

Assessment of the Estonian Research Development Technology and Innovation Funding System

Final Report

by

**PREST
The Victoria University of Manchester
UK**

**Maria Nedeva
Luke Georghiou**



THE UNIVERSITY
of MANCHESTER

<u>1. Introduction</u>	3
<u>1.1 General background</u>	3
<u>1.2 Study objectives</u>	4
<u>1.3 Structure of the report</u>	5
<u>2. Methodology</u>	6
<u>2.1 Some basic assumptions</u>	6
<u>2.2 Definition of concepts</u>	6
<u>2.3 Research Methodology</u>	8
<u>3. The Estonian RTDI funding system</u>	9
<u>3.1 Main policy documents</u>	9
<u>3.1.1 Organisation of Research and Development Act</u>	9
<u>3.1.2 Knowledge-based Estonia: Estonian Research and Development Strategy 2002-2006</u>	9
<u>3.1.3 Summary</u>	11
<u>3.2 Funding streams</u>	12
<u>3.3 RDTI funding level</u>	13
<u>3.4 Institutional framework for RTDI funding</u>	15
<u>3.5 Funding mechanisms</u>	25
<u>3.6 Summary</u>	28
<u>4. Problems and options for change</u>	30
<u>4.1 Problems of the RDTI funding system in Estonia</u>	30
<u>Insufficient funding for RDTI</u>	30
<u>Lack of base-line funding for research institutions</u>	33
<u>Fragmentation of the RDTI system</u>	33
<u>Visions of research/science</u>	36
<u>4.1.1 Summary</u>	36
<u>4.2 Options for change</u>	37
<u>4.2.1 Insufficient funding for RDTI</u>	37
<u>4.2.2 Lack of base-line funding for research institutions</u>	39
<u>4.2.3 Fragmentation of the system</u>	41
<u>4.2.4 Visions of research/science</u>	45
<u>5. Scenarios</u>	46
<u>5.1 Choosing ‘comfortable life’</u>	46
<u>5.2 Winning the battle, losing the war</u>	47
<u>5.3 Jumping in the deep end and...</u>	48
<u>Annex One</u>	51
<u>Research and Innovation Funding Council: making the case</u>	51
<u>Further comments on the Research and Innovation Funding Council (RIFC)</u>	51
<u>Cases of RDTI funding systems</u>	52
<u>The United Kingdom</u>	53
<u>Norway</u>	57

Assessment of the Estonian Research Development Technology and Innovation Funding System

1. Introduction

1.1 General background

When Estonia regained its independence in 1991 the research/innovation system of the country needed not simply to be transformed but to be rebuilt. As a direct result of the exclusion from the broader research structures of the former Soviet Union, of which it was previously part, many users and funding sources were lost. There was no adequate public funding for research and the share of the private sector in research funding was very low at about 10%¹. Thus, it was necessary, and decided, to embark on a radical programme of transformation. In fact, Estonia was one of the three countries, together with the Czech Republic and Latvia, to initiate fast, radical (shock) change of its national research and innovation system².

Since the time of these initial stages of transformation and radical policy action the national research/innovation system of Estonia has advanced considerably. Advances have been achieved in all aspects of the functioning of the system, namely policy development and implementation, institutional change, change of funding structures and mechanisms, change of orientation (mainly the influence of development in the EU) etc.³

The Estonian Strategy for Research and Development 'Knowledge-based Estonia' '...defines the aims, opportunities and principles for promoting RD&I in Estonia, and is the basis for RD&I organisation and activities in the coming years.'⁴ Approved by the Estonian Parliament (the Riigikogu) in December 2001 this document spells out the national aspiration of Estonia to become '...a knowledge-based society where the sources of economic and labour force competitiveness, and improvement in the quality of life, stem from research directed towards the search for new knowledge, the application of knowledge

¹ See: Marek Tiits, Rein Kaarli, Research and Development in Estonia 2000-2001, Research and Development Council, Tallinn, 2002;

² See: Slavo Radošević, Restructuring and reintegration of Science and Technology Systems in Economies in Transition, 1996;

³ For more on these see: Marek Tiits, Rein Kaarli, Research and Development in Estonia 2000-2001, Research and Development Council, Tallinn, 2002

⁴ Knowledge-based Estonia: Estonian Research and Development Strategy 2002-2006

and skills, and the development of human capital...'⁵ Achieving this national aspiration, however, crucially depends on developing an adequate and efficient RDTI funding system.

That is why it was decided that the Ministry of Education and Research in Estonia would organise (and manage) an assessment of the RDTI funding system currently operating in Estonia. It was also perceived as important that the experts carrying out this assessment should not have vested interests in the system. Hence, PREST (Policy Research in Engineering Science and Technology), an Institute of the University of Manchester in the United Kingdom were commissioned to carry out the assessment.

1.2 Study objectives

The objectives of the assessment of the RDTI funding system in Estonia as specified by the Terms of Reference are as follows:

- to conduct a review of the current R&D funding system in Estonia;
- to review the objectives of the Estonian R&D Strategy 2002-2006;
- to review best practice in R&D funding elsewhere; and
- to propose an efficient, transparent and accountable R&D funding system.

While, the national innovation/research system of Estonia has been studied extensively, these studies have focused predominantly (if not exclusively) on the part of the system dealing with 'innovation' and heralded by the Ministry of Economic Affairs and Communications rather than on its research part as championed by the Ministry of Education and Research⁶. In this context our work has more integrative ambitions whereby one of our aims is to discuss the funding mechanisms spanning both sides of the national system. We believe that such discussion will bring to light some issues (problems of the funding system and its structures and mechanisms) that are difficult to spot when the emphasis is placed on one aspect of the complex processes of knowledge production and use.

We also believe that the success of social change, particularly policy driven change, is to a great degree contingent upon the ability of local stakeholders to implement certain transformations and upon their commitment to such transformations. Achieving these major social preconditions for implementing

⁵ Knowledge-based Estonia: Estonian Research and Development Strategy 2002-2006

⁶ European Commission, 2001, *Innovation Policy issues in six candidate countries: the challenges*, Innovation/SMEs programme; Hernesniemi H., 2000, Evaluation of Estonian Innovation System, Report; Kurik S., et al., 2002, Innovation in Estonian Enterprises 1998-2000, Innovation studies, Tallinn; Reid A., 2003, Optimising the Design and Delivery of Innovation Policy in Estonia: an Evaluation of Policy Instruments for Intensifying Business Innovation, Innovation studies, Tallinn;

measures aiming to alter particular social systems is, by its very nature a demanding, difficult and time consuming process. Experience elsewhere indicates that external mediation can be useful in achieving the levels of consensus and commitment necessary to embark upon social change. Thus another, albeit implicit, aim of this work is to mobilise the different stakeholders in Estonia and initiate a dialog which, we hope, would ultimately result in agreement regarding policy measures for change and commitment to implementing these measures.

Finally, it is worth noting that the quality of research in Estonia is not an issue in this report. We believe – and the results from the international evaluation(s) of the research units in Estonia provide ample evidence – that the quality of research in Estonia is not better and not worse than elsewhere in Europe. If anything, there are areas of basic science (physics, for example) in which scientists in Estonia measure well when compared with the best in the world. This, however, is not discussed in later sections of this report since its overall objective is not to pass judgement on research quality but to examine the existing funding regime and assess whether it is conducive to achieving the national aspirations of Estonia.

1.3 Structure of the report

This document is the draft report on our findings and suggestions and is structured as follows:

- In Part 2 the methodology used to conduct this study is presented;
- In Part 3 our understanding of the ways in which the RDTI funding system in Estonia operates has been discussed;
- In Part 4 the problems of the RDTI funding system in Estonia have been outlined and options for dealing with these problems formulated; and
- Part 5 contains scenarios illustrating the complex interdependencies that effect particular choices of options.

2. Methodology

2.1 Some basic assumptions

For the purposes of this work it has been assumed that:

- It is potentially beneficial in the context of this study to distinguish between 'funding system', 'funding structures' and 'funding mechanisms' for R&D.
- At the most general level three distinctive groups of social participants in the research and development funding process can be distinguished. These are research funders (public, private and other), recipients of research funding (various research performers) and beneficiaries from research funding (industry and services, for example). While a significant level of overlap between groups is possible it does not necessarily occur.
- The funding structures are the patterns of relationships between the social participants that emerge in the process of funding for research. Particular attention should be paid to the types of exchange that can occur in the context of these relationships. Also the interactions between these social agents can sometimes go beyond the funding itself.
- In the context of this study the term 'funding mechanisms' refers to the set of rules, regulations and monitoring and evaluation techniques that support particular research funding regimes.
- There are three different sets of issues involved in the process of funding for research, development and innovation. These are: i) how much funding is available; ii) how is this funding allocated (including monitoring returns etc.); and iii) how is this funding being absorbed.
- Any research, development and innovation funding system can support three basic types of activities, namely: i) research; ii) education and training; and iii) commercialisation of research results. In this report the focus is on mainly on research.
- Any assessment of the effectiveness and efficiency of national R&D funding systems should be carried out in relation to two kinds of factors. These are: i) internal (national aspirations and performance); and ii) external (the influence of developments such as the European Research area, for example).
- Any changes that can be suggested following the assessment of a national R&D funding system should account for tradition and the local context.

2.2 Definition of concepts

Since some issues regarding the meaning of some of the concepts used here was raised during a discussion in Estonia definitions of research and innovation are provided below. The definitions of research are broadly based on the definitions in the Frascati manual.

Research and Development (R&D)

For the purposes of this study Research and Development (R&D) means '...creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications. R&D is a term covering three activities: basic research, applied research and experimental development.'

Basic research

Basic research is experimental or theoretical work, undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Strategic applied research

Strategic applied research is defined as applied research where the work, although directed towards practical aim, has not yet advanced to the stage where eventual application can be clearly specified. Applied research which is not strategic in nature will have quite specific and detailed products, processes and systems etc., as its aim. It is recognised that the boundary between basic research and strategic applied research is often subjective.

Applied research

Applied research is also original investigation undertaken in order to acquire knowledge. It is, however, directed primarily towards specific practical aims or objectives.

Innovation

Innovation means the use of new ideas and knowledge (results from research) to implement new technology, management processes, products and services⁷.

Comment on use of concepts

⁷ Organisation of Research and Development Act

During some of our meetings in Estonia we perceived a tendency to assume that thinking about research in terms of 'basic', 'strategic', and 'applied' is somehow a sign of 'old' (understand 'wrong') thinking about these issues. That is not necessarily the case. So for example, if one thinks about conceptual shifts (e.g. Mode 1 – Mode 2 etc.) the change does not seem to affect so much the levels of applicability of the results from research activity as the relationships between these levels. In other words, while it is still true that research can be conceptualised in the terms of the Frascati manual the relationships between the different types of research are not linear and sequential but distributed. Applied research does not necessarily follow from basic research (the reverse is also true) and development does not necessarily conclude the process.

It is worth pointing out that such conceptual assumptions are never simply a theoretical issue and usually inform visions and beliefs underpinning the way in which we structure our social practices. In this particular case we believe that rejecting completely the Frascati definitions of research has direct consequences for the ways in which the RDTI funding system in Estonia operates. We will get back to this point in Parts 3 & 4 of the report.

2.3 Research Methodology

Information to feed into this study was gathered using two main methods - documentary analysis (both policy documents and previous reports) and semi-structured interviews with Estonia stakeholders.

Close to twenty meetings (19) some of which with several people were conducted during a study visit to Estonia during April (21-25 April, 2003). We met representatives of different stakeholders in the RDTI funding system in Estonia: ministries, funding agencies, research institutes, universities and industry. The following clusters of issues were discussed:

- a) brief explanation of the funding system;
- b) problems of the funding system as perceived by the interviewees;
- c) ideas for change of the system; and
- d) opinions regarding the objectives of the strategy paper 'Knowledge based Estonia' - their realism and the boundary conditions for achieving these.

Apart from that a Workshop aiming to present preliminary findings, collect feedback on these and initiate a discussion/dialog between stakeholders in Estonia was organised on May 8th 2003. Feedback from the Workshop has been incorporated in this report.

3. The Estonian RTDI funding system

3.1 Main policy documents

3.1.1 Organisation of Research and Development Act

In effect the Organisation of Research and Development Act is the main law regulating the organisation of research and development in Estonia. 'The purpose of the Act is to provide the bases for the organisation of research and development and to ensure legal means for the preservation and further development of scientific and technological creation as a component of Estonian culture and Estonian economy'⁸. This document entered into force in May 1997 and was amended in 2002 to reflect the latest changes in the RDTI system.

More specifically the Organisation of Research and Development Act:

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

The document has been used in this report to inform on the main functions (responsibilities) of the institutions and agencies directly involved in financing RDTI in Estonia. This helps to draw an 'ideal' picture which is later corrected by accounts about real practices.

3.1.2 Knowledge-based Estonia: Estonian Research and Development Strategy 2002-2006

The Estonian Research and Development Strategy is a document prepared collaboratively by the Ministry of Education (now Education and Research), the Ministry of Economic Affairs (now Economic Affairs and Communications) and the Estonian Academy of Sciences. Following discussions by the Cabinet of the Estonian Government and extensive public debate the Strategy was altered to incorporate the different concerns. The Strategy was approved by the Estonian Parliament (the Riigikogu) in December 2001.

⁸ Organisation of Research and Development Act

This document clearly articulates the vision of the future of Estonia (and respectively its national aspirations), sets out the objectives and key areas for the promotion of research, development and innovation, and outlines the boundary conditions for implementation of these objectives.

The vision of the future of Estonia reads: ‘..Estonia is a knowledge-based society where new knowledge, the application of knowledge and skills, as well as the development of human capital, constitute the source of economic and labour force competitiveness and an enhanced quality of life...Estonia has preserved its identity, supporting research and promoting national and intellectual values..Cooperation between the state, the private sector and the third sector is based on the recognition of common objectives and striving for their achievement. Openness and innovation have turned Estonia into an appreciated international cooperation partner.’⁹

This document sets out two main objectives for Estonian RDTI, namely:

- Updating the knowledge pool (the focus here is on raising the quality and level of scientific research); and
- Increasing the competitiveness of enterprises (with emphasis on developing integration mechanisms between the research and business sectors).

Three key areas (priority areas) have been selected: user-friendly information technologies (IT); biomedicine; and materials’ technologies.

In line with this vision the Strategy announces an intended increase in total R&D expenditure from the current level of 0.7% of GDP to 1.5% by 2006, which will be a move towards the average EU level. Three basic principles for research funding till 2006 have been discussed in the Strategy: i) increase in the state financing; ii) increased participation of private and overseas capital; iii) ensuring the effectiveness, transparency and social and economic benefits of public funding for research.

As A. Reid points out ‘..this strategy sets out a number of ambitious goals but remains somewhat thin in terms of linking quantifiable targets to instruments and to stated objectives.’¹⁰ It should be also noted that the strategy document sounds fairly ‘theoretical’ and needs further elaboration if it is to become a viable plan for action. Moreover, reading the document there is a feeling of a certain ‘dislocation’ – two fairly extreme underlying philosophies seem to transpire without clear possibility for synthesis. These are the belief in the beauty and

⁹ Knowledge-based Estonia: Estonian Research and Development Strategy 2002-2006

¹⁰ Reid A., 2003 Optimising the Design and Delivery of Innovation Policy in Estonia: an Evaluation of Policy Instruments for Intensifying Business Innovation, Innovation Studies, Tallinn.

elegance of science in its 'purest' form as 'academic science' (blue sky research) and the vision of science as directly useful and contributing to wealth creation or 'commercial science'¹¹. Successive paragraphs exemplify these diverging visions and there is no clear possibility for workable compromise (synthesis).

3.1.3 Summary

- Two main policy documents frame the conditions for the formulation and implementation of policy (and funding) for RDTI in Estonia: the Organisation and Development Act and the strategy document 'Knowledge-based Estonia'.
- The national aspirations of Estonia are made explicit in the strategy document. The vision of the future of Estonia conveyed by the document is this of a knowledge-based society the success and prosperity of which crucially depend on research, innovation and knowledge related skills.
- Two main objective of Estonian RDTI have been set out - to update the knowledge pool and to increase the competitiveness of enterprises. These are to be achieved in three key areas, namely IT, biomedicine and materials technologies.
- To achieve these objectives an intended increase in total RDTI expenditure from the current level of 0.7% of GDP to 1.5% of GDP by 2006 was announced.
- While very clear the strategy document is still fairly 'general' and requires a further level of concretisation to become a useful foundation for policy action.
- Both documents express a certain 'dislocation' in the RDTI system of Estonia – dislocation between the belief in the 'academic science' model and the model of science as 'commercial'.

¹¹ For more on 'academic science' and 'commercial science' see: Boden R., Cox D., Nedeva M., and Barker K., *Scrutinising Science: The changing UK Government of Science*, Palgrave, forthcoming.

3.2 Funding streams

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

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

In practice one of the funding streams is extremely under-developed. This is the one where funding is allocated for the realisation of national research and development programmes. At present very few programmes are operational (one on Estonian Language and Culture under the Ministry of Education and Research) and respectively very few ministries are really involved in funding RDTI (the Ministry of Agriculture and the Ministry of Defence are two examples where ministries have some, albeit very limited role). Moreover, according to the R&D Act the programmes are viewed to be the responsibility of a particular ministry where one of the main benefits of such initiatives is that these are cross-cutting.

3.3 RDTI funding level

The level of RDTI funding in Estonia has been stable at about 0.6% of GDP for the last six years. According to GERD as a proportion of GDP Estonia ranks eight among the EU candidate countries (where the Czech Republic with 1.64% and Slovenia with 1.44% are the leaders). The comparison between Estonia and the member countries of OECD according to this indicator is also not very favourable¹².

Table 1 contains information about the distribution of public funding for RDTI between funding streams (and budget lines).

Table 1: Funding streams in 2002 and 2003 (in thousands EEK)

Funding stream	2002	2003
Targeted financing	197,000	208,000
ESF	79,600	80,000
Infrastructure fund	44,458	53,140
State R&D institutes	8,015	12,710
Estonian Academy of Sciences	16,510	16,510
EU programmes		51,460
Membership fees		40,994
Archimedes Foundation		13,596
Enterprise Estonia/ESTAG	128,678	158,000
Total	474,261	634,410

Source: Data provided by Helle Martinson.

Looking at Table 1 it can be noted that the Targeted financing is by far the most influential funding stream in Estonian research and innovation. There is also a slight increase of the finance directed through this stream in 2003. Another relatively large funding stream is the one administered by Enterprise Estonia/Estonian Technological Agency - ESTAG¹³ - and this has also increased in 2003. In fact in absolute terms this is the single largest increase in the Estonian RDTI funding system. It should be also noted that the increase of the total RDTI funding in 2003 is by and large accounted for by the three budget lines

¹² Data from: *Research and Development in Estonia 1996-1999*

¹³ From the beginning of 2003 the Estonian Technology Agency (ESTAG) ceased to exist as a separate institutional entity. Enterprise Estonia, a part of which ESTAG used to be, currently has among many different instruments also a set of policy instruments aimed at encouraging and supporting technological development and innovation. For the purpose of clarity, however, we will refer to this set of instruments as Enterprise Estonia/ESTAG.

supporting international co-operation and participation in the European research structures.

Table 2: R&D expenditure – Targeted funding, ESF and Infrastructure fund (2002-2003)

Institution	Target finance	Infrastructure fund	ESF
University of Tartu	54348	15442	29805
Tallinn Technical University	20503	7056	9480
Estonian Agricultural University	6680	3778	3810
Tallinn University of Educational Sciences	1270	667	1284
Research establishments	39784	9523	11981
Institutes Agricultural University	10162	2075	5079
Institutes Technical University	5185	1214	1994
Institutes University of Tartu	19825	4734	5121

Source: Estonian Ministry of Education and Research

Table 2, on the other hand shows that the level of concentration of research funding in Estonia is fairly high with the University of Tartu in the lead¹⁴. Such concentration of resources, usually a result of increased selectivity, is fairly common and has been registered by studies elsewhere¹⁵. At the same time it might indicate biases in the funding system (an inherent bias against more applied research areas, for example).

¹⁴ This is particularly evident given that some of the entries are not single institutions but composite categories like 'research establishments'.

¹⁵ See, for example: Georghiou L.G., Halfpenny P., Nedeva M., Evans J. and Hinder S., (1996), *Survey of Research Equipment in United Kingdom Universities*, London, ISBN 0 946007 07 1; J. Howells, M. Nedeva and L. Georghiou, (1998), *Industry-Academic Links in the UK*, HEFCE, ISBN 0902369 021;

3.4 Institutional framework for RTDI funding

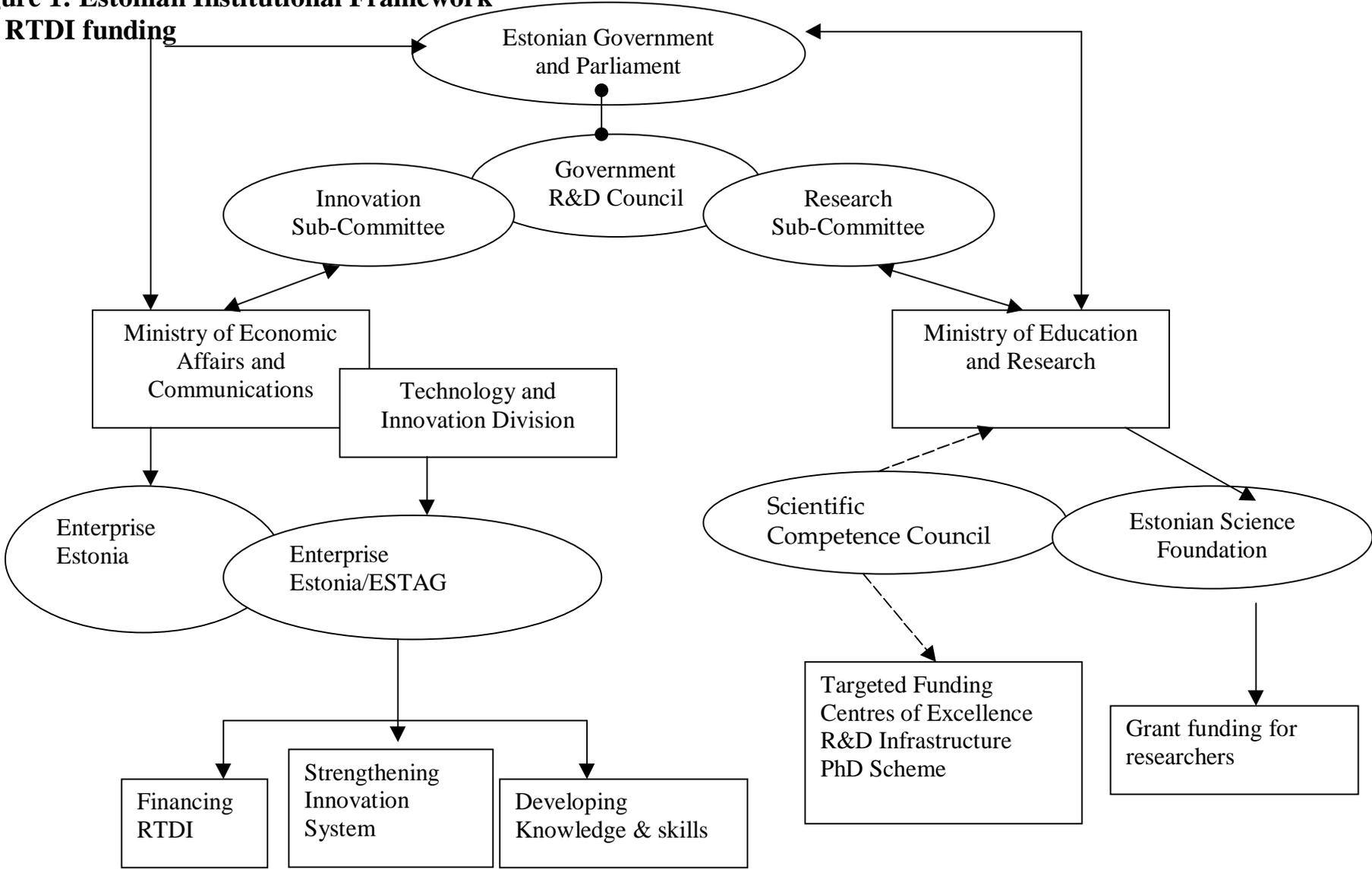
This part of the report presents the institutional framework for financing RTDI in Estonia. Figure 1 is a graphical expression of the system. In this section the current legislation and the accounts by stakeholders have been used to draw a picture of the institutional RTDI framework currently operating in Estonia.

At the highest political levels responsibilities for deciding the budget for RTDI is with the Government and Parliament of Estonia. At this level the state budget for RTDI activities is decided as separate budget lines for the different ministries and streams of funding. Once the state budget has been agreed by the Estonian Government it has to be approved by the Parliament of the country.

According to the current legislation of Estonia the following are among the R&D organising responsibilities of the Government of the Republic:

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

Figure 1: Estonian Institutional Framework for RTDI funding



- shall establish the procedure for the formation of the Scientific Competence Council and shall establish its rules of procedure and approve its membership; etc.

In fulfilling its responsibilities in the context of developing policy for research and development, the Estonian Government is supported by the **Research and Development Council**. The Research and Development Council is an advisory body and was established in 1990. This is chaired by the Prime Minister and according to the legislation of Estonia it is within its remit to:

- advise the Government on R&D strategy;
- offer opinion regarding national R&D programmes presented by the ministries;
- submit annually a report to government on R&D in Estonia and on R&D objectives for the forthcoming period;
- advise government regarding the preparation of the draft state budget (in terms of overall amount and allocation among different ministries and types of finance); etc.

The Research and Development Council has 12 members (the Prime Minister, the Minister of Education and Research, the Minister of Economic Affairs and Communication, one member of the Government appointed by the Prime Minister and eight members appointed by the Government) and its membership is approved by the Government for up to three years. The Council is chaired by the Prime Minister and its work is supported by a small Secretariat.

Almost from the outset the Research and Development Council experienced considerable problems. According to some, soon after its establishment the Council became an arena for the scientists to argue for increased (ever-increasing) budgets. This went against the principal aims and objectives of the Council and ultimately resulted in it effectively ceasing to exist by 2000. Another possible factor contributing to the difficulties experienced by the Councils might be that during that time neither the government nor industry (or for that matter the society as a whole) were interested in the workings of science and research and the importance of RDTI activities for achieving the national aspirations of Estonia was not explicit.

The Research and Development Council resumed its work in 2002 following some necessary transformations. Thus the membership was reduced from 20 to 12 and a balance of representation was (is being) ensured. Currently the membership consists of 4 ministers, 4 academics and 4 industrialists.

In the light of fulfilling its functions in the innovation/research system of Estonia particularly important is the introduction of two sub-committees of the Council.

One of these – the Research Policy Council - is chaired by the Minister for Education and Research and is responsible for the development (and possibly the implementation) of the research policy of the country. The other one – the Innovation Policy Council – is chaired by the Minister of Economic Affairs and Communications and has responsibilities for the innovation policy of Estonia.

We would like to emphasise that the Research and Development Council only advises Government on the research, technology and innovation objectives. The Government of Estonia is the body deciding on the objectives of and budget(s) for research and innovation. Particularly influential in the decision making process are two key members of the Government, namely the Prime Minister and the Minister of Finance.

While *de jure* all ministries should take responsibility for organising R&D activities (including financing)¹⁶ within their respective governance domains *de facto* the two ministries that are primarily involved in financing RDTI (and respectively formulating and implementing policies for RDTI) are the Ministry of Education and Research and the Ministry of Economic Affairs and Communications¹⁷. Correspondingly, these two ministries have some additional responsibilities.

In addition to the overall responsibilities for supporting R&D in their respective domains that all ministries have, the Ministry of Education and Research is responsible for:

- Implementing the national R&D policy and organising R&D activities;
- Developing proposals concerning R&D policy and R&D strategy and submitting these to the Government;
- Organising the financing of R&D at research and development institutions;
- Co-ordinating international collaboration;
- Organisation of research evaluations; etc.

The Ministry of Economic Affairs and Communications, on the other hand, is charged with the following responsibilities:

¹⁶ According to current legislation all ministries, among other things, should take responsibility for: i) organising the research and development in their areas, ii) developing national R&D programmes arising from national development plans and falling within their area of responsibility, iii) approving the statutes of state R&D institutions performing within their domain; and iv) determining the amount and justification of the funds necessary to finance R&D within their areas.

¹⁷ The Ministry of Agriculture is responsible for the funding of its two institutes and also have a small allocation for financing research in the area of agriculture. The funding involved, however, is so small that it is almost negligible.

- To implement national innovation policy;
- To prepare proposals concerning the research and development, and innovation policy and submit these to the Government;
- To organise the financing of applied research, development and innovation; and
- To co-ordinate and organise the international co-operation in the field of technology;

Looking at the responsibilities of the Ministry of Education and Research and the Ministry of Economic Affairs and Communications as specified by law the division of the RDTI funding system in two distinctive parts is already apparent.

The executive agencies of the two main ministries, namely **the Estonian Science Foundation (ESF)** and **Enterprise Estonia/ESTAG**, and the **Scientific Competence Council (SCC)** which is an advisory body to the Ministry of Education and Research form the next level in the institutional set-up of the Estonian RTDI funding system.

The Scientific Competence Council is an advisory body to the Minister of Science and Research charged with responsibilities for:

- Developing the principles and strategy for the targeted financing of R&D institutions;
- Making proposals concerning the opening, amendment and termination of targeted financing of research topics at R&D institutions;
- Assessing the effectiveness of the targeted financing of R&D institutions and the conformity of the research results with international standards;
- Making proposals for the approval of the results of evaluation of R&D;
- Based on evaluation, making proposals for the establishment or reorganisation of state R&D institutions or the termination of their activities;
- Making proposals concerning the covering of infrastructure expenses of research and development institutions within the government of the Ministry of Education and Research;
- Making recommendations regarding financing of research related to doctorate study;

The SCC is required to report on its activities to the Minister of Education and Research and to the Research and Development Council at least once every three years. The Government of Estonia following a proposal from the Minister of Education and Research approves the membership of the Council for three years. Nine recognised scientists comprise the membership of the SCC and good coverage of scientific competence (in terms of disciplines) is ensured.

Making proposals regarding the allocation of targeted finance is the most important function of the SCC in the context of this work. Targeted finance allocations are said to provide long term funding for R&D and infrastructure to publicly funded research institutions. Historically the intention was that the funding stream allocated by the SCC would provide stability and continuity in the system. The funding is project based whereby research groups submit proposals, these proposals are assessed and funding is allocated.

When deciding on research funding the members of the SCC look at the following three areas: 1) the quality of the research proposal (proposed research); 2) critical mass of applying unit (2 full-time researchers or more); and 3) there is an attempt to ensure continuity of funding so some security in the system is guaranteed. In practice, however, there are no guarantees that the funding will be continued after the 5 or so years for which allocation has been made.

A major contradiction in the work of the SCC is this between the intention to introduce continuity and security in the research system and the working practices of the Council promoting short-termism. In practice the SCC allocates relatively short-term research grants (up to five years) which are highly competitive. The requirement to re-apply for funding every year contributes to increase the level of insecurity and unpredictability of RDTI funding.

The **Estonian Science Foundation (ESF)** is the oldest among the new research funding institutions in Estonia. The ESF was established in 1990 by the Estonian Government and is currently an independent foundation. It is responsible for the allocation of about 20% of the research budget of the country. The ESF submit an application for funding to the Ministry of Education and Science annually – this application is a document stating how much funding is necessary and how this funding is going to be used. While this appears to be a well functioning mechanism in practice the actual submission is not an estimate of current demand but an extrapolation of the level of funding for the previous year (research grants plus funding necessary for maintaining the office)¹⁸. Having said that, we would like to point out that this reflects a level of realism rather than lack of good will or competence – in other words the real demand for funding can be estimated but since it is clear from the outset that it cannot be satisfied extrapolating the level of funding is a more realistic option. The budget of the ESF has been roughly the same since 1999 when it was drastically reduced to accommodate the introduction of targeted financing. This agency promotes basic and applied¹⁹ research in universities and research institutions by awarding

¹⁸ It should be noted that this is the usual practice in the case of submissions from the Ministries and other funding bodies.

¹⁹ The ESF support research in more applied areas such as engineering, agriculture and medical science.

research grants to individual researchers and research teams. The maximum duration of an ESF grant is four years.

The ESF is responsible for a relatively small budget - about 12% of the total RDTI funding from public sources in Estonia (2003). For comparison, during the same year the SCC was responsible for allocating 33% and Enterprise Estonia/ESTAG for 25% of the total RDTI public expenditure.

Resource allocations by the ESF are competitive and it operates a strict peer review system. Calls for new proposals are organised annually and about 500 proposals are usually submitted. Each proposal is evaluated by at least two referees and to deal with issues arising in the context of the relatively small size of the country international researchers are also used as reviewers. This is made possible by using traditional as well as more recent links to the research communities in Russia, Sweden and Finland.

The highest decision making body of the ESF is its Council comprising fifteen members. Seven members of the Council represent the four universities, the Estonian Academy of Sciences, the Ministry of Education and the Estonian Union of Scientists and the other eight are eminent Estonian scientists elected for three years by the previous Council on recommendation from the universities and the other research organisations. These scientists chair the 8 Expert Commissions of the ESF, which are organised on a fairly disciplinary and include up to 10 experts in the respective areas of research²⁰. These commissions chose the reviewers and rank the proposals in their areas on the basis of the assessment that have been received. Decisions regarding funding are in the remit of the Council.

The proportions of the ESF budget allocated to the eight different research areas, and respectively allocated by the Expert Commissions were fixed in 1995 by the Research and Development Council thus ensuring that competition is contained within the areas.

Apart from operating a fairly strict peer review procedures the ESF also has a system for monitoring of the progress of supported projects. Every year successful applicants are required to submit a brief progress report. Failure to do that results in termination of research funding. Funding for the next year can be stopped as well in cases where the members of the Expert Commission do not consider the research progress to have been sufficient. When a project is completed the principal investigator (grant holder) is required to submit a final report. The final report is used to assess the quality of the work that has been funded by the ESF. Publications, particularly publications in journals with high

²⁰ The Expert Commissions are in: Exact Sciences, Chemistry and Molecular Biology, Bio-geo Sciences, Engineering, Medical Sciences, Agricultural Sciences, Social Sciences and Humanities.

reputation, are the main expected outcome and are believed to be the main criterion for a project's success.

Within Estonia, the remit and the operational principles and practices of the ESF are generally viewed in a highly positive light. A weakness of the foundation that has been mentioned by different stakeholders in the research funding process, including representatives of the foundation, is that they administer a very large number of relatively small grants. At any time the small administrative unit of the ESF deals with over 700-800 grants and have to process up to 500 new applications annually. There is awareness that one solution to this problem is to achieve a higher level of concentration but making exclusive choices is very hard.

And last but not least in the RDTI funding system of Estonia is **Enterprise Estonia/ESTAG**. Enterprise Estonia/ESTAG is a relatively new funding agency and was set up in 2001 following recommendation by international experts. ESTAG is one of the seven agencies that together form **Enterprise Estonia** and was set up with the help of and inspired by the Finish Technology Agency (TEKES). The main responsibility of ESTAG is to implement the innovation policy of the Ministry for Economic Affairs and Communications. ESTAG is funded by the national budget with a separate budget line. Funding allocated by ESTAG constitutes about 25% of the total public funding for research and innovation in Estonia.

Officially '...the Estonian Technology Agency assists enterprises in Estonia by supporting technological development and innovative projects. The agency offers guidance for preparing such projects, provides grants and loans to cover the costs of the projects, and renders assistance and consultation when such projects are implemented...'²¹

Currently ESTAG operates eight different funding schemes, which roughly fit under the headings of financing RDTI (funding of applied R&D, advance technology programmes etc.), strengthening the innovation system (RDTI infrastructure, High-tech incubator scheme, Competence Centres, and SPINNO), and developing knowledge and skills (Innovation Awareness and Research-industry mobility)²². Clearly articulated rules have been formulated for each scheme that is being operated by ESTAG.

The application and project assessment procedures used by ESTAG are fairly complex and are discussed in considerable detail in the Reid report. Here it suffices to point out the following:

²¹ See www.eas.ee

²² For more see: Reid A., 2003 Optimising the Design and Delivery of Innovation Policy in Estonia: an Evaluation of Policy Instruments for Intensifying Business Innovation, Innovation Studies, Tallinn

- ESTAG provides soft loans (up to 75%) and grants (between 25% and 50%) to enterprises for feasibility studies, applied research and product development;
- ESTAG provides grants (50% to 100%) to research institutions for conducting applied research and feasibility studies;
- Funding decisions are based on expert opinion accounting for four sets of criteria: level of innovativeness; market prospects, management capability and financial stability (capacity to provide matching funding).

Ironically (but not so hard to understand) ESTAG is the only funding agency in Estonia where the stated problem is not that there are no sufficient funds but that there are not sufficient numbers of applications for the funding that they already have. Thus the overall budget utilisation rate in 2001 was 58% whereby there was a significant difference between the utilisation rate for applied research funding for R&D institutes (81%), the lower rate for product development of enterprises (52%) and the extremely low rate for feasibility study grants (12%)²³.

There is a feeling that this can be attributed to different factors in the case of different target institutions. Thus the companies are apprehensive of bureaucracy and the necessary form-filling since they do not experience in working in such manner. Also there simply are not sufficient numbers of companies with innovation capacity - about 1,000 companies with some innovation capacity is a generous estimate. The universities and research institutes, on the other hand, have quite different set of problems mainly related to requirements for speedy commercialisation. ESTAG are prepared to finance work that will take no longer than three years to commercial implementation and in the case of new products this time is even shorter at about one year.

In terms of funding decisions and failed applications ESTAG's internal study shows that meeting the requirements of the market related criteria is a major problem for the applicants.

It should be noted that supporting technology transfer is not among the responsibilities of ESTAG. At the same time technology acquisition and transfer is the main innovative activity of the emerging Estonian enterprises. This process is also necessary if Estonia is to bring the technological level of its enterprises to levels similar to those of the countries members of the EU speedily.

²³ Reid et al., p. 35

Two issues deserve attention in the context of the work of ESTAG. One of these relates to the really short term horizons of the developments financed by ESTAG – expecting commercial effect within up to three years of funding allocation is at its best unrealistic. Even initiatives like EUREKA supporting really close to market research and development found that it is not realistic to expect significant commercial impact earlier than three years after completion of the project (which is about 7-8 years after the project has started)²⁴. The second issue is that while supporting applied research in enterprises and research institutes is a stated aim of ESTAG given the short term expectations for commercial application it is likely that it is substituted for supporting developmental work. In the light of that an important question that needs to be asked is ‘who funds/supports applied research?’.

²⁴ Georghiou L., Nedeva M., et al., 1997, 1998, EUREKA Annual Impact Report

3.5 Funding mechanisms

This section of the report explores the funding mechanisms that have been established in Estonia. These mechanisms involve the agencies directly involved in RDTI funding, namely the Scientific Competence Council, the Estonian Science Foundation and the Estonian Technology Agency and the recipients of public funding, namely the Estonian universities, research institutes and part of industry. The funding mechanisms are defined by the exchange(s) that occurs in the context of the relationships between 'funders' and 'funded'. The discussion below focuses particularly on the criteria used by the different funding agencies in the process of assessment of proposals and research results, on the monitoring procedures that have been introduced by the different agencies and the levels of transparency in the process of funding.

All public funds for RDTI in Estonia are allocated on competitive basis as grants (and/or loans in the case of ESTAG). Closer look at the funding mechanisms that are being operated in Estonia provides further evidence about the split of the national research/innovation system into two almost completely independent parts – this of the Ministry of Education and Research lead academic science and the part of the system lead by the Ministry of Economic Affairs and Communications which is closer to the ideas of commercial science.

On the 'academic science' part of the system two funding bodies operate – the Scientific Competence Council and the Estonian Science Foundation. At broadly institutional level these target their funding to the same types of research performers, namely the universities and the research institutes although the recipients of funding differ in detail. While the SCC allocates funding to research groups the ESF supports individual researchers (or teams). Also quite different is the size of funding that these bodies allocate – the targeted funding allocated by the SCC is more than twice the size of the funding allocated by the ESF (see Table 1, page 14).

Both the SCC and the ESF have responsibilities predominantly for funding basic research. Hence it is not surprising that the criteria for allocation of research funding used by these bodies are quite similar as well. Thus, in theory the criteria for assessment that are being used are the number of publications, originality, novelty and topicality of the proposed research, qualifications and competence of the principal investigator and the research team, involvement of Masters and PhD students, impact of possible applications of the results for the Estonian economy, society and environment, and collaboration with partners from other

institutions, including firms²⁵. There is evidence, however, that in practice the primary criterion used for assessment of proposals relates to past achievement rather than future development. Number of publications in reputable journals is used both to indicate competence to carry out the proposed research and as evidence for research success at the end of the project. Both funding bodies have lists of what is considered to be 'reputable' journals. In addition to that the SCC looks at the size of research groups in view of ensuring that there is critical mass to complete the research that has been funded.

Judging by the criteria used to allocate research funding - and following that to assess the level of success of financed research projects - the dominant expectations of these funding bodies lean towards the purely academic ones, namely publications, novelty and originality. There are no explicit mechanisms to encourage interactions with society and industry. On the contrary, it can be argued that these assessment criteria discourage researchers from pursuing links with industry and society – they have to focus on getting their papers published if they are to receive funding for the next year.

Overall, however, these expectations are actually met with approval by the academic community. If anything researchers expressed concerns regarding how well the particular assessment criteria capture academic excellence rather than objections to the type of criteria that are being used. In other words, the funding system dealing with 'academic science' is locked in a cycle where both funding and recipient institutions operate based on a model of science that is purely academic. This model of science (research) usually does not include considerable concern regarding the usefulness of science/research and its links with economy and society. Having said that it is possible that some consideration to the usefulness of science is given but this is almost inevitably viewed as secondary to intellectual achievement.

In fact the dominant criteria used to allocate research funding in Estonia (this is particularly valid in the case of the SCC) are likely to hinder any change of the visions and perceptions of researchers as to what good science is and what it is about. In other words researchers do not have much interest in researching more practical issues (or thinking about possible applications for their research) since these are not likely to produce publications of the level and quality necessary to qualify for targeted funding.

Using uni-dimensional criteria related to academic excellence to allocate research funding and to assess research results works against particular disciplines and research areas. It is hard, for example, for social science and engineering disciplines to compete for research grants under such funding regime.

²⁵ Please note that this is a list of assessment criteria used by both funding agencies and hence these have different significance (importance) for each of the agencies.

One consequence of the fact that both the SCC and the ESF *de facto* allocate competitive research grants using similar, predominantly bibliometrics based criteria is that funding decisions become backwards looking. In other words funding decisions are based on proven past experience as a result of which research is cognitively locked within certain established trajectories. The RDTI funding system in Estonia has a fairly limited capacity to fund new research areas and topics where experience and competence are yet to be acquired. This brings to the front the importance of base-line funding which allows the space in the research system where radical cognitive innovation can occur.

The SCC and the ESF have developed procedures to monitor research progress demanding annual submission of progress report. While annual reports are necessary and useful in terms of following the progress of the projects supported by the SCC and the ESF, researchers have come to see preparing these as another cumbersome procedure. Establishing some monitoring procedures is no doubt important but there should also be awareness of the possibility for 'evaluation' overload.

In the context of the relationships between 'funders' and 'funded' some transparency issues emerged. These are mainly associated with the work of the SCC and include:

- Serious doubts that its members have the necessary expertise to assess research proposals from across the whole spectrum of research disciplines²⁶;
- Lack of clarity of assessment criteria;
- Shifting assessment criteria;
- Insufficient and untimely feedback on applications; etc.

Most transparency problems associated with the work of the SCC, in our opinion, stem from its structural position rather than from the lack of good will. So, the SCC is expected to allocate fairly limited resources across a very broad spectrum of research. One difficulty in doing that is in using uni-dimensional criteria for assessment that are appropriate (to a certain degree) to academic, theoretical sciences but tend to disadvantage more practically oriented disciplines (areas of research) such as engineering. Another boundary condition contributing to difficulties perceived in the work of the Council is the almost complete absence of overall coherent policy for RDTI – given that, the Council, like other funding bodies is operating as independent agent, which contradicts its functions. And last but not least, the SCC at present does not have any

²⁶ If and when necessary the members of the SCC seek input from experts in the particular areas. Knowledge of this procedure, however, has not filtered to the members of the research community – beneficiaries from the funding.

administrative support which explains its problems in communicating with the research community (providing useful feedback).

Expectations appear to be almost drastically different on the side of the research system championed by the Ministry of Economic Affairs and Communications and implemented by ESTAG. As appropriate to 'commercial' science complex/composite criteria for funding allocation are being used (level of novelty, market assessment, project management and financial arrangement/ability to procure/provide matching funding). Funding decisions do not depend crucially on perceptions of research excellence but rather on expectation for (fast) commercial impact of innovation. These expectations, however, do not seem to fit with the realities in Estonia– the insufficient number of proposals that ESTAG receives is a clear indication of that. Another, though indirect indication, is the fact that most academics we met forgot even to mention ESTAG as one of the research funding agencies in Estonia.

3.6 Summary

- Looking at the institutional set-up of the Estonian RDTI funding system it appears to be well structured and logical.
- In theory the RDTI funding levels are decided on the basis of annual submissions by the institutions involved in the financing of publicly funded research. In practice, however, these submissions do not reflect real demand for funding but expectations for meeting this demand. Hence, submissions are an extrapolation of the funding allocations for the previous year.
- There is certain duplication of functions in the RDTI funding system of Estonia involving the SCC and the ESF. While reportedly the ESF is operating strict peer review procedures the operating principles, including criteria for assessment, monitoring and feedback, the SCC employs seem to lack the necessary level of transparency.
- A certain level of fragmentation of the funding structures for RDTI in Estonia should be noted. Two distinct part of the system can be easily identified: one under the Ministry of Education and Research and the other one under the Ministry of Economic Affairs and Communications. These two parts operate according to significantly different principles grounded in different visions of research (science) and its place in society.
- There is no structural possibility for bridging the two parts of the funding system. One consequences of this is that neither of the parts can fulfil its

functions – the ‘academic science’ part is bound to exhaust its possibilities to finance basic research and the ‘commercial science’ part cannot fund innovation without strong applied science (currently falling between funding streams).

- To increase its efficiency the RDTI funding system in Estonia needs to start functioning as a whole, in other words the two parts of the system need to be re-aligned.
- Any increase of public funding for RDTI will have very limited consequences if such re-alignment is not achieved.
- Any structural change aiming to achieve such re-alignment would be futile (have very limited social consequences) if current levels of funding for RDTI are not increased.
- There is a need to introduce base-line funding for research institutions in Estonia.

4. Problems and options for change

4.1 Problems of the RDTI funding system in Estonia

This section of the report outlines the problems experienced by the RDTI system in Estonia that are directly or indirectly related to issues of funding. The problems have been conceptualised as problems-reasons and problems-manifestations. These two types of problems differ according to their level of aggregation, their empirical status and the opportunities for policy action that these afford. Hence, the problems-reasons are usually at a higher level of aggregation, these are not necessarily empirically detectable and they are the problems that provide frameworks for policy action. Attempts to act on the problems-manifestations are usually wasteful, do not necessarily produce the desired outcomes and can lead to contradictory developments.

Four main problems-reasons have been identified. These are: i) insufficient funding for RDTI; ii) fragmentation of the RDTI system; iii) lack of base-line funding for research institutions; and iv) problems related to the visions of research.

Insufficient funding for RDTI

- ***The level of funding for RDTI in Estonia is generally perceived as insufficient.*** There seems to be a consensus that the current levels of funding for RDTI are insufficient if Estonia is to sustain a vibrant and able research community, develop an innovative high technology industry and become knowledge-based society. It is worth noting that international experts²⁷ also support the consensual opinion of the stakeholders in Estonia, including policy-makers as indicated by the strategy document 'Knowledge Based Estonia'
- ***Under funding is much more serious for the research institutes.*** Research institutes in Estonia, irrespective of their legal status, experience levels of under funding considerably more serious than these at the universities. This is mainly due to the fact that the universities have teaching budget (some of which is from private education) that can be used (is being used) to cover ongoing expenditure that the institutes have to meet from their research

²⁷ Hernesniemi H., 2000, Evaluation of Estonian Innovation System, Report; Kurik S., et al., 2002, Innovation in Estonian Enterprises 1998-2000, Innovation studies, Tallinn; Reid A., 2003, Optimising the Design and Delivery of Innovation Policy in Estonia: an Evaluation of Policy Instruments for Intensifying Business Innovation, Innovation studies, Tallinn; Kaarli R., Laasberg T., 2001, Research and Development in Estonia 1996-1999: Structure and Trends, Tallinn;

budget. One consequence is that the salaries of researchers at the research institutes are much lower than the salaries of university academics (sometimes about half of that in fact). It is self evident that such situation is not conducive to carrying out high level research and promotes the ageing (and generally staff depletion) of the research institutes. It is also true that the research institutes used to be the major performers of research and that research capacity in universities is still quite limited.

- ***Under funding creates pressures in the system.*** Scarce funding sometimes can lead to animosity between research performers and distrust between research performers and research funders. In fact, we believe that the dispute that involved the Rectors of the universities in Estonia, the SCC, the Ministry of Education and Research (the Minister) and the research institutes is a manifestation of exactly such pressures. Such and similar pressures and disputes are usually destructive. Moreover, they are not conducive increasing the level of co-ordination in the system and to working towards the achievement of common goals, namely the (re)building of the innovation capacity of Estonia and bringing it in line with performance elsewhere (in Europe).
- ***Recognised need to increase the level of RDTI funding in Estonia.*** Again there appears to be an overall agreement in Estonia that the level of funding for RDTI needs to increase if Estonia is to achieve its national aspirations. There is a slight contradiction however between the universally recognised need to increase funding substantially and the partial failure to do so. One side of this equation is the pressure from performers of research who have failed to develop arguments for increased funding that are sufficiently convincing (which in its turn is probably explained by the explicitly dominant 'academic' science mentality). Arguments for increase of funding for research in Estonia appear to be broadly cultural rather than specifically utilitarian, which usually fails to convince particularly in times of relatively severe financial limitations. On the other hand, there is also the fact that an increase only or even predominantly from public funds is not sustainable.
- ***How much funding – 'Knowledge Based Estonia'.*** The Estonian strategy document 'Knowledge Based Estonia' announced an increase of RDTI expenditure to 1.5% of GDP by 2006. It is foreseen that this increase will come mainly from industrial contributions to R&D. The realism of this objective is questioned within Estonia almost universally – the opinions of stakeholders largely fit on a continuum between 'cautious optimism' to 'informed scepticism'. We found that stakeholders in Estonia question most strongly the expectation that Estonian industry is (will be) in a position to invest in RDTI activities. It is also symptomatic that RDTI funding has not increased

substantively until now. There is an expressed need to use public funding (an increase in public funding) to gear/stimulate funding from industry²⁸.

- **Research funding from different sources is used mainly to cover salaries.** It was quite clear from our meeting with representatives of the research community (and research managers) that in most cases and institutional contexts the research funding is hardly sufficient to cover the salaries of the researchers/academics. Hardly any resources are left for current expenses (ongoing maintenance, telephone, electricity etc.) and next to nothing for buying equipment and materials for experiments etc. It is symptomatic that in 1995, 85% of the experiments at the Institute of Physics were carried out at the institute and now less than 50% are carried out there. Experiments are carried out in the USA, Sweden, Finland, Russia etc. using historical and newly forged collaborative arrangements.
- **Ageing research community.** Researchers, research funders and international experts alike share concerns about the increasing average age of the research community in Estonia. Few young people chose research as a career. The following are probably factors contributing to that: i) the salaries that research institutions can offer do not compare favourably with remuneration offered by other sectors of the economy; ii) the overall lack of stability in the RDTI system makes it very hard to manage a research career; iii) project based funding allocated on the basis of past achievement in fact excludes relatively junior researchers from the competition for/access to resources for research. It was reported that in some research performing institutions in Estonia the average age of staff is over 50 years.
- **Research infrastructure issues.** More recently it has been recognised that success in carrying out leading edge research is congruent on two preconditions, namely highly qualified people and very sophisticated equipment²⁹. That is why the issue has been attracting research as well as policy attention³⁰. Partly due to the current funding regime – project based funding usually does not make sufficient provisions for the maintenance and purchase of research equipment – there appears to be a problem with research equipment in Estonia. Recently (during May 2003) there have been some developments working towards dealing with the most pressing issues in this context.

²⁸ See: Georghiou L. et al, (2003), Raising EU R&D Intensity: Improving the Effectiveness of Public Support Mechanisms for Private Sector Research and Development, Report to the European Commission by an Independent Expert Group.

²⁹ Nedeva M., Georghiou L., Halfpenny P., 1999, 'Benefactors or Beneficiary – the Role of Industry in the Support of University Research Equipment', in Journal of Technology Transfer, Vol 24, No 2/3; Irvine John et al., 1997, *Equipping Science for the 21st Century*,

³⁰ Georghiou L.G., Halfpenny P., Nedeva M., Evans J. and Hinder S., (1996), Survey of Research Equipment in United Kingdom Universities, London;

Lack of base-line funding for research institutions

There is no base line funding in Estonia and all funding is project based. This introduces a very high level of short-termism and insecurity in the research/innovation system. Particularly affected are the publicly funded, research performing institutions – universities and research institutes alike – since funding is not only insufficient but also unpredictable. Research performers and research funders alike recognised this to be a problem. The lack of base line funding for research institutions is a contributing factor to some, if not most, of the problems-manifestations discussed under the previous section (particularly the ageing of the research community and the infrastructure/research equipment problems). In addition the lack of base line funding is manifested in:

- Making the RDTI funding process almost completely unpredictable;
- Increasing the level of institutional and personal insecurity to level affecting the ability to carry out research;
- Reducing the level of flexibility of the RDTI system since decisions regarding the direction of research are centralised;
- Stripping research performing institutions of any possibility to formulate and follow research strategies;
- Affecting institutional research strategies and personal research agendas not by providing overall framework but by taking away responsibility; and
- Increasing the administrative overhead/burden of research performing institutions and researchers alike.

Fragmentation of the RDTI system

Three aspects of fragmentation of the RDTI system in Estonia can be distinguished. These are the mismatch between research capacity and users of research, the split of the system into two distinct parts and the fragmentation of funding for research.

Mismatch between research capacity and research users

This is partly accounted for by the fact that until relatively recently Estonia was a part of a much larger country and hence all its structures were an integral part of the structures of the former Soviet Union. Becoming an independent country apart from other things also meant that it is entirely possible that Estonia has research capacity in areas for which the natural user is at present in another country. This appears to be the case in some branches of physics, for example.

- ***Science and industry.*** The links between academy and industry (research and industry) in Estonia appear to be at a fairly under developed stage. Isolated cases of cooperation between researchers and industry were reported but as a rule this was not industry within Estonia. Irrespective of the underdeveloped character of the links two types of interactions are fairly wide spread: i) movement of people mainly from academia to industry (particularly high tech spin off companies recruit from university labs as well as support and later recruit students, both undergraduate and postgraduate; and ii) small high tech companies still have to use the equipment at the university labs but they believe that given the current equipment situation this will change soon so that equipment will be better in the companies. There was a clearly perceptible feeling of mistrust between academic researchers and industrial entrepreneurs, which however is not a situation unique for Estonia.

Split of the system into two different parts

As noted in previous sections of this report the RDTI system of Estonia appears to be almost strictly divided into two parts: one responsible for research (academic research) under the Ministry of Education and Research and the other one having responsibilities for innovation and led by the Ministry of Economic Affairs and Communications. This split is contained within the legislation for research and innovation, it is institutionally sealed and perpetuated by funding practices. It is empirically observed in:

- ***Overlap of institutional functions.*** A certain level of overlap in institutional functions was noted particularly in the case of the SCC and the ESF. While nominally these institutions operate in different domains of the research landscape in practice they are perceived to be very similar.
- ***One-dimensional/inappropriate criteria for assessment.*** There were some reservations expressed about the one-dimensional and/or inappropriate criteria for assessment of research proposals/research results. Particularly strong concerns regarding the one-dimensional nature of the assessment criteria were voiced by the representatives of more applied research areas such as some branches of engineering and computer science which fall between the funding streams. On the other hand, there were voices expressing some concern regarding the appropriateness of the criteria that are being used and arguing that irrespective of the anticipated consequences the criteria should be shifted towards high level impact ones (while staying academic). For example, that the number of publications should be substituted for ISI citations, participation in conferences with posters with participation as invited speaker etc.

- ***Uniformity of assessment criteria and procedures.*** This set of issues although related to the ones mentioned above is somewhat different. It seems that in Estonia uniform criteria are used to assess proposals/research results in drastically different research areas. This can and usually does lead to a number of biases. This is a particularly topical issue in the case of the SCC where proposals from different research disciplines compete for the same funding and funding is allocated following the same criteria (where it is quite natural to expect that research in social sciences and humanities, for example, is harder to publish in international journals).
- ***Prioritisation issues.*** Priorities for research are still somewhat general in Estonia. This message came loud and clear from different stakeholders including representatives from universities, research institutes, industry and funding agencies. This probably should be linked to a much broader issue, namely the fact that clear policy vision regarding the future of Estonia is yet to emerge (although a proto-vision is contained in the strategy documents). A transition from rhetoric to social action in this area is necessary.
- ***Problems associated with ESTAG funding.*** Quite paradoxically while the 'academic' science part of the national research/innovation system in Estonia is oversubscribed and the problems it experiences are associated mainly with the lack of sufficient funds, the 'commercial' science part of the system is under subscribed. In other words quite substantial chunks of public funding for RDTI cannot be absorbed due to the mismatch between operating principles and the ability of the research and industrial communities to meet these conditions.
- ***Applied science.*** There seems to be a problem with the financing of applied research in Estonia. This seems to fall between funding streams, which can partly be explained by the fact that the instrument of national research programmes has not taken off.

Fragmentation of funding for research

Under the currently operating funding regime research funding is very fragmented. In other words research funding reaches the research institutions in the form of a (in some cases) very large number of relatively small research projects. It was reported that in some institutions the number of research projects is roughly the same as the number of academic employees. This has a number of implications among which: i) the multiplicity of small projects are relatively unfocused – these are not focused by being part of broader research programmes; ii) the very high number of small projects introduces certain inefficiency in the funding system – most researchers write and submit proposals

most of the time; iii) administering these proposals very likely increases the administrative overhead of the research institutions; iv) managing large number of small project almost inevitably raises issues of co-ordination; v) competing with everyone else all the time makes cooperation and collaboration almost impossible.

Visions of research/science

Problems related to the visions of research and science are very important in the context of developing strategies for change since people structure their life (act) mainly according to their visions and beliefs. Also the visions and beliefs sometimes take time to change.

- *The image of science.* It is broadly felt (mainly by researchers and research managers) that there is a problem with the image of science/research in Estonia. This problem can be registered at different levels of social aggregation. Thus, at the level of policy-making it is expressed in the fact that research has not been/is not perceived as a priority where financing decisions are concerned (in other words priority is being given to more immediately pressing concerns like rising the living standard without any regard for the future). In relation to the public at large a certain loss of respect can be detected in the disinterestedness and the lack of general support for research. Probably the recruitment problems that research institutions are experiencing can be also, at least at part, attributed to the tarnished image of science and research. It can be argued that this cluster of problems reflects mainly a backlash from history and the opening of a large number of opportunities.
- *Visions of science.* This cluster of issues is related to the one discussed above but different in that 'visions' are generally more structured and persistent than 'images' and also these usually have much more serious social effect. Two different visions of research and its role and place in society have taken hold within the RDTI funding system of Estonia and underpin funding structures and practices. While each of the visions – this of 'academic science' and 'commercial science' – can be used to underpin structures and social practices their coexistence within the same system is a problem (some of the issues arising in this context have been discussed elsewhere).

4.1.1 Summary

Four problems-reasons of the RDTI funding system in Estonia have been identified:

- Insufficient funding for RDTI expressed in: under-funding of research organisations; pressures in the system originating in this under-funding; aging research (innovation) community; obsolete research equipment and crumbling infrastructure; etc.;
- Lack of base-line funding for research institutions making the funding process unpredictable, reducing the level of flexibility in the system, preventing the development of research strategy at institutional level and increasing the administrative overhead of research institutions;
- Fragmentation of the RDTI (funding) system as expressed in the mismatch between research capacity and research users, the duality of the system and the ensuing fragmentation of research funding;
- Problems broadly associated with the image and visions of research;

4.2 Options for change

Options for change of the RDTI funding system in Estonia are suggested below. Please note that these options are not mutually exclusive and in fact quite a few are meaningful only when combined with others. How the combinations of options might work is illustrated in the section after this one by the means of several scenarios.

4.2.1 Insufficient funding for RDTI

There are two principal ways to deal with the issue of insufficient funding for RDTI – to increase the funding (both public and private) and/or to increase the level of selectivity and prioritisation. In practice, solutions are rarely effective when sought within only one of these possibilities.

Option 1: Maintaining the current situation

The first option is to maintain the current situation. In other words, significant increase of public and private finance for RDTI is not envisaged and the priorities remain fairly general as expressed by the three key areas for development argued in 'Knowledge-based Estonia'.

Strengths:

- Avoids further disturbance;
- Avoids political and other pressures that might occur in the process of change;

Weaknesses:

- It is impossible to achieve the national aspirations of Estonia within current funding levels;
- Perpetuates all problems discussed in the previous section;
- Ultimately, maintaining the current situation will result in depletion of the research base (ageing community and obsolete equipment, for example);
- If action is delayed the future costs of recovery will be greater as historically accumulated capabilities are lost.

Option 2: Public funding for RDTI is increased

According to this option the public funding for RDTI is increased without any change in prioritisation.

Strengths:

- Increase of public funding is likely to alleviate some pressing problems like level of salaries, funding for the current expenditure for research institutions, and even equipment issues;
- Increased public funding might lead to increase of private (industrial) funding;
- Being a sign of commitment to developing a knowledge-based society this measure might help attract finance from overseas;

Weaknesses:

- It is likely that without further prioritisation increase of funding will have very limited effect because the likely increase will be spread too thinly to have a major effect;
- Increasing funding without further prioritisation (and development of research and innovation policy) is probably not politically sustainable;
- Likely to maintain strengths in traditional research disciplines rather than developing strengths in strategic research areas;

Option 3: Increase the level of prioritisation without increasing the level of funding

This option assumes that existing public funding is focused even further on very few priority topics.

Strengths:

- Avoids major disturbance in structures but divisive in research communities;

- Weakens arguments for increase of public funding;
- Provides opportunities for developing international Centres of Excellence in very few areas;

Weaknesses:

- Demands very systematic process for selection of areas;
- Extremely high levels of concentration of resources carry inherent risks related to lack of possibility to react to change – institutional or cognitive;
- Neglect of interdependencies in the development of research topics (development of IT, for example, needs developed maths);
- Ultimately leads to depletion of the research base;
- Lack of capacity to deal with issues of national significance (maintaining the electricity grid, for example);
- Can affect education adversely.

Option 4: Public funding is increased and involved with specific priority areas

According to this option public funding for RDTI is increased and specific priority areas are decided upon.

Strengths:

- Possible to achieve the national aspirations of Estonia and become a knowledge-based society;
- Provides a framework for dealing with the problems arising in the context of under funding;
- Provides opportunities for developing Centres of Excellence in some areas and maintaining some competence in others;

Weaknesses:

- Likely to cause considerable disruption;
- Demands the design and implementation of a systematic and reliable process for selection;

4.2.2 Lack of base-line funding for research institutions

Option 1: Maintain current situation

This option precludes the introduction of base-line funding for research institutions.

Strengths:

Maximises competition for resources.

Weaknesses:

- Perpetuates the main problems associated with lack of base-line funding (instability, lack of security, lack research strategy at institutional levels etc.);
- Locks research within existing trajectories;
- Eventually will lead to a depletion of the science base;

Option 2: Base-line funding for some research institutions

It is possible to introduce an option where, in order to minimise the need for additional funding in the system, base line-funding is introduced only for some institutions. The most likely candidates are the research institutes since their needs are most pressing and research capacity is still large concentrated there.

Strengths:

- Minimises requirements for additional funding;
- Alleviates the situation of research institutes;
- Creates at least some level of stability in the RDTI system;

Weaknesses:

- Difficult to argue the case of one institution against another (research institutes vs. universities);
- Likely to aggravate already existing tensions;

Option 3: Base-line funding for all

According to this option base-line funding open to all institutions performing publicly funded research is introduced. This base-line funding is selective and is allocated following assessment procedures. The amount of funding allocated to different units of assessment can vary according to the results of this assessment. (as in the case of the Research Assessment Exercise in the UK, for example)

Strengths:

- Provides a framework for dealing with most problems discussed previously;

- Increases the level of stability in the system;
- Provides conditions for increased intellectual creativity;
- Pre-condition for the development of institutional research strategies;

Weaknesses:

- Likely to cause disruption;
- Cannot be realised without additional public funding for research;
- Need for implementing of working and workable selectivity procedures which combine excellence and relevance of research;
- Needs structural change to occur (somebody has to do it);

4.2.3 Fragmentation of the system

Option 1: Maintain current situation

According to this option the current duality of the system – ‘academic science’ and ‘commercial science’ – is maintained and no structural changes are envisaged.

Strengths:

- No major disruption in the functioning of the system;
- Avoidance of political and policy disputes;

Weaknesses:

- Perpetuation of the problems discussed above;
- Waste of resources (even if resources are increased) for RDTI;
- No possibility for coordination of research and innovation policy (strategy);
- Whole levels of research (applied research, for example) fall between funding streams;
- Will eventually lead to breaking down of the whole research/innovation system;

Option 2: Non-institutional forum bridging the two sides of the system

It is possible to consider introducing a semi-formalised, non-institutional forum attempting to bridge the two sides of the system. One such possibility is to start regular ‘round table’ discussions.

Strengths:

- Provides forum for discussion of funding options across funding agencies;
- Can be introduced with minimal disruption;
- Does not necessitate changes in legislation;

Weaknesses:

- Danger that such forum will stay simply a discussion forum;
- No possibility/mechanism for action or influencing funding agencies/policies;
- Introduces additional complication in already over-complex system;

Option 3: Initiate National Research Programmes

According to legislation funding for national research programmes is one of the research financing mechanisms in Estonia. This mechanism, however, has never been fully implemented. Initiating cross-institutional national research programmes can help bridge the gaps in the system.

Strengths:

- Provide a platform for interactions between different funders of research;
- Involve funding for research with areas strategic for the country;
- Increase the level of coordination within the system;

Weaknesses:

- Cross-institutional funding is problematic within the current legislation;
- The current structure of the funding system prevents the initiation of national research programmes;

Option 4: Structural change Mark 1

This option for change involves structural transformation on the side of the system led by the Ministry of Education and Research. More precisely the proposal is:

- To change the targeted funding into base-line funding;
- To charge a department of the Ministry of Education and Research with responsibilities for administering the base line funding and organising the selection procedures;
- To maintain the Estonian Science Foundation and its working principles but increase its budget;

- The Scientific Competence Council can become a Strategy Board coordinating the work of the Ministry Department and the ESF.

Strengths:

- Deals with functional duplication in the system;
- Encourages good practice;
- Deals with some of the issues associated with the structural position of the SCC;
- Will ultimately increase the efficiency and effectiveness of funding for basic research;

Weaknesses:

- Likely to cause some disruption;
- Does not deal with the main structural problem of the system (innovation part left out);
- Prevents coordination between innovation and research policy;

Option 5: Structural change Mark 2

This option is the one suggesting the most radical structural change in the RDTI funding system of Estonia. More specifically, it is proposed to:

- Create a new institution – the Research and Innovation Funding Council (RIFC);
- RIFC is to develop and implement the Estonian innovation and research policy(s);
- Administratively RIFC consist of the Technology and Innovation Division currently under the Ministry of Economic Affairs and Communications and the Department responsible for research at the Ministry of Education and Research;
- ESTAG and the ESF are agencies of RIFC;
- ESTAG's funding principles need to change so that higher level of congruence between these and funding demands can be achieved;
- RIFC administers the base-line funding, funding schemes for infrastructure and PhD funding (linking this with research intensity of institutions and completion rates);
- SCC with changed membership to reflect its changed remit is the Strategic Board of RIFC.

Strengths:

- Dealing effectively with the existing rift between funding agencies;
- Streamlining the funding system;
- Increased opportunities for coordination;
- Possibility for the emergence of research policy embedded in innovation policy;
- Dealing with the fragmentation of research funding (multiplicity of stand-alone research grants);

Weaknesses:

- Relatively high level of disruption;
- Possible political and other resistance;
- Needs serious work to conceptualise the new institution;

Option 5: National Foresight Programme

We believe that carrying out a National Foresight Programme in Estonia can be potentially beneficial in the light of the RDTI problems that have been identified. A Foresight programme can afford the following benefits:

Benefits-goals

- identification of research and innovation developments through transparent processes;
- prioritisation of these developments in relation to Estonia's aspirations and needs as preparations are made for entering the EU;
- identification of priority industrial sectors/sub-sectors and their technology needs;
- identification of research areas where commercialisation of research results is viable;
- identification of possibilities for encouraging spin-off high technology companies;
- development of national level, coherent innovation policy emphasising the importance of knowledge utilisation for the future of Estonia;
- more efficient use of public finance;
- formulation of national research programmes;

Benefits-means

- increased interactions between representatives from government, industry and academia;
- creating pre-conditions for the development of trust in the relationships between different stakeholders in Estonia;

- initiating a process of communication and exchange of information among stakeholders in the innovation process;
- achieving consensus (broad agreement) regarding the current and future problems facing Estonia and ways to deal with these problems;
- deeper understanding of the distribution of Estonia's R&D resources and expertise;
- collecting focused research, development and innovation information;
- increased level of co-ordination between different policy making bodies;

Moreover, there is some expertise in designing and carrying out Foresight exercises in Estonia.

4.2.4 Visions of research/science

No obvious measures aiming to change the vision of science can be suggested. It suffices to say that such transformation can take a long time and that there is a relationship of interdependence between structural change and change in visions and beliefs. We would also like to emphasise that while measures to raise the profile of science in society (general public) are definitely a necessity these are context specific and can be decided only on the basis of detailed local knowledge we do not possess.

5. Scenarios

5.1 Choosing 'comfortable life'

In 2003, following input from an international evaluation of the RDTI funding system in Estonia different options for change were discussed by the relevant communities. These included increased level of public funding for research, more focused strategic research priorities, carrying out a structural reform aiming to re-align the two different parts of the funding system, and designing and implementing a national foresight programme to assist in developing consistent and realistic research and innovation policy.

While the research community was particularly keen on some changes (increase in the level of research funding, for example) its members were more or less seriously opposed to the tightening of priorities and a structural reform threatening the 'academic science' vision of research and its role in society and economy. Politicians, on the other hand, while supporting the formulation of more focused research priorities in principle, failed to appreciate the need for increase of public funding (continuing to rely on increase of private/industrial finance) for RDTI, and could not see why to spend more funds on Foresight if there is already a strategy document. All stakeholders saw the proposed structural changes as undesirable, unachievable or plainly disruptive.

There was a process of intense (and sometimes very heated) consultations but nothing happened – public funding for research largely remained unchanged, the three key areas for development were not specified any further and the funding structures remained as they are.

Five years later it was clear that all problems directly or indirectly related to RDTI funding and identified in 2003 have persisted. The increase in RDTI funding from industry that was foreseen (expected) in 2003 did not materialise – Estonian industry was not sufficiently mature and/or innovation/research intensive to invest in RDTI but preferred to import technologies.

This stagnation had a number of social consequences. To mention but few: i) the national aspirations of Estonia to become a knowledge-based society could not be achieved; ii) basic research in Estonia (and its research institutions) became even more under funded than in 2003 with the consequent further ageing of the research community and the research equipment and facilities; iii) the depletion of the research base and the virtual absence of applied research also meant that innovation was impossible (grounded in the Estonian research base); iv) this as expected had adverse effects for education and training – Estonia could not produce the highly skilled work force necessary to develop high tech economy;

v) all that impacted on the directions that the indigenous industry took and the levels of investment of large multi-nation companies.

In 2008 Estonia had to abandon its national aspirations and to settle for being a developing country without great prospects where the future integration into broader political and socio-economic structures is concerned. This was particularly serious because Estonia did not have many other options (apart from developing into a knowledge-based society) for becoming a prosperous and successful society.

This scenario illustrates how ignoring the problems of the RDTI system in Estonia, hesitation to take risks and choosing 'comfortable life' can have devastating effects for the future of the country.

5.2 Winning the battle, losing the war

In 2003, following input from an international evaluation of the RDTI funding system in Estonia different options for change were discussed by the relevant communities. These included increased level of public funding for research, more focused strategic research priorities, carrying out a structural reform aiming to re-align the two different parts of the funding system, and designing and implementing a national foresight programme to assist in developing consistent and realistic research and innovation policy.

Following prolonged debates on the necessary and desired changes the research community in Estonia was mobilised and started developing arguments for increased public funding for RDTI. Three main arguments were developed: i) the wealth creation capabilities of research and innovation; ii) research as a business itself (developing the idea that even if research does not contribute directly to wealth creation through its use in social practice it can bring resources in Estonia); and iii) the internationalisation argument according to which in view of the pending EU integration of Estonia it needs to bring its levels of investment in research to these of the member countries. Key researchers and research managers managed to attract the support of high tech industry in Estonia (spin off companies) for these arguments.

In developing arguments in favour of the increase of public funding for research, however, the research community was opposed to focusing this finance any further and/or making it more selective. Also, it was acknowledged that a structural reform if at all possible should be attempted much later (during the following five years or so).

The arguments of researchers and industrialists convinced the politicians and it was agreed that the level of public funding for research will be increased

gradually over the next five years. It was foreseen that the increase will have to reach at least 1.2% of the GDP to have any effect. And so the process began...

Meanwhile, no measures to attempt to focus this funding were undertaken. The RDTI funding system continued to operate in the way in which it operated before June 2003 – no base-line funding was introduced, the structural fragmentation was maintained, no national research and development programmes were formulated and the national foresight programme was just a vague idea.

While during the first three years (up to 2006) public funding for RDTI increased slightly (to about 0.8% of the GDP) this increase failed to gear industry into funding RDTI activities. Industry in Estonia continued to either be very low technology or small spin off high technology firms with fairly uncertain long term future. Due to this failure to stimulate industry the capacity of Estonia to maintain the relatively high level of public funding for research were exhausted. Other 'pressing' concerns like investing in health care and even straight forward consumerism prevailed. Thus by 2007 the level of public funding for research was declining again.

It is worth noting that the analyses experts on STP issues showed that the increase of public funding for research had very limited effect in the context of the research/innovation system. Without clear policy and strategy and respectively lacking focus and concentration it was soon apparent that the funding is spread too thinly again.

No need to say that after 2007 new concerns regarding the level of funding were raised and the necessity for undertaking a structural reform of the RDTI funding system was forgotten. By 2010 the situation of Estonian research and innovation was worse than it was in early 2000. Estonia was decidedly not a knowledge-based society – on the contrary it had to abandon its national aspirations and attempt to find other roads to prosperity.

This scenario illustrates that in attempting policy driven change it is possible to win the battle and lose the war. In other words, taking positive action in certain areas is usually a necessary but not a sufficient condition for success.

5.3 Jumping in the deep end and...

In 2003, following input from an international evaluation of the RDTI funding system in Estonia different options for change were discussed by the relevant communities. These included increased level of public funding for research, more focused strategic research priorities, carrying out a structural reform

aiming to re-align the two different parts of the funding system, and designing and implementing a national foresight programme to assist in developing consistent and realistic research and innovation policy.

A consultation (debate) including all stakeholders in the RDTI funding process was initiated. At the beginning it was hard – trust had to be built where there traditional suspicion reigned, understanding had to be achieved where drastically different assumptions were used. Gradually though the different parties in the discussions started realigning their visions and closer interaction almost inevitably resulted in trust and good will. Thus eventually a consensus regarding the changes that were necessary, desirable and possible was achieved.

It was decided that:

- The level of public funding for RDTI will be increased;
- This increase will be involved with defining stricter priorities;
- The increase will be used to mobilise RDTI funding from industry;
- Legislation (and other measures) aiming to encourage international companies to use (and invents in) the science base of Estonia needs to be introduced;
- A national Foresight programme will be designed and implemented to inform innovation and research policy (priorities) and to help formulate topics for cross institutional national research programmes;
- Industry in to be a vital partner in the Foresight and participant in the national research programmes;
- A structural reform aiming to bring the two parts of the RDTI funding system closer will be carried out in parallel with the changes mentioned above;
- The Foresight exercise can be used as an activity building the new Research and Innovation Funding Council;
- Existing schemes and initiative will be streamline to make the system less complex (and confusing);

Having achieved an agreement regarding necessary policy driven change the stakeholders in Estonia were sufficiently committed to it. Thus, during the following five years the public support for RDTI increased, the Foresight programme helped formulate a number of strategic research priorities that Estonia was to follow on its own and another set which were to be pursued in cooperation with larger structures (the EU, Finland, Russia and Sweden). International cooperation permeated every level of research, innovation and graduate and post-graduate education. Also a number of relatively small high tech companies in Estonia formed partnership arrangements with companies abroad. As a result, Estonia achieved maximum effect from its investment in

RDTI both in terms of supporting research and innovation and raising the innovative capacity of industry.

It was not all a smooth ride, however. The most acute problems were experienced in the context of the structural reform. Setting up working and workable social institutions, particularly ones including quite disparate social groups, can be hard. During the initial stages of the existence of the RIDC internal conflict was the rule rather than the exception. However, the common task – to design and manage (administer) a national Foresight programme helped the different groups to reconcile their interests and realign their practices.

By 2010 Estonia was well on its way to achieving its national aspirations and becoming a knowledge-based society.

Annex One

Research and Innovation Funding Council: making the case

One of the options for change suggested in this report is for the establishment of a new institution in the RDTI funding system of Estonia. Its working name is 'Research and Innovation Funding Council (RIFC)' and it is to have overall responsibilities for financing RDTI as well as for implementing the co-ordinated policies of the Estonian government. Requiring a fairly radical institutional and structural transformation of the RDTI funding system this suggestion, which is one among many, inevitably raised issues and concerns demanding additional attention.

This annex aims to clarify some point regarding the setting up of a Research and Innovation Funding Council in Estonia. This is necessary so that, policy makers in Estonia can make informed choices from the options discussed under section 4.2.3 in the main body of our report. We would like to emphasise that the choice of options is a policy/political matter which is by default in the hands of local policy-makers and it is not our intention to interfere with this process. Neither is the intention to favour one option against another. This Annex is necessary mainly due to registered concerns (within Estonia) regarding the creation of an institution bringing together the research and innovation funding streams and expressed wishes to find precedents elsewhere.

The annex consist of two parts – one of these provides further ideas about the RIRC itself and the other one presents two cases of organisation of funding for research and innovation: the UK and Norway. While probably other cases can be found we consider these two to be a good (and sufficient) illustration of the points that need to be made.

Further comments on the Research and Innovation Funding Council (RIFC)

It seems that a major set of concerns relate to the fact that if a RIFC is set up all public funding for research and innovation will be under one institution. On the one hand this is viewed by some, as a return to pre-independence times and on the other, such a move is perceived to be a threat to the relatively recently (re)-established democratic practices. In practice the RIFC does not have to either. In our view:

- The RIFC will have the remit and responsibilities of any research and innovation intermediary institution operating in the more developed national

innovation systems. The Research Councils are only one such institution and looking at examples across Europe these do not have to fund (and as a rule do not fund) exclusively basic research.

- These functions could include: responsibilities for allocating selective base-line funding to research institutions; responsibilities for designing, implementing and administering a national Foresight programme; responsibilities for providing input into and implementing the national policy for innovation and research; supporting PhD research training and post doctoral research; etc.
- This institution by its very nature and structural position (being an intermediary institution) needs to have links with higher level of governance on the one hand and with the research/innovation community on the other. Links with the higher levels of governance could be ensured if: the head of the institution has very high scientific and political profile; and the Board of the RIFC has overlapping membership with the R&D Council.
- Links with the research and innovation community(ies) would be ensured by the executive arms of the RIFC, namely the Estonian Science Foundation and ESTAG³¹. These institutions while accountable to the RIFC should have independent status and ring-fenced budgets.

It is not possible to exhaust the issues arising in the context of the setting up a new institution – RIFC - in the Estonian RDTI funding system. These issues are complex and relate to the internal structure and the external relationships of the institution, as well as to the social and legal problems/issues this might present.

Assessing possibilities for change of the RDTI funding system in Estonia, establishing the RIFC ranks very high in terms of providing opportunities for implementing desirable change and for bridging the existing conceptual and structural gap. Setting up new institutions, however, is always a very challenging process. Success can not be guaranteed and results can be expected no earlier than 3 years after the first steps have been taken.

Cases of RDTI funding systems

Here we have chosen to draw attention to two national systems for financing RDTI activities. One of these is the national system of the United Kingdom and the other one the national system of Norway. These cases illustrate different

³¹ It might be beneficial to the RDTI funding system in Estonia to restore ESTAG's legal status as an independent organisational structure rather than a collection of policy measures.

aspects of RDTI financing in that in the case of the UK a number of funding bodies exist but their activities are fairly well co-ordinated while in Norway there is only one RDTI funding institution – the Norwegian Research Council.

Due to considerations regarding space and time it has not been possible to provide comprehensive accounts of the workings of the respective national research/innovation systems. Hence, following brief descriptions of the funding and institutional arrangements, we have brought forward some of their characteristics that are deemed to be relevant in informing policy-makers in Estonia. At the same time, the sources that have been used are referenced so these can be considered further.

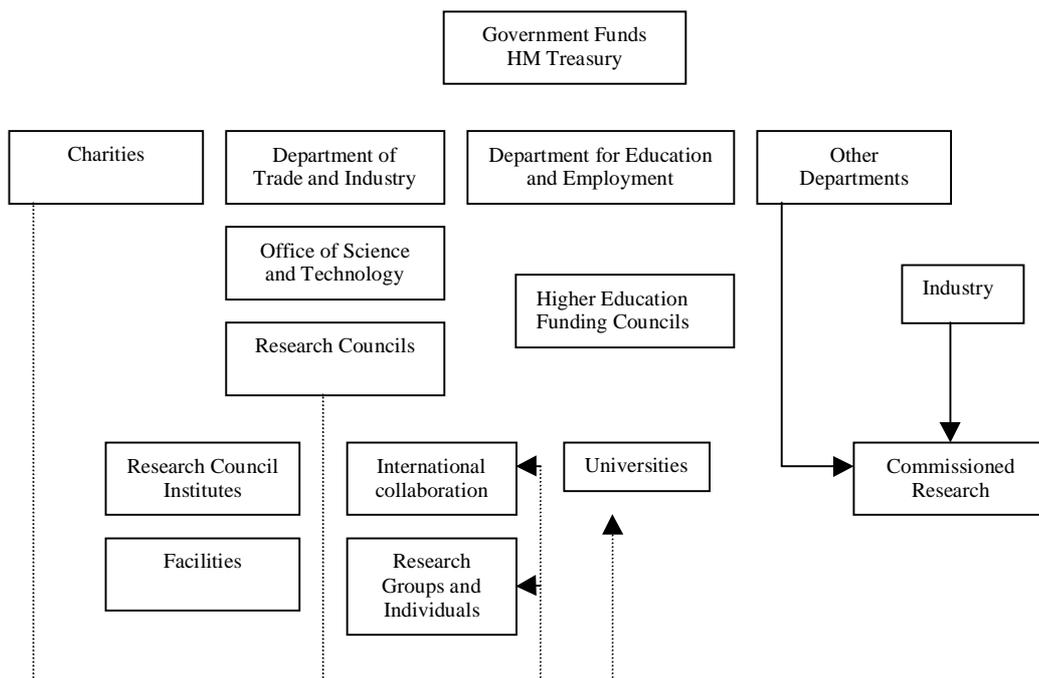
The United Kingdom

The RDTI funding system in the UK has been extensively studied and a number of publications on this issue exist³².

Looking at the Figure 1, the UK NRS appears clearly structured whereby the structure expresses clear lines of policy making and responsibilities, bordering on hierarchy. In reality the relationships between institutions at different levels of policy making are much more complex and usually decision-making involves extensive negotiation.

Figure 1: Research Funding Flows in the UK

³² See for example: Nedeva M., (1995), 'Science and technology policy in the 1990s: the case of the United Kingdom', in Parissakis G. and N. Katsaros (eds.) *Science Policy and Research Management in the Balkan Countries*, Kluwer Academic Publishers, p. 219-232; Cunningham P., (1998) (ed.) *Science and technology in the United Kingdom*, Cartermill International; Georghiou L., 'The United Kingdom National System of Research, Technology and Innovation', in Laredo P., and P. Mustar, (ed.), 2003, *Research And Innovation Policies in The New Global Economy: An International Comparative Analysis*, Edward Elgar; Cunningham P. and S. Hinder, (1998) *A Guide to the Organisation of Science and Technology in Britain*, 5th edition, London: British Council; etc..



Source: Based on Cunningham and Hinder, 1998

‘At the hub of the UK system of innovation governance is the Department of Trade and Industry. This Government department is tasked with the overall aim of increasing “competitiveness and scientific excellence in order to generate higher levels of sustainable growth and productivity in a modern economy”. More specifically, the DTI influences UK innovation through a variety of channels. With regard to *science and science policy*, the Office of Science and Technology (OST), located in the DTI, is responsible for the funding of basic research both within, but largely via, the six Research Councils. It also provides the secretariat for the Chief Scientific Advisor who coordinates science and technology across Government and produces the annual *Forward Look of Government Funded Science, Engineering and Technology*, which summarises recent and planned Government expenditure and policy on S&T, and, jointly with the Office of National Statistics, the annual *Science, Engineering and Technology Statistics*³³. In order to promote the *exploitation of S&T*, the DTI takes the lead on a number of mechanisms (such as Foresight, LINK and Foresight LINK, Higher Education Innovation Fund) designed to promote the commercial exploitation of Government funded research and stimulate collaboration between the research community (including universities)

³³ See: <http://www.dti.gov.uk/ost/>

and industry. The DTI's Innovation Unit³⁴ aims to create the right *climate for innovation* by changing attitudes within the public and private sectors. This is done, for example, by promoting the strategic importance of innovation, improving communications between companies and financial institutions, publication of the annual UK scoreboard of company R&D expenditure, development of regional business networks, encouraging exploitation of the science base, and enhancing the innovation content of educational materials. The DTI operates and/or funds a number of schemes for the *promotion of innovation in companies* mainly based around the identification and dissemination of best practice and the exchange of people (and their ideas and expertise). Examples include Business Links offices in England and their equivalents in the devolved administrations, which act as "one-stop-shops" - points of contact for many of the Government's innovation support schemes, a number of internet-based information gateways (particularly targeting SMEs), and a range of Best Practice guides, tools and initiatives, plus technology transfer schemes such as the Teaching Company Scheme (TCS), Faraday Partnerships and the International Technology Service. The DTI attempts to foster the *creation and growth of new companies* (especially New Technology Based Firms) through initiatives such as the Enterprise Fund. Finally, the Department encourages the *acquisition, development and use of technology* and provides R&D support and advice to SMEs (and larger firms, in the fields of energy, space, and civil aeronautics) through a number of measures.

Whilst the DTI is the key Government actor in UK innovation policy, a number of other Departments and Ministries undertake innovation related activities, for example, by commissioning intra- and extra-mural R&D in support of their departmental objectives. Furthermore, the UK Government aims to operate a policy of "joined-up government" – which attempts to ensure that policy decisions and implementation are coordinated across all government departments and agencies. Of particular relevance is the Department for Education and Skills (DfES). This Department has responsibility for all issues relating to education in England (from primary age through to higher education, training and lifelong learning and skills development). It also oversees the Further Education Funding Council for England (FEFCE) and Higher Education Funding Council for England (HEFCE), which provide funding for staff and infrastructure in institutes of further and higher education respectively. The Department for Work and Pensions (DWP) was created after the June 2001 Election from elements of the former Department of Social Security, parts of the former Department for Education and

³⁴ See: <http://www.innovation.gov.uk>

Employment and the Employment Service. It forms a single contact point for matters relating to jobs, job vacancies, unemployment and other state benefits, child support, and pensions. Lastly, the Office of the Deputy Prime Minister (ODPM) has oversight of sustainable economic development in the English regions. The ODPM was formed following the restructuring of the former Department of Transport, Local Government and the Regions (DTLR) in early 2002, which vested responsibility for transport and transport-related matters with the Department of Transport. Regional innovation policy remains with the DTI and is delivered via the Regional Development Agencies, for which the DTI has responsibility.³⁵

In summary the UK RDTI funding system is characterised by:

- A relatively stable Gross Expenditure on Research and Development at around two percent of the GDP;
- Expenditure on defence is still high, though it has decreased as a proportion of the total in recent years;
- Block funding, covering infrastructure and the proportion of salaries of academic staff allocated to research, is distributed to universities via the Higher Education Funding Councils (separate for England, Scotland, Wales and Northern Ireland). This money is allocated by a formula, the largest element of which derives from a quality rating awarded in the Research Assessment Exercise, a panel-based rating of research performance carried out every four or five years³⁶;
- Funding for projects and centres is allocated competitively on the basis of peer review by the Research Councils;
- The Department of Trade and Industry (DTI) is the pivotal point of the UK RDTI funding system. The Office of Science and Technology (OST) is located within the DTI although it has ring-fenced budget³⁷;
- All funding for innovation is under the LINK programme lead by the DTI.

³⁵ This section draws heavily on Cunningham P., Monitoring, updating and disseminating developments in innovation and technology diffusion in the Member States – The TREND CHARD: United Kingdom, Covering period: October 2001 – September 2002, October 2002.

³⁶ See: Georghiou L., ‘The United Kingdom National System of Research, Technology and Innovation’, in Laredo P., and P. Mustar, (ed.), 2003, *Research And Innovation Policies in The New Global Economy: An International Comparative Analysis*, Edward Elgar

³⁷ In fact it has been argued that this ring-fencing prevent full harmonisation between OST and the rest of the DTI and thus the harmonisation between research and innovation policies.

In conclusion, we would like to emphasise that there are a large number of actors in the UK system but the level of synchronisation is fairly high. If anything, there have been arguments that although the OST is within the DTI the fact that its budget is ring fenced prevents further synchronisation. It is also worth noting that due to the long process of its development and the long traditions of negotiation in British political life the synchronisation of the national research system is achieved through negotiation. This is hard to achieve in less developed (less old) national research systems.

Norway

The RDTI funding system of Norway is quite streamlined compared with other research and innovation funding systems. Namely it has one institution at the executive level – the Norwegian Research Council – which allocates roughly one third of the total public funding for research, development and innovation. The remaining funding is allocated by the Ministries directly to the relevant research institutions (usually research institutes). The Research Council has three main functions: it advises government on its RDTI policies; it is a funding agency supporting research and innovation across the whole spectrum; and it has a co-ordination function ensuring interactions between different research performers, research performers and industry etc.³⁸

The Research Council of Norway (RCN) was established in 1993 by merging five research funding institutions. The ultimate objective of the merger was to improve the co-ordination of funding ‘...across disciplines, across sectors of Norwegian society and to bridge the gap between applied and basic research.’³⁹

A comprehensive review /evaluation of the RCN was carried out in 2001. The evaluation was commissioned by the Royal Norwegian Ministry of Education, Research and Church Affairs and *Technopolis* took overall responsibility for carrying out the work. However, a large number of experts in STS were involved in the study⁴⁰.

The study provides:

- An overview of the role and place of Research Councils and intermediary type organisations in the national research system;

³⁸ See: <http://www.forskningsradet.no/english/about/>

³⁹ van der Most F., van der Meulen, B., (November 2001) *RCN's role in the dynamics of research: a scientists perspective*, University of Twente.

⁴⁰ Arnold E., Kuhlmann S., van der Meulen B., (December 2001) *A Singular Council: Evaluation of the Research Council of Norway*, Final report.

- A very well informed discussion of role and mandate of the RCN in the context of the socio-economic realities in Norway;
- Methodologically sound assessment of the work and functioning of the RCN during the eight years of its existence;

The main messages of the evaluation report are as follows:

- The RCN is unique in that it provides the only case where all public funding for RDTI activities is under one institution;
- At the outset the RCN had very ambitious aims;
- Despite having many achievements the Council is falling short of realising the challenging ambitions with which it began;
- The limited progress can be attributed not so much to a poor performance by RCN as to an inconsistency between the aims and missions given to it and the means put at its disposal;

The overall conclusion of the evaluation is that a singular funding institutions can work if the boundary conditions are appropriate and means matching the institutional goals are put at its disposal (adequate budgets, for example).