Assessing Impacts of the Estonian R&D Financing Programme on the Business Enterprise Sector

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Introduction

"Demand for evaluation has been fueled by the desire to understand the effects of technology policies and programs, to learn from the past and, more instrumentally, to justify the continuation of those policies to a sometimes skeptical audience" (Georghiou and Roessner 2000, p. 657). The amounts allocated to such initiatives are considerable, for example, the European Union Structural Funds have funded the research, technological development and innovation initiatives in the EU25 over the period of 2000-06 with approximately 10,198 MEUR (Technopolis 2006, p. 4).

In 2006-2007 PRAXIS Center for Policy Studies conducted impact analyses of eight national business support schemas that were implemented in 2001-2004 (see Kuusk and Jürgenson 2007 for summary). This was the first trial in Estonia to discover if the support measures are relevant and if the expected results and impacts are achieved. To our knowledge this is the also the first time when such impact assessment study was performed in the Central and Eastern European countries. One of the instruments assessed was R&D Financing programme that was the main policy instrument aimed at increasing research, development and innovation activities in the enterprise sector.

In chapter one the theoretical framework is presented to establish the logic of assessing impacts of research and development activities. Estonian R&D Financing Programme is described is section chapter two and its impacts assessed in chapter three based on the established assessment framework. Chapter four discusses the results from the pespectives of local economic context, innovation policy and governance of the Programme. The article closes with a concluding section.

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1. Assessing Impacts of Research and Development Activities on Enterprises

Market imperfections' based corrective actions regarding R&D, following from the neoclassical economic theory of R&D (for key elements see Nelson, 1959 and Arrow, 1962) has been the most widespread understanding about the role of State in economic development since the 1950s. It was argued that the social returns to research investment exceeded the private returns faced by the individual firm, a condition leading to underinvestment by the firm from the societal point of view in research due to appropriability problems, indivisibilities, and risks and uncertainties. However, the innovation systems approch that emerged in the beginning of the 1990s (Freeman 1987, Lundvall 1992, Nelson 1993) and that rapidly gained popularity among some national governments and infuencial international organisations (Sharif 2006) has greatly enlarged understanding of innovation processes. Innovation is treated as interactive, non-linear process in which actors, e.g. firms, interact with other organisations, including research institutes, customers, and in many cases success in innovation is dependant upon feedback mechanisms. New rationales for government intervention, the so-called 'system failures', were related to overcoming failures in infrastructure, transition, lock-in/path dependency, institutions, networks and capabilities (Smith 2000, for summary, see Woolthuis et al. 2005).

To undestand the effects government interventions have on overcoming those failures, and to measure the effects of public assistance on firms' innovation activities, the concept of additionality has been developed (appeared first in Georghiou, 1994 and Buisseret et al. 1995).

Input additionality analyses if the subsidy is reflected in increased R&D expenditure by the firm itself. Should the firm accept the subsidy for an activity that it would have carried out anyway and allocate those resources to another activity, it would render the subsidy as "deadweight". 'Full crowding out' refer to the situation when firms do not change their R&D plans, but rather use the subsidy to reduce their own spending. Or 'partial crowding out' can take place when firms increase in their R&D expenditures is smaller than the amount of the subsidy.

Output additionality, the extent to which the end results are different as the result of the subsidy, captures mostly both additionalities in outputs (typically patents and prototypes in R&D acitivites) as well as in outcomes (improved business performance resulting from product, process or other type of innovation).

Next to input and output additionalities, still, "little effort has been made to identify ways in which government policy influences the type of R&D conducted by firms or the ways in which such R&D is conducted. An emerging approach to evaluation – that of behavioural additionality – aims to measure explicitly changes in the ways firms conduct R&D as a result of government policy instrument" (OECD 2006, p. 10). The following behavioral additionalities are mentioned in the relevant contributions (Falck 2007, pp. 667-668, OECD 2006): acceleration (speeding up the course of the project), cognitive capacity (positive impact on competencies and expertise), challenge (availability to take more risks), follow-up (help to establish follow-up projects), management (company management routines improved), network (creating networks), scale (activities conducted on a larger scale) and scope (wider range of markets, applications or players are included).

2. Estonian R&D Financing Programme

The objectives of the Estonian R&D Financing Programme (2001-2003), albeit formulated with the slightly varying emphasis in various documents (EAS 2001a, EAS 2003a), have remained the same over the years: "The goal is to apply the developed technologies and innovations in business, thus increasing the effectiveness and improving the performance figures of the company implementing the project and the Estonian business sector on the whole" (EAS 2001).

Over the years different indicators have been used in different documents to evaluate the effectiveness and impact of the programme, although the target levels of the indicators were not set before 2006 and therefore in the case of projects of years 2001-2003 only the goals set by the companies themselves in the project applications and the results attained can be compared. Indicators of the programme through 2001-2006 as listed in various documents, are listed in Table 1.

Table 1. Indicators of the R&D Financing Programme, 2001-2006

Output indicators	Performance indicators	Impact indicators
Number of supported projects	Increase of R&D expenditures independent of EAS	The growth of turnover achieved per year as a result of the projects supported, incl. export turnover
The share of projects exceeding EEK 2 million in the financed project portfolio	% of feasibility studies as a result of which an R&D project is created	New products and services developed, their share in the turnover of the company
Follow-up financing decisions	New growing companies established	Jobs created and preserved
Private investment involved (i.e. the applicant's self-financing portion)	Product development projects started in the business sector based on applied research	
	Number of applications for legal protection of industrial property by types, incl. patenting abroad	

Source: Authors based on EAS 2006, EAS 2005, EAS 2004, EAS 2003b, EAS 2002.

The R&D Financing Programme has three main sub-instruments: (1) support for feasibility studies, (2) applied research support for R&D institutions (also respective loans issued before introduction of the EU Structural Funds in 2004), and (3) applied research and/or product development support and loans for companies. An overview of the main conditions of granting support has been given in Table 2.

Table 2. Conditions of the R&D Financing Programme

Applicants	Companies and R&D institutions
Forms of support	Grants and loans
Support levels	– Feasibility studies[3] – max. 75% in the case of applied research and max. 50% in the case of a product development project – Applied research – up to 75% of the total costs – Product development projects – up to 50% of total costs – In the case of R&D institutions the support may reach up to 100% Conditions of a product development loan: – Interest rate – 1-5% – Term – 8 years – Maximum repayment holiday – 3 years
Eligible expenditure	Staff costs Expenses on instruments, equipment, buildings and land Consultation and other service costs, incl. patents Overhead expenses Other running operating expenses
Period of processing the application	Up to 3 months

Source: EAS 2001.

One of the keywords in terms of the structure of the measure is cooperation. Cooperation between R&D institutions and a company or between companies was not a prerequisite for applicants, but it gave additional points upon evaluation of the application.

The total budget for the R&D Financing Programme for the period 2001-2003 was 15.3 mln EUR, the distributed funding was 10.4 MEUR, out of which 7.4 was granted to enterprises (Table 3).

Table 3. Programme budget and number of applications/support (and loans) 2001-2003

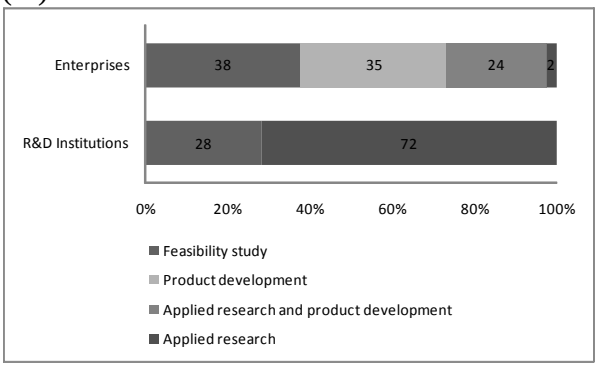
	Applications (number)			**Budget (MEUR)**		
	Submitted	**Approved**	**Success rate (%)**	**Applied**	**Approved**	**%**
Enterprises	123	82	66.7	13.7	7.4	54.2
R&D Institutions	42	25	59.5	7.9	3.0	37.5
Total	165	107	64.8	21.6	10.4	48.1

Source: State Audit Office 2004, EAS 2006.

In 31 instances out of 82 support was given for feasibility studies to companies, for the R&D institutions the applied research was the most supported activity (Figure 1). Information and communications technology, biotechnologies, material technology and energy and environmental technology projects dominate among the supported projects, both in number of project supported and the funding allocated (Figure 2).

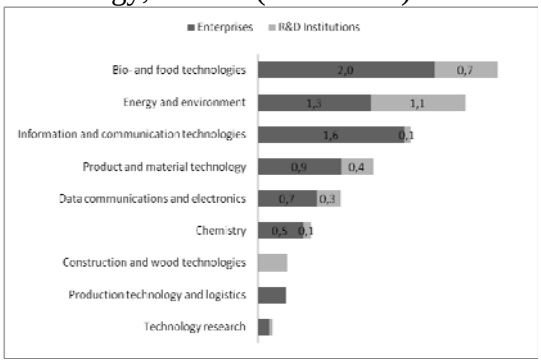
[3] Feasibility study is usually short-term and may include services outsourced from experts. It is meant to prepare a project business plan and a technology strategy, to assess the potential market share of the developed product and/or service, identify competitors, conducting patent research, etc.

Figure 1. Supported projects by type of support (%)



Source: EAS 2006

Figure 2. Division of support by fields of technology, MEUR (2001-2003)

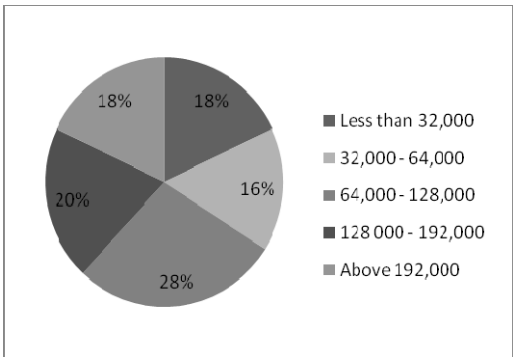


Source: EAS 2006, authors.

Micro companies and small companies dominate the field among the final recipients and through 2001-2003 12%[4] of supported companies (6) were start-up companies (i.e. registered at the beginning of the project or in the preceding year).

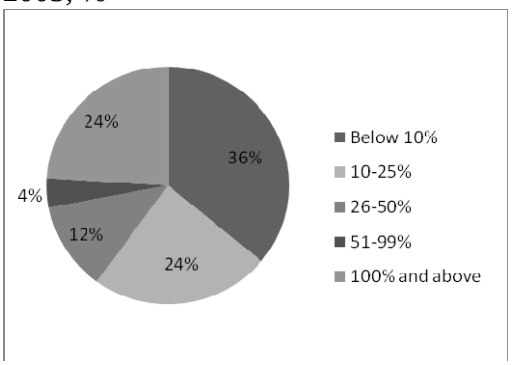
Most of support through 2001-2003 was between EUR 64,000 - 128,000, while the highest exceeded 1 MEUR (partially a loan) (Figure 3). Although mostly the support did not exceed 25% of the turnover of the supported company, the turnover of a quarter of the companies was smaller than the amount of support (Figure 4).

Figure 3. Size of support and/or loans to projects through 2001-2003, EUR and % [5]



Source: EAS 2006

Figure 4. Share of support and/or loan of the turnover of the company in the year of application, projects supported through 2001-2003, % [6]



Source: EAS 2006

The number of world-class research-intensive companies is estimated to be about 50 in Estonia and the number of internationally competitive companies who have development capacity, but limited research capacity is around 150-200 (Gabrielsson et al. 2007, pp. 19-27). It this light more than 20% of the total number of companies in the target group were supported through 2001-

[4] Does not include feasibility surveys.
[5] Does not include feasibility surveys.
[6] Does not include feasibility surveys.

2003 (does not include feasibility studies). In spite of the fact that the number of final recipients has been relatively modest the total amount of support given to companies amounts to 11% of companies' R&D expenditure through 2001-2003 (PRAXIS based on Statistics Estonia and EAS).

3. Impacts of the Estonian R&D Financing Programme

3.1. Research Method

The main sources of information for assessment of impact carried out were the databases of Enterprise Estonia (EAS), which were supplemented by data obtained directly from the beneficiaries and consultants. To that end a web survey was carried out among all applicants, but the response rate of those who did not receive any support was so low that we cannot draw any conclusions on the basis thereof. Also, face-to-face interviews were carried out with the implementers of the projects.

A web survey among all the supported companies and R&D institutions was carried out from October 2006 to January 2007 with responses received from 29 entrepreneurs and 12 R&D institutions. Since one of the supported companies received support twice in the surveyed period, the results of the web survey describe 31 projects. The share of the respondents in all the projects is 49% in the case of companies and 60% in the case of R&D institutions.

In addition, leaders of projects were interviewed in January 2007. During the interviews the background of the responses given in the web survey were specified and the successfulness of the project was investigated in greater detail as well as the factors which impeded and favoured it. 28 interviews were carried out in total, incl. with 13 R&D institutions, covering 14 projects, because in one instance one applicant had two projects, one of them being a follow-up project. Thus, in the case of R&D institutions 70% of projects were interviewed (out of 20). One of the projects was merely successful feasibility study. As for companies 13 were interviewed; projects were included in the sample based on the intention to involve companies of a different size group and cover projects of different fields of activity (Tables 4 and 5). Additionally, two consultants advising R&D projects were interviewed.

Table 4. Division of the whole of companies and the sample of interviews by project sizes[7]

Project size (EUR)	Whole of companies		No of projects		Interview sample	
	No of projects	%	No of projects	%	No of projects	%
Less than 32,000	9	18.0	6	19.4	1	9.1
32,000 - 64,000	8	16.0	5	16.1	2	18.2
64,000 - 128,000	14	28.0	10	32.3	3	27.3
128 000 - 192,000	10	20.0	6	19.4	1	9.1
Above 192,000	9	18.0	4	12.9	4	36.4
Total	50	100	31	100	11	100

Source: Authors, EAS 2006 regarding the whole of companies.

[7] Does not include feasibility surveys.

Table 5. Division of the whole of companies and the sample of interviews by fields of activity of projects

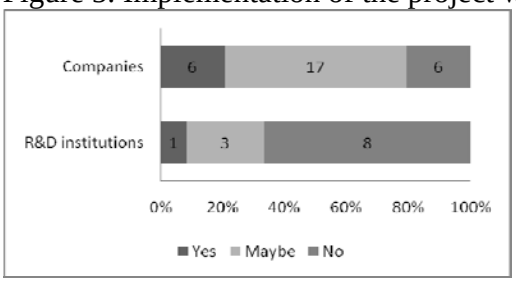
Technology field	Whole of companies		Web survey sample		Interview sample	
	No of projects	%	No of projects	%	No of projects	%
Electronics	21.5	26.2	9.5	30.6	4	28.6
Product and material technology	16.5	20.1	5	16.1	2	14.3
Energy and environment	12	14.6	3	9.7	3	21.4
Data communications and electronics	9	11.0	3	9.7	1	7.1
Technology research	8	9.8	1	3.2	1	7.1
Bio- and food technologies	6	7.3	3.5	11.3	2	14.3
Chemistry	5	6.1	3	9.7		0.0
Production technology and logistics	4	4.9	3	9.7	1	7.1
	82	100.0	31	100	14	100

Source: Authors, EAS 2006 regarding the whole of companies.

3.2. Input Additionality

As a result of web-survey and interviews carried out it can be concluded that only a few projects would have been implemented without the support from the R&D Financing Programme. In the case of R&D institutions the share of such project is virtually non-existent (Figure 5). Compared to other business support measures evaluated it follows that R&D Financing Programme is one of the business support programmes with the smallest deadweight.

Figure 5. Implementation of the project without support (n=41)

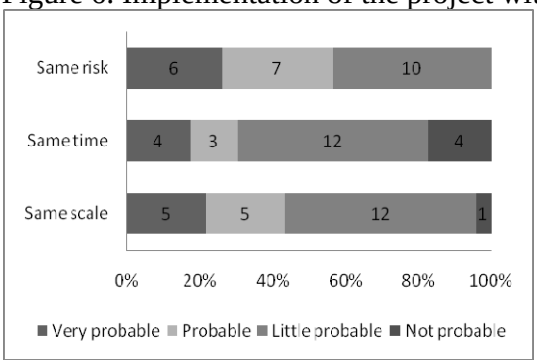


Source: authors based on web-survey.

In 2001 evaluation of a similar programme was carried out in the UK and there 66% of companies replied that the project would probably not have been implemented without support, 30% said that it might have been implemented and 4% were certain that the project would have been implemented (DTI 2001). In comparison with these results the additionality of the Estonian programme is not very high.

Upon implementation of projects without support, one should have made the greatest concessions in the timetable and volume, while the smallest ones in the risk level of the project (Figure 6). This means that the support rather enhanced the implementation of the project than allowed for taking higher risks.

Figure 6. Implementation of the project without support (company projects, n=23)



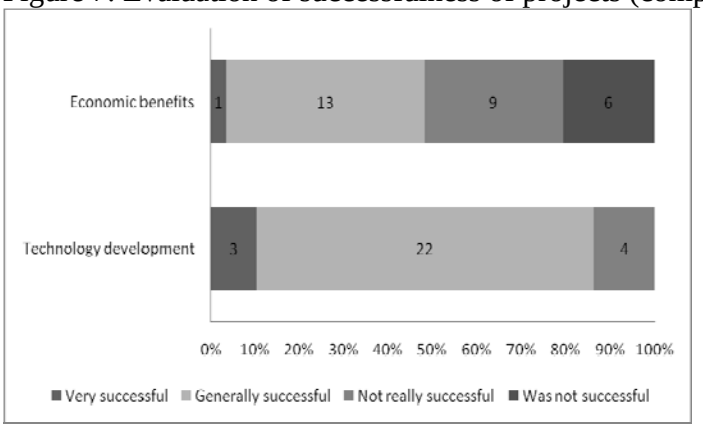
Source: authors based on web-survey.

In sum, 21% of the projects (6) is mere additionality. In UK the share was 66%. 15% (17) of the rest (23) would have made concessions in time, project scope or risk level. Thus, 59% of the projects is partial additionality. In UK the share was 32%. There was no additionality in the case of 20% (6) of the projects. In UK the share was 2%.

3.3. Output and Outcome Additionalities

It was asked to evaluate the successfulness of the project (achievement of the goals) for the purposes of technology development as well as economic feasibility. It appears that in most cases the planned development was successful, but nearly half of the projects of the companies were economically rather unsuccessful (Figure 7). As a result of the aforementioned UK programme seven out of every ten projects reached the market (DTI 2001).

Figure 7. Evaluation of successfulness of projects (company projects, n=29)



Source: authors based on web-survey.

The expectations of R&D institutions regarding the economic feasibility of the projects are smaller and different from those of companies. R&D institutions are clearly interested in financing their research and the possibility to cover staff costs and there is often no ambition to apply the results in business or make money on it. In the case of 7 projects out of 12 projects of R&D institutions interviewed it was admitted that the results of the project were either not applied in business at all (2 projects) or applied very little only by the companies who directly participated in development, although at the beginning of the project more extensive usage of the

results was expected. In the case of projects launched by the interviewed companies the results of three projects (out of 9) had not been applied at all.

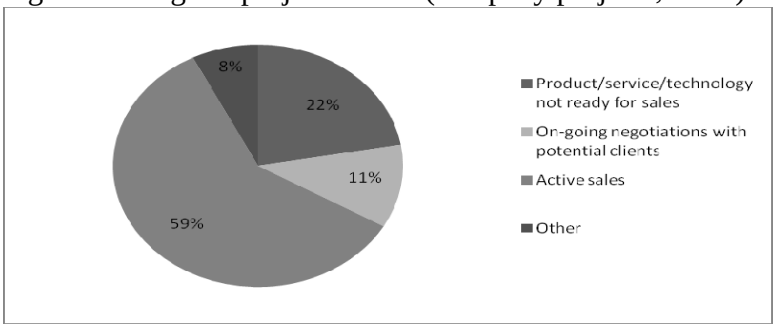
The main reasons for failure (both in case of projects initiated by R&D institutions as well as companies) pointed out in the interviews:

- In single events the development turned out to be technologically unfeasible or it was late – a competing technology reached the market sooner.
- More often the reason lied in the incapacity for marketing, as a result of which a large portion of the technological capacity was not applied in business or realised as economic gains.
- On several occasions the result of development was not applied or it was postponed due to the incapacity for making the required investments in the phases following development (industrial tests, introduction of the product, development of the production capacity). Here we should make a difference between start-up and technology-intense companies who for obvious reasons may not have it easy to find capital for expansion and between companies who have a longer history and with regard to whom the respective problems could have been identified at the application stage.

In approximately half of the cases the project was completed on time and the rest not. Delays in projects do not necessarily indicate serious problems in implementing them, but rather poor forecasts regarding the duration of the project. Also, the project timetable was not often postponed due to reasons dependent on the applicant, but also EE. EE delayed payments and if any changes needed to be made to the project, this resulted in long pauses (according to EE, a delay of 3-6 months is ordinary in the case of extensive changes). There were problems with high technological risk and projects whose research was still at an early stage, thus making planning activities more complicated – it may turn out in the course of work that the focus of the entire project should be changed.

Completion of a project does not necessarily mean that the results have been implemented. 59% of projects launched through 2001-2003 are at the stage of active sales as of 2007 (Figure 8). Many admitted that due to the lack of previous experience they were unable to plan the commencement of use of the results correctly. However, one company said that the technology is outdated and the sale has been terminated.

Figure 8. Usage of project results (company projects, n=29)



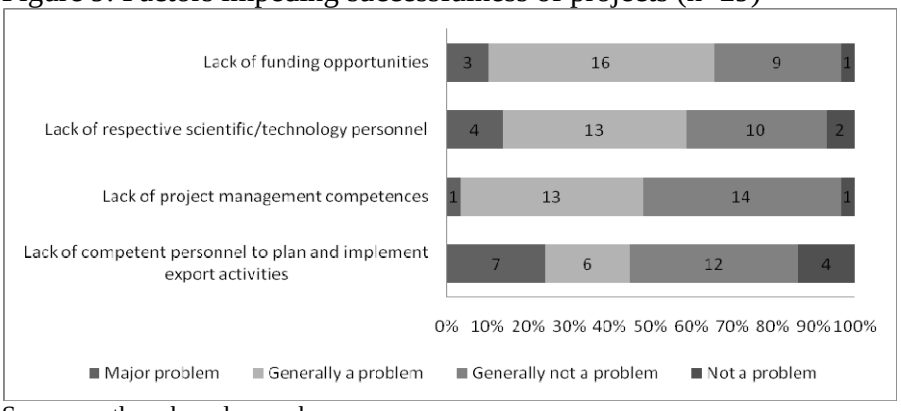
Source: authors based on web-survey.

Most companies either could not evaluate or did not want fulfilment of specific forecasts established, except in single cases whereby the company kept separate accounts on the sales revenue of the product developed. It is especially difficult to assess the turnover, export turnover and jobs added as a result of the support in companies whose project included development as well as in companies where the support of EE accounted only for a fraction of the budget of the development project. All in all, the forecasts were often overestimated and therefore comparison of the actual situation and forecasts would not give any information about the successfulness of the projects, but rather on the inability of making forecasts (impossibility).

In November 2006 EAS carried out follow-up monitoring of projects financed through 2001-2004 where it was focused on evaluation of the attainment of the goals of the projects based on the number of jobs and turnover. It was concluded that with the help of support (or loan) the turnover generated was slightly over one kroon per kroon of support (or loan). Leaving aside three the most successful projects (out of 34 investigated projects), the turnover generated per kroon of state support would have been merely 50 sents (EAS 2007). In the case of the aforementioned UK survey it was concluded that £1 of support increased the turnover of the supported companies by £2.38 (DTI 2001). This result is not entirely comparable to that of Estonia, because the methodology used was very different. In the UK the deadweight and losses pertaining to relocation were subtracted from the total impact, which was not the case in Estonia.

According to entrepreneurs, the main factor impeding success has been the lack of financing and the shortage of experienced and competent people is considered almost as important. Entrepreneurs were short of funds for developing, for instance, the production capacity or marketing (Figure 9). It must be taken into account that in the case of many projects these problems may have risen in a period when the credit was not as available in Estonia as it has been in recent years.

Figure 9. Factors impeding successfulness of projects (n=29)

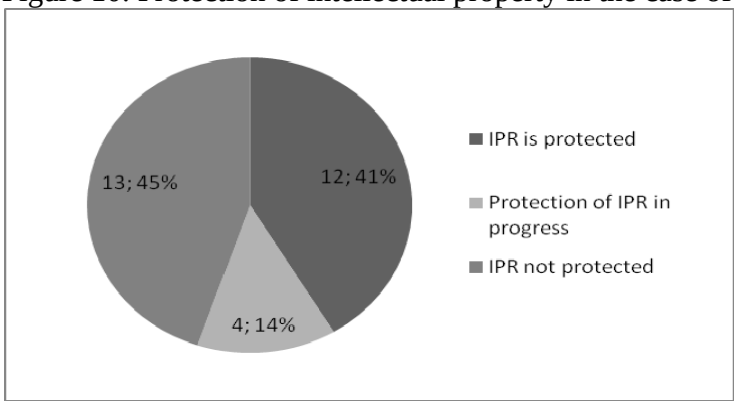


Source: authors based on web-survey.

Companies that produce and sell the product or technology created as a result of development themselves have reached the sales stage the quickest. In the case of licensing intellectual property rights the sales activities have usually not yet begun. These are probably more complicated projects as well.

Allegedly, the intellectual property generated in the framework of projects is protected. Here, in addition to patents and utility models, the protection of copyright and software licensing was kept in mind. In the case of 20% of projects no protected intellectual property is created, in one instance the results are freely available and in four instances (14%) the business secret is kept itself. In the field of information technology intellectual property is not protected due to the complexity of patenting (Figure 10).

Figure 10. Protection of intellectual property in the case of company projects (n=29)



Source: authors based on web-survey.

8% of R&D institutions use intellectual property licensing for protection of the results, 84% use partial protection of the intellectual property created as a result of the project and publication/dissemination of unprotected results and 8% replied that no protected intellectual property is created and the results are freely disseminated/published. In the case of licensing R&D institutions also use patents (4), utility models (3) and trademarks (1). No spin-off companies were directly established. On the basis of the knowledge obtained in the course of the project new projects have been initiated, with spin-off companies having been established to disseminate their results, but this impact is indirect.

3.4. Behavioural Additionality

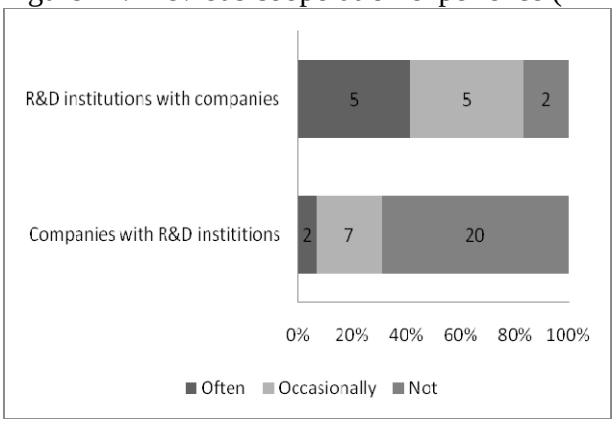
In addition to additionality of input and output, changes in company behaviour and various positive side effects proved to be important results. Several economically failed projects showed considerable side effects, which do not allow for calling the project a complete failure. Examples of the side effects:

- The management skills of such projects, technological knowledge and competencies which allow for launching new and more successful projects increased. Several projects were the first attempts to perform good development work, which made the R&D&I capacity of the company rise noticeably.
- New development ideas were generated and new projects were initiated on the basis thereof.
- Equipment and infrastructure required for further development work was acquired.
- Relations with the existing partners was strengthened or new partners were found. Cooperation with these partners has continued, sparking new development ideas.
    - Cooperation with foreign partners proved especially valuable.

  - Cooperation of R&D institutions with companies influenced the priorities of their further research – more attention is paid to cooperation projects with companies.
- In the case of R&D institutions the level of publications rose and it became easier to publish them in science magazines. The projects also rendered a lot of material for doctoral theses. While the aforementioned side effects contribute directly to the goals of the programme, their impact on business is weaker.

In the case of projects launched on the initiative of companies R&D institutions had been involved in the project as partners in approximately in half the cases. In the case of R&D institutions' projects companies were always involved. Most of the companies had no prior experience in cooperation with R&D institutions, which shows the importance of the experience (Figure 11).

Figure 11. Previous cooperation experience (n=41)



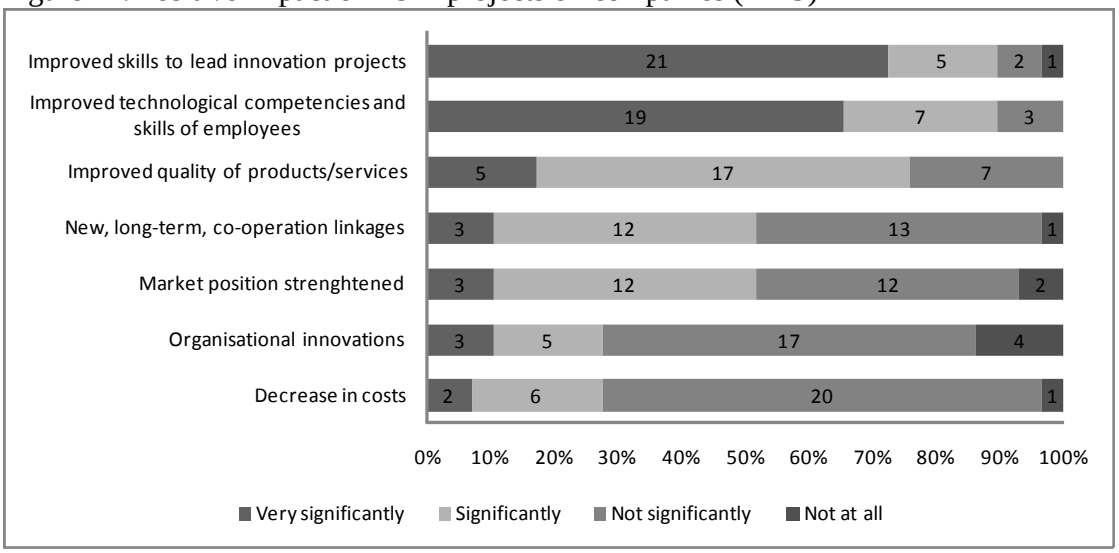
Source: authors based on web-survey.

Based on the interviews it may be claimed that R&D institutions were not too ready to cooperate with companies. This is one of the reasons behind modest application of the results of the projects launched by R&D institutions. R&D institutions were more motivated by the interest in technological development and the companies involved were not often ready to invest large sums in the application of the results. Often, the partners were long-term partners with whom cooperation was well-oiled and who use the project results for their own good without seeking any broader possibility of use. Often the reason for keeping the results within the company lied in the fact that the intellectual property was not protected.

In the case of companies operating in high-tech fields the behavioural additionality is weaken in the sense of collecting development experiences – they have developed cooperation networks, competence and knowledge, and R&D activity is a daily matter. However, they often have limited marketing competence and capacity. This competence and capacity could have been considerably supported by the projects (possible potential behavioural additionality the emergence of which could be supported more by having EE establish respective requirements and conditions, e.g. systematic demanding of marketing plans at the respective project stage. So far, at least in the period under observation, it has been relatively random).

As for side effects, companies consider acquisition of new knowledge and skills and innovation project management skills the most important. The projects have had the weakest impact on cutting costs in the company (Figure 12).

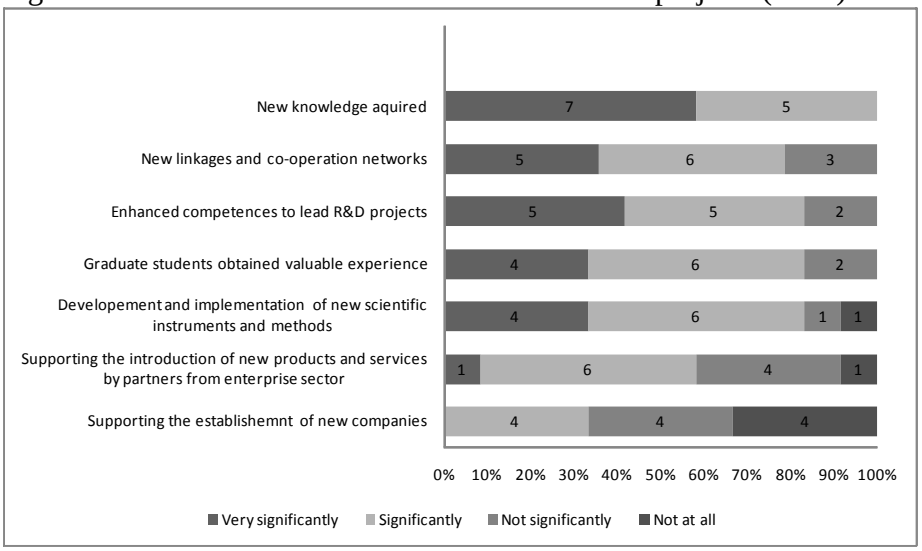
Figure 12. Positive impact of R&D projects on companies (n=29)



Source: authors based on web-survey.

In the case of R&D institutions' projects the side effects are important as well. Half of those interviewed found new partners among companies. New knowledge and the increase of the capacity for management of such projects was considered very important. The impact on establishment of new companies or introduction of innovations in companies is considered less important (Figure 13).

Figure 13. Positive side effects of R&D institutions' projects (n=12)



Source: authors based on web-survey.

3.5. Displacement and Leakage

There was no significant intra-company displacement as a result of the R&D Financing Programme. To receive support, the companies struggled to raise their own financing portion (e.g. a bank loan) and did not direct the funds raised elsewhere. There was no inter-company displacement either, because most of the project results are aimed at foreign markets.

There was slight leakage:

- The intellectual property rights created in the framework of some projects belong to foreign entrepreneurs.
- In the case of several projects foreign (technology-intense) subcontracting was used. This means that new jobs created as a result of the project were created outside Estonia.
- One company has terminated its activities in Estonia and established a new company in another country jointly with the partners.

4. Discussion

4.1. Additionality of the R&D Financing Programme

The additionality analysis of the projects shows that only few projects would have been implemented without the support from the R&D Financing Programme indicating a small deadweight of the programme. Although there have been great expectations regarding the measurement of additionalities (and especially input, output and outcome additionalities), it is largely discouraged by the fact that some indicators proved not be measurable (e.g. increased turnover, export turnover and jobs created owing directly to the support). If these are to be measured, continuous collection of respective data by companies should be demanded from companies and information should be collected regularly. But, as requests for detailed prognoses are very difficult to make in high-technology and risky areas (e.g. biotechnology), it should be taken into account that these indicators are suitable for low-risk projects and in many events (e.g. process development) are hard to measure. Creation of jobs is not always the main goal in the case of R&D projects if the production process is made more effective and value-addedness increased, although that might take place with some employment created in other countries. An additional indicator to be considered is the value added created per employee.

Although in most cases the development of technology was successful, nearly half of them failed to deliver economic returns. Partially this has to do with the fact that in the case of many economically unsuccessful projects the marketing of results was thought of too late. A very detailed marketing plan should have been developed in parallel to the technological development work of the project, because it would have meant additional requirements for the latter. It is also important because often the people attending to R&D projects are, in terms of the personality type, inventors rather than innovators (especially in the case of R&D institutions, but also in many companies). In many cases the result of the development remained unimplemented or was delayed because of capability to make necessary investments in post-development stages (scaling up, enhancement of production capacity, etc). According to the companies, the main factor inhibiting success has been the shortage of the means of financing, and almost as much importance is attributed to scarcity of experienced and qualified personnel. Also, it seems that

2001-2003 was a learning phase and the capacity of applicants as well as the knowledge and experience of evaluators has improved by today.

As was argued in section one, behavioural additionality has become central concept in the evaluation of the R&D support programmes. Estonian case study confirms the relevance of such concept, especially in the long run. We did observe the strong existence of many behavioural additionalities, especially acceleration, cognitive capacity, management, network and scope additionalities. The network and scope additionalities target the major problems of the Estonian innovation system, largely based on Soviet legacies: weak linkages between public R&D institutions and enterprise level R&D; negative incentives retarding innovation at enterprise level (quantitative planned production targets during Soviet era, cultural path dependencies carried over to the following periods); weak, almost non-existent user-producer linkages (Jürgenson et al. 2005; see also Freeman 2006; Freeman 1995). Administrative capacities of organisations regarding R&D activities that are also low, have been also increased with the current programme. Radoševic and Reid (2006) have also concluded that given the very weak organizational capabilities of locally owned small firms in the new EU member states and accession countries, innovation policy should try to strike balance between supporting linkages and supporting firm's absorptive, technology and production capabilities (p. 307).

Results of some evaluations refer to tendency to choose projects with a lower risk level in the case of public sector support, which would more likely allow for reporting of the programme's good results later on (see Lach 2002). Thus, the tendency is to opt for smaller additionality and greater economic effect, as a result of which it is recommended that special attention be paid to these aspects (TAFTIE 2003, TAFTIE 2003). Nevertheless, the implementers of this programme cannot be accused thereof – no remarkable economic impact at the account of additionality or vice versa has been noted. When the programme proceeds it is advisable to pay sufficient attention to the balance between these two goals.

4.2. R&D Financing Programme in the Estonian Innovation Policy

Although Estonia has had an all-encompassing research, development and innovation strategy since the end of 2001 it is not clear how much the strategy is complied with upon distribution of support, especially as regards preferential development of the key areas (user-friendly information society services, biomedicine, material technologies) and application of the innovations created in these sectors in the traditional industry. An analysis of the division of support by technological areas seems to indicate the importance of the key areas (half of the projects were implemented in these areas). Considering the fact that the areas preferred have not been mentioned in the regulation of the programme it may be said that the result achieved is accidental rather than the result of intentional work.

Estonian innovation policy has been argued to be favourable towards high-technology companies and projects, while bulk of the traditional industrial sector has been left out of focus. This refers to the need for more accurate segmentation of clients. The respective plans have already been made in the action plans of EAS (EAS 2004, EAS 2005), but the reports do not indicate if, how and for what purpose it has been done. In the course of the analysis it became evident that the needs of companies in various areas and having various development experiences, the results attained and the methods of attainment are so different that they cannot be measured. For

instance, in the case of a company commencing development for the first time, competent advice during the application process as well as implementation of the project could have significant impact on the successfulness of the project. Thus, an analysis of the clients to the extent of the characteristics describing them (e.g. size, field of activity, R&D experience) and calculation thereof would contribute to more effective attainment of the goals and later evaluation of the impact attained. Minimally, differentiation between the following groups could be considered: Companies operating in the traditional fields; large and relatively R&D-intensive companies and technology-intensive start-up companies.

Due to the limitedness of the current research we could not study in depth companies and project that were not granted with funding, thus, there is no basis to comment on the sufficiency of funds allocated to the Programme.

4.3. Governance of the R&D Financing Programme

The impact assessment confirmed among other findings that such R&D support scheme, while delivering excellent immediate results in many developed countries whose innovation systems are based on 'science, technology and innovation', are working much less on 'doing-using-interacting based innovation systems' (see Jensen et al. 2007 for distinction). While spillovers resulting from R&D grants are relevant in the long run, obstacles related to lack of specific (e.g. marketing) skills have to be dealt as well via, for example, realignment of education policy as well as immigration of highly skilled personnel. This calls for more attention on innovation policy governance: horizontal co-ordination between various ministries.

The research project resulted also with conclusions and recommendations regarding the governance of the R&D Financing Programme.

Some supported projects contained a very high product innovation rate, entailed very high technological risks and had huge budgets. Usually, the management of such projects must be relatively flexible, but according to the interviewees, the R&D Financing Programme did not favour flexibility. Therefore it is advisable to make the programme more flexible in the case of high-risk projects, e.g. regarding making changes to the project plan, because in the case of long-term and many unforeseen factors and risks the respective need may arise. This does mean addition of rights to companies, but also the obligation to notify the financier of the essential circumstances relating to the project, e.g. when the market situation has changed dramatically.

Although the projects of the R&D Financing Programme had been divided into stages, these stages, according to the interviewed, often served an administrative rather than substantive purpose. In some instances the Financing Committee added to the financing resolution a clause that an updated marketing plan or another strategic document must be enclosed with the reports. However, it was rather an exception than a rule. Usually, the compliance of activities with the initial plan was evaluated with regard to all stages. In the case of projects whose risk level is higher it would be reasonable to update plans systematically and request additional documents at later stages (cf *Tollgates, Six Sigma* approaches). In the case of more risky projects it may become evident by the end of the first stage that the project is technologically not feasible or, considering the change of the market situation, a failure.

The successfulness of various projects was impeded by the lack of capacity to invest in post developmental phases as a result of which expansion of supported activities towards introduction of the development results could be considered – something that has been recommended earlier, too (see Technopolis 2005).

One of the main problems upon preparation as well as evaluation of applications is, according to the interviewed, the non-transparency and ambiguity of the system, which calls for very intensive communication with the staff of EAS who may not necessarily be too helpful. Reduction of the role of the specific person "opening the door" and development of a sustainable system is possible through issuance of more detailed guidelines, e.g. about preparation of applications.

Only summaries of the evaluation criteria of the projects have been published. For instance, various interviewed persons said that when preparing project applications the acceptable risk levels of the projects were unclear. EAS finds that if the transparency is increased, the flexibility of the programme will suffer, because it is difficult to define innovativeness and the so-called soft factors. According to EAS, in the current situation the Evaluation Committee has the subjective freedom or subjective flexibility to take them into account. Greater transparency would encourage establishment of more open relationships between EE and the clients and improvement of the low reputation of EAS.

Also, the mechanism of selection of experts evaluating applications and decision-making must be made public. Since in various fields the circle of players is very small in Estonia and "everyone is either friends or enemies," foreign experts could be involved in evaluation of applications. To improve the situation applicants have been given the opportunity to exclude potentially biased evaluators and comment on the evaluation report. The latter is a document compiled by an EAS consultant on the basis of foreign evaluators. Several expert assessments of projects contained remarkable assessments of the weaknesses of the project, which were unreasonably little discussed in the synthesis report of the EAS expert and in single events they influenced the supervision over implementation of the project.

Ideally, the overseer of projects or mentor could point out the problems in time. This would allow EAS to demand that these issues be thought of more and that respective steps be taken (upon completion of some interim stage) or that the project be suspended if the former is refused.

Conclusions

The objective of the current paper was to assess the additionality of the Estonian R&D Financing Programme, the main policy instrument aimed at increasing research, development and innovation activities in the enterprise sector. The assessment was carried out by PRAXIS Center for Policy Studies in 2006-2007 2007 and it was the first trial in Estonia to discover if the support measures are relevant and if the expected results and impacts are achieved.

Based on the databases of Enterprise Estonia, web survey and interviews, we concluded that measurement of input and output additionalities is challenged by the fact that companies do not generally separate activities associated with the public support from general activities. Based on evidence available, still, it can be concluded that input and output turned out to be generally low. But it would not give a basis for arguing that R&D granting schemes are not relevant. Instead, we

did notice the changes in the enterprises' behaviour and many positive spillovers that turned out to be of utmost importance. In many cases the managerial skills, technological knowledge and proficiency of running such projects increased and thereby new and probably already more successful projects can be launched. There occurred new development ideas, which gave rise to new projects. Relations with existing partners were tightened, or new partners were found with whom further cooperation has been done and this has produced new development ideas. Sometimes also cooperation of R&D institutions and enterprises influenced the priorities of former's further research activity and since them more attention is paid on cooperation projects with enterprises. Signs of slight leakage were observed.

Although in most cases the development of technology was successful, nearly half of the projects were economically unsuccessful. The latter is related to the lack of marketing efforts and lack of production capacities.

Many R&D Financing Programme governance matters were also addressed. There is a need for segmenting of applicants and giving more room to 'traditional manufacturing companies' whose grant proposals might not be as 'sexy'. On the other hand, surveillance over high-tech projects needs to be more flexible as project plans might need to be modified often.

References

Arrow, K.J., 1962. Economic welfare and the allocation of resources for inventions. In: Nelson, R.R. (Ed.), The Rate and Direction of Inventive Activity: Economic and Social Factors. Princeton Univ. Press, Princeton, NJ.

Buisseret, T.J., Cameron, H.M., Georghiou, L., 1995. What Difference Does It Make? Additionality in the Public Support of R&D in Large Firms, International Journal of Technology Management, Vol. 10, Nos. 4/5/6, Evaluation of Research and Innovation, pp. 587–600.

Davenport S, Grimes C, Davies J (1998) Research collaboration and behavioural additionality: A New Zealand case study *Technol Anal Strateg* 10 (1): 55-67 Mar 1998

DTI, *Evaluation of Smart (including SPUR) 2001*. DTI Evaluation Report Series, No. 3, 2001.

EAS 2007, Follow-up monitoring of projects financed through 2001-2004.

EAS (2006). Teadus- ja arendustegevuse projektide toetamine. Logframe aastaks 2006.

EAS (2005). Tegutsevate ettevõtete divisjoni tegevuskava 2005.

EAS (2004). Tegutsevate ettevõtete divisjon. Tegevuskava 2004;

EAS (2003a). Teadus- ja arendustegevuse toetamise programm. Programmdokument.

EAS (2003b). EASi 2003.a. eelarve ja koondtegevuskava;

EAS (2002). EASi agentuuride tegevusplaanid 2002

EAS (2001). Rakendusuuringute ja tootearendusprojektide finantseerimise alused Eesti Tehnoloogiaagentuuris.

Falck, R. Measuring the effects of public support schemes on firms' innovation activities. Survey evidence from Austria, *Research Policy*, 36 (2007) 665–679

Freeman, C. (2006). "Catching Up" and Innovation Systems: Implications for Eastern Europe, in Piech, K. and Radoševic, S. (eds), *The Knowledge-Based Economy in Central and East European Countries; Countries and Industries in a Process of Change*, Palgrave Macmillan, pp. 295-313.

Freeman, C. (1995). The "National Systems of Innovation" in historical perspective, *Cambridge Journal of Economics*, 1995, 19, 5-24.

Freeman, C., *National Systems of Innovation: The Case of Japan Technology Policy and Economics Performance: Lessons from Japan*. London: Pinter. 1987.

Gabrielsson, N., Kalvet, T., and K. Halme (2007). *Innovation Staff Recruitment. Program Feasibility Study*, Innovation Studies 9/2007. Tallinn: Enterprise Estonia.

Georghiou, L., 1994. Impact of the Framework Programme on European Industry, EUR 15907 EN, Office for Official Publications of the European Communities, Luxembourg.

Georghiou, L. and D. Roessner, Evaluating technology programs: tools and methods, *Research Policy*, Volume 29, Issues 4-5, April 2000, Pages 657-678

Jensen, M.B., Johnson B., Lorenz E., Lundvall, B.A. Forms of knowledge and modes of innovation, *Research Policy*, 36, 680–693, 2007.

Jürgenson, A. *Teadus- ja arendustegevuse finantseerimise programmi mõjude hindamine* (Impact Assessment of R&D Financing Programme). PRAXISe Toimetised Nr 36, 2007.

Jürgenson, A., Kalvet, T. and R. Kattel (2005). *Business Support Measures in the Budget Strategy for 2007-2013*, Policy Analysis No 9, Tallinn: PRAXIS Center for Policy Studies.

Kuusk, K. and A. Jürgenson (2007). Riiklike ettevõtluse tugimeetmete mõjude hindamine. PRAXISe Toimetised 32/2007.

Lach, S. (2002). Do R&D Subsidies Stimulate or Displace Private R&D? Evidence from Israel. *Journal of Industrial Economics***,** Vol. 50 Issue 4, lk. 369-390.

Luukkonen, T. Additionality of EU framework programmes, *Research Policy*, 29, 711–724, 2000.

Lundvall, B-Å., (ed.) *National Innovation Systems: Towards a Theory of Innovation and Interactive Learning*. London: Pinter, 1992.

Nelson, R.R. *National Innovation Systems a Comparative Analysis*, New York and Oxford: Oxford University Press, 1993.

Nelson, R.R., 1959. The simple economics of basic scientific research. Journal of Political Economy 67, pp. 148–163

OECD. *Government R&D Funding and Company Behaviour: Measuring Behavioural Additionality.* Paris: OECD, 2006.

Radoševic, S. and Reid, A. (2006) "Innovation Policy for a Knowledge-based Economy in Central and Eastern Europe: Driver of Growth or New Layer of Bureaucracy?" in: Piech, K. and Radoševic, S. (eds), *The Knowledge-Based Economy in Central and East European Countries; Countries and Industries in a Process of Change*, Palgrave Macmillan, pp. 295-313.

Riigikontroll (2004). *Ettevõtluse Arendamise Sihtasutuse tootearendusprojektide tulemused. Kontrollaruanne nr 2-5/04/109*

Sharif, N. "Emergence and Development of the National Innovation Systems Approach." *Research Policy* 35, 5: 745-766, 2006.

Smith K (2000) Innovation as a Systemic Phenomenon: Rethinking the Role of Policy *Enterprise and Innovation Management Studies, Vol.1*, No.1, 73-102

Schibany, Andreas, Gerhard Streicher, Nikolaus Gretzmacher, Martin Falk, Rahel Falk, Norbert Knoll, Gerhard Schwarz and Martin Wörter (2004). *Evaluation FFF. Impact analyses. Background report 3.2.* Vienna:

Joanneum Research – Institute of Technology and Regional Policy, WIFO – Austrian Institute of Economic Research, KOF – Swiss Institute for Business Cycle Research.

TAFTIE (2004). *Additionality – the agencies make a difference.* Task Force Report.

TAFTIE (2003). A report on indicators for measuring the impact of technology stimulation by TAFTIE members. A report of the Input/Output-indicators project of TAFTIE to the Vienna Annual Meeting on November 26, 2003.

Technopolis, Strategic Evaluation on Innovation and the knowledge based economy in relation to the Structural and Cohesion Funds, for the programming period 2007-2013, Contract n° 2005 CE.16.0.AT.015, Synthesis Report, 2006.

Technopolis (2005). *Evaluation of the design and implementation of Estonian RTDI policy: implications for policy planning. Final report.* Belgium: Technopolis Consulting Group Belgium SPRL.

Woolthuis, R.K., Lankhuizen, M. And V. Gilsing, A system failure framework for innovation policy design, *Technovation*, 25, (2005), 609–619.