELLISTS
Examiners:

- Mr Boris Pukl, Slovenian Research Agency
- Mr Per Koch, Research Council of Norway
- Drs A. M. Wolters (Arjan), Directorate General for Enterprise & Innovation, Strategy, Research and International Affairs Department, Ministry of Economic Affairs for Netherlands
- Ms Marta Truco, DG Research, European Commission

Consultants:

- Dr Wolfgang Polt, Head of Vienna Office of Joanneum Research Institute for Technology and Regional Policy

Estonian participants:

- Mr Lauri Tammiste, Head of the Division of Economic Analysis, Ministry of Economic Affairs and Communications for Estonia *(national co-ordinator of the Community Innovation Survey CIS4 in Estonia)*
- Mr Aavo Heinlo, Chief RTDI Analyst, Estonian Statistical Office *(co-author of the Community Innovation Survey CIS4 in Estonia)*
- Mr Indrek Kelder, Business R&D Financing Programme manager. Enterprise Estonia
- Mr Ott Pärna, CEO, Estonian Development Fund *(public start up equity investment fund)*
- Mr Pirko Konsa, Member of Executive Board, Tallinn Technology Park Tehnopol
- Mr Marek Tiits, Chairman of the Board, Institute of Baltic Studies
- *Dr Katrin Männik, Consultant, Representative Baltic States, Technopolis Group Belgium (observer)*

Observations
Estonia has made considerable progress in terms of the innovation activities of its enterprises[35] and Estonian R&D and innovation policy is regarded as one of the most developed amongst the New EU Member States[36]. Nevertheless, several reports[37] also point to room for improvement in terms of the innovation performance of enterprises, the mix of policy instruments supporting them and the overall implementation of RTDI policy. Some issues in this vein which we want to discuss with you as stakeholders (and participants in the programmes) are as follows:

Questions to the participants

- What were in your opinion the most important recent changes in the instruments supporting RTDI? Do you consider the currently available policy instruments as being appropriate and sufficient to meet the challenges being faced by enterprises? Where do you see gaps in the mix of instruments? Where do you see potential overlaps?
- Is R&D currently too focused on scientific excellence rather than business needs? How can linkages between the research base and industry be improved? What are the best instruments for that? What would be appropriate policy measures to motivate Estonian enterprises to become 'strategic innovators'?
- Are there any gaps evident in the continuity of funding along the spectrum from basic R&D to innovation and demonstration/development? If so, where?
- What should be the role of sector/technology/cluster-specific measures (as compared to more generic policy instruments)? Whether and how should they be prioritised? In which sectors/regions do you see the potential for such measures?
- There is currently no specific tax treatment of R&D/innovation expenditure. The RTDI strategy for 2007–2013 foresees the discussion of such an instrument. Do you think that such a measure should be introduced? Why / why not? If so, how should it be concretely designed to have the best effect?

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34 *The focus group meeting is held within the framework of the Commission's OMC-CREST initative and its RTDI policy peer review mission to Estonia. It is moderated by Dr Wolfgang Polt, Head of the Vienna Office of Joanneum Research Institute for Technology and Regional Policy.*

35 *See European Innovation Scoreboard 2006 and Innovation in Estonian Enterprises 2007*

36 *European TrendChart http://www.cordis.lu*

37 *Innovation in Estonian Enterprises 2007; Reid, A. (2003) Optimising the Design and delivery of Innovation Policy in Estonia. Tallinn; Technopolis Consulting Group (2005) Evaluation of the design and implementation of Estonian RTDI policy: implications for policy planning. Tallinn; Technopolis, MERIT, Logotech, ISMERI, LACAVE&ass (2006) Strategic Evaluation on Innovation and the Knowledge Based Economy in relation to the Structural and Cohesion Funds for the programming period 2007-2013. Nedeva, M. Georghiou, L. (2003) Assessment of the Estonian research development Technology and Innovation Funding System. Manchester*

- Are enterprises in the service sector addressed sufficiently by the current system of RTDI support?
- What are the roles of venture capital and business angels in Estonia?
- What measures can be taken to increase the absorptive capacity of SMEs?
- What can be improved in terms of the delivery of the different instruments, and if so what would you suggest? How would you judge the comparative performance of the institutions responsible for the implementation of these instruments? Are there any barriers to firms limiting their access to funding for RTDI? If so, what are they and how can they be removed?
- How does communication take place between policy-makers and different stakeholders, e.g. firms in different sectors, academics in different fields, technology users and developers etc? Do industry and/or academia play a role in policy making?
- Do you consider the overall framework for supporting RTDI in Estonia to be clear and realistic, and its implementation to be transparent to stakeholders in the RTDI field? Please mention the most important measures or instruments that you consider will contribute significantly to the economic development of Estonia during 2007–2013?

Annex C | List of Interviewees

Estonia

In addition to the Focus Groups, in the period from 14 May to 14 August individual interviews were conducted with the following persons:

- Mr. Tiit Jürimae, Head of Unit, European Commission – DG Research, Brussels
- Ms. Katrin Männik, Consultant, Representative Baltic States, Technopolis Group, Tallinn
- Mr. Erik Terk, Director, Estonian Institute for Future Studies, Tallinn
- Mr. Marek Tiits, Researcher, Chairman of the Board, Institute of Baltic Studies, Tartu

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