Innovation policy in six candidate countries: The challenges
Contract: INNO-99-02

Innovation Policy Profile: Estonia

Compiled by: Estonian Institute for Futures Studies

Final Version, September 2001

ADE

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Study commissioned by the Directorate General for Enterprise - European Commission.

The views of this study are those of the authors and do not necessarily reflect the policies of the European Commission.

Contents

Section 1 - The innovation policy framework

1.1 Issues for innovation policy arising from the process of economic accession

Economic decline caused by restructuring was sharper and stronger in Estonia then compared to most other post-socialist countries.

Economic decline caused by restructuring was sharper and stronger in Estonia then compared to most other post-socialist countries. The first stabilisation based mainly on the new (western) markets and on monetised economy was achieved at the second half of 1994 and then the economic growth cycle (1995-1997) began. The basis for growth was created by a rapid establishment of new firms, a decisive and core-owners-oriented privatisation, a rapid development of the financial sector and a liberal foreign economic policy. The share of industry decreased during restructuring together with that of agriculture, mainly against the background of the service sector's rapid growth. Since 1995, industry, which had experienced the changes of markets, production and ownership, started grow again. In 1997, when Estonia was able to sell both to the East and the West, economic growth even exceeded 10% a year. The first sign of hard times ahead appeared in the second half of 1997 – the strong fall in stock market. The following troubled years were bound to the impacts of the Asian crisis and the Russian financial crisis, but partly they were also caused by the imbalance inherited from the previous unstable growth period.

Starting from 1999, one can speak of the beginning of a new growth period, more balanced than the previous one. The costs of transition were a high degree of concentration in the economy (especially in the financial sector) and the takeover of most of the leading domestic Estonian companies by foreign capital (mainly Swedish and Finnish).

The loss of the Russian markets had a great impact on the Estonian foodstuff industry (fish processing, milk products) and through the latter on the agriculture. Construction and other domestically oriented economic sectors decreased as well. Other industries, which were more oriented to the West, suffered to a lesser degree. It is important to mention that the transit of Russian raw materials (primarily oil products) to the West through Estonian railways and ports continued and even increased in volume.

To sum it up, the crisis period in Estonian economy was less destructive than presumed, but lasted longer than predicted (e.g. several foodstuff enterprises did not go bankrupt immediately, but began to vegetate).

Starting from the 4th quarter of 1999, one can speak of the beginning of new growth period, more balanced than the previous one. The cost

of the hard times was a strong degree of concentration in the economy (especially in the financial sector) and the changeover of most of the leading domestic Estonian companies by foreign capital (mainly Swedish and Finnish).

If Estonia's problem before the crisis period was a critical growth of the current account deficit, the deficit has declined after the crisis and does not show signs of increase even now. The general opinion is that the base of Estonia's monetary policy – the currency board system - successfully passed its test in the crisis.

The share of qualification- and capital-intensive industrial sectors is low in Estonian exports. Although, there are some signs that enterprises are gradually moving towards higher value added production.

The economy of Estonia as a small country is strongly oriented to exports. Most industrial sectors export the majority of their production. (Appendix A, Tables 1-2). As exports are predominantly directed to Western markets (over 70%), it is evidence of the acceptable quality or at least price/quality ratio of the production. At the same time too high a percentage of Estonian exports are still concentrated in traditional industries like wood and furniture production, textile and clothing industries and foodstuff industries. Also the calculations made by EU/ECE classifications show that the share of qualification- and capital-intensive industrial sectors is low in Estonian exports. Although, there are some signs, for example, in the timber- and wood processing industry that enterprises are gradually moving towards a more value added production. Relatively good examples are Estonian engineering and electronic industries, which, unlike the Latvian and Lithuanian analogous sectors, are oriented mainly to West. Although the subcontracting prevails, the sectors, especially the electronics, are switched to the North European high technology clusters. After the decrease of the foodstuff industry production volumes caused by the Russian crisis, the production of machinery and equipment has raised to the first place in Estonian industrial export.

Table 1 - Indicators for Estonian economy, 1994–1999

	1994	***1995***	***1996***	***1997***	***1998***	***1999***
GDP, billion euros	1,9	2,7	3,3	4,1	4,7	4,6
Real GDP growth rate, %	**-2.7**	**4.3**	**4.0**	**10.6**	**4.0**	**-1.1**
Industrial output growth, %	3.0	1.9	2.9	12.5	1.5	-3.0
Unemployment, %	7.6	9.7	10.0	9.7	9.6	
Exports, billion euro	**1,1**	**1,3**	**1,6**	**2,6**	**2,9**	**2,8**
Foreign trade balance, billion kroons	-0,3	-0,5	-0,9	-1,3	-1,4	-1,1
Foreign trade deficit/GDP, %	-15.3	-19.3	-26.5	-32.3	-29.9	-24.0
Exports/GDP, %	**56.1**	**50.8**	**47.7**	**62.5**	**61.9**	**60.9**

Sources: Statistical Office of Estonia, Bank of Estonia

Estonia has been rather successful in obtaining foreign investments. This has helped to cover the foreign trade deficit and maintain the positive balance of payment in addition to supporting economic restructuring. The cumulative volume of FDI into Estonian economy has reached 2.44 billion USD by the beginning of the year 2000. The largest share of FDI has gone to the service sector: telecommunications, banking, transportation, hotels. From 1997, the positive change in the investment structure could be noticed: some growth of new technologies in investment structure. In 1998, a record volume of FDI was achieved – over 575 million USD, (10 per cent of GDP) – but the dominating part of these investments was connected with the take-over of two main Estonian commercial banks. Companies partly or wholly owned by foreign capital account for about 1/3 of Estonian GDP and over 50% of the country's exports.[1]

One good example among the foreign investors, who have moved from the cheap labour use toward the development of the more value-added products/services, is Elcoteq Corporation, which started its activities in Estonia in quite cheap labour-oriented operations: subcontracting in electronics and assembling mobile telephones. But since the beginning of this year also the engineering centre (21 employees) operates in Tallinn and there are plans of widening this centre. It is the part of the mother company's Corporate Engineering Services and its purpose is to offer engineering and pre-manufacturing services.

The main export-related problems derive from the smallness of the enterprises. Estonian companies very often depend upon the local sellers, agents or joint company's foreign partners. But the winning of a foreign market niche, however small, produces a new problem – the production capacity is too small.

Privatisation has also exerted its influence on the Estonian innovation system; research departments and laboratories were largely closed

Privatisation has also exerted its influence on Estonian innovation system. Many of the so-called all-union and local big enterprises, which had had the product and technology development departments, found a new owner, whose main attention concentrated on the reorganisation of production and the research departments and experimental laboratories were closed. This was typical even when the company was sold to a foreign owner. According to the data from the Estonian Confederation of Employers and Industry there are about 60-70 experimental laboratories in Estonian bigger companies today

[1] Estonian Investment Agency , 2000, "Estonia – a Popular Destination for Foreign direct Investments".

(~30 of them deals with food control). On the other hand the privatisation has brought a lot of new technology together with FDI to the firms.

In Nov 2000 the Government decided to add ¼ of the forthcoming infrastructure privatisation money to the new Business Development Foundation. The greatest share of it will go for R&D and regional business investments. According to Urmas Vahur, the director of Estonian Business Development Foundation "Enterprise Estonia" "Enterprise Estonia", they reckon with 10,2 million euros extra funds from the privatisation proceeds in their 2001 budget. In case the income should be greater, it is planned to be used in 2002.

In Estonia the discussions about subsidize the restructuring of the big enterprises or not took place in 1993-94. In general it never happened. Right now the state owns only few infrastructure enterprises: energy, railway. The state do subsidize some enterprises like Estonian Post or passenger rail transport, but it is subsidizing of the services these companies provide not the restructuring. In several cases the restructuring of the companies has been included in the privatization contract (the privatization plan and restructuring plan are worked out hand in hand) and in these cases the state has tried to make the investor to finance the restructuring. The investor has to take some responsibilities, e.g. enable jobs for certain no of people; restructure the power plants; keep the mine working for certain years, etc.

As to the Estonian science and research expenses – these have been slightly over 0.6% of the GDP since 1996. This equals to one quarter's expenditures of the EU and OECD countries. Most of this expenditure has gone to national science financing and therefore has not had any direct output to the economy. Nevertheless, the share of experimental development is displaying a growth trend.

Data about R&D financing (see also section 1.2.) in 1998[2] showed that the government's share is around 62 per cent of total financing (28,8 million euro). Even though government spending is low, it is private investment that obviously lags the most. More than 70 % of the R&D expenditures in the private enterprises are covered by the companies' own resources. It is typical of the small companies (less than 20 employees) that when they have R&D expenditures they come mostly from foreign resources. Only every 39th company (over 20 employees) made expenditures to the R&D in 1998. As to the sphere of activity, the companies mainly specialised in science and research stand out from the others, because the share of R&D of their

[2] 1998 is the first year when there are statistics available about the R&D expenditures in the private sector enterprises.

net turnover amounted to 62%. Compared to the other sectors the share of R&D is relatively high in furniture production – 4.4%. In textile industry and textile products it is 2.3%. The high technology marker lies by 5%, only few firms in Estonia reach past this line. But statistics on the enterprises' R&D expenditures shows a rising tendency – in 1999 every 28th company made expenditures to the R&D (see also Appendix A, Tables 3-8).

Table 2 - Science and research financing in Estonia (million euro)

	1994	*1995*	*1996*	*1997*	*1998*	*1999*
State	10,6	11,5	13,8	16,6	19,0	23,4
Enterprises	1,3*	2,1*	2,0*	2,1*	6,8	9,4
Non-profit organisations	0,4	0,4	1,0	1,2	1,5	0,6
Foreign capital	1,0	1,6	2,1	3,6	1,9	3,0
Research institutions	0,6	0,6	0,7	1,2	1,2	0,3
Total	**13,9**	**16,2**	**19,5**	**24,8**	**30,4**	**36,6**
GDP (million euro)	1 934,5	2 601,5	3 351,9	4 111,0	4 686,3	4 816,4
R&D expenditures from GDP	**0,72%**	**0,62%**	**0,58%**	**0,60%**	**0,65%**	**0,76%**

** only the enterprises who's main activity is R&D*
Source; Statistical Office of Estonia

Innovation policy indicator – the number of patents granted – is small in Estonia. There are only 15-20 Estonian patent applications per year. Since 1996, 315 patents have been registered in Estonia, equalling to ~0.1 patent per 10,000 inhabitants per year. In order to reach a comparable level with other OECD countries, Estonian innovators should produce 780 applications per year.

Table 3 - Results of activities of the Estonian Patent Office 1992-1999

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**Total**
Trademarks									
No. of Applications for trademarks	1 365	11 932	2 733	2 830	2 659	3 101	2 963	4 417	**32 000**
No. of Estonian trademark applic.	384	1 521	543	589	513	666	637	723	**5 576**
No. of trademarks registered	0	299	7 500	3 745	3 726	3 179	2 848	2 064	**23 361**
Patents									
No. of applications for patents	0	0	482	82	213	375	463	619	**2 234**
No. of Estonian patent applications	0	0	16	16	12	15	20	13	**92**
No. of patents registered	0	0	0	0	22	108	82	103	**315**
Utility models									
No. of applications for utility models	0	0	32	52	31	45	47	31	**238**
No. of Estonian utility model applic.	0	0	27	50	30	42	38	25	**212**
No. of utility models registered	0	0	15	55	28	36	51	32	**217**
Industrial Design									
No of Industrial design applications							149	107	**256**
No. of Estonian design applications	0	0	0	0	0	0	33	24	**57**
No. of industrial designs registered	0	0	0	0	0	0	131	78	**209**

Source: Statistical Office of Estonia: Science 1998

Table 4 - Patents/Inventiveness coefficient - resident patent applications per 10,000 persons

	1996	*1997*	*1998*	*1999*
Estonia	0,08	0,10	0,14	0,09

Source: European Commission: Science … and patent offices of countries

There are no figures available on Estonian patent activity abroad.

Since Estonia regained independence in 1992 the level of industrial R&D and the number of scientists in the research institutes and R&D departments of former all-union enterprises has been reduced considerably. According to the specific institutional set-up of the Soviet-period innovation system, a large part of the Estonian industrial R&D activities took place in industrial R&D institutes, which were subordinated to the corresponding ministries. The large enterprises had their own laboratories, construction and development offices and experimental departments, which focused on applied R&D.

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After 1992 there has been a big reorganisation of the research institutes and the enterprises' laboratories and this has decreased the full-time equivalent of scientists steadily, falling to 2,750 in 1998 (table 6).

Table 5 - Researchers per 10,000 workers in Estonia

Estonia I -*total number of Estonian scientists and engineers*	**57**
Estonia II - *the full-time equivalent*	**39**

Source: Statistical Office of Estonia: Science 1998

The portfolio content of the researcher staff (table 6 & 7) as mention by H. Hernesniemi, is not that what is needed in order to develop Estonian firms, their productivity and new products for them. There are too few researchers with engineering and computer science backgrounds. Natural scientists are oriented towards basic research. Agricultural scientists are oriented more towards phenomena related to nature and towards farming, and not at all towards developing technology and products for foodstuff or wood processing industries. We can get a wider picture of the new human skills available to satisfy the needs of the innovation system from statistics covering higher education. The compilers of the Estonian Innovation Programme estimated that Estonia should prepare 150-160 new PhDs per year in order to sustain industrial development. Currently, 10-15 new PhDs graduate each year in technical sciences and technology (table 7; see also Appendix A, Table 9).

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Table 6 - Distribution of scientists and engineers by field of science, 1995–1998

	1995	*1996*	*1997*	*1998*	*1999*
Natural sciences	1 335	1 339	1 266	1 203	1 222
Engineering	864	897	916	756	697
Medical sciences	550	519	513	445	433
Agricultural sciences	417	292	319	322	282
Social sciences	658	655	640	656	598
Humanities	679	706	673	675	680
Other sciences	..	..	..	..	
TOTAL	**4 503**	**4 408**	**4 327**	**4 057**	**3 912**
Full time equivalence	***3 109***	***3 047***	***3 004***	***2 754***	

Source: Statistical Office of Estonia: Science 1998 and Statistical Yearbook of Estonia 2000

Table 7 - Personnel engaged in research and development in business enterprise sector by economic activity

Economic activity	***Scientists & engineers***	
	1998	***1999***
Transport, storage & communication	95	59
Other business activities	78	187
Research and development	57	64
Computer services	43	67
Manufacture of chemicals and chemical products	41	46
Education	24	X
Other fields have less than 20 persons		
TOTAL	468	651

Statistical Yearbook of Estonia 2000 ,and Estonian Statistics 2/01, Statistical Office of Estonia

Table 8 - Country specific indicators of economic and technological performance

Indicator	Source	Period covered	Comments
Science and research development , share of GDP	Statistical Office of Estonia	1998 – 0.61 1999 – 0.76 2000 – 0.79	Small, but increasing
Researchers per 10,000 workers: 57 (39 with full-time equivalent)	Statistical Office of Estonia	1998	Average, compared to other countries
Registered patents – 315	Statistical Office of Estonia	1992-1999	Small
Patents / Inventiveness coefficient - resident patent applications per 10,000 persons	European Commission: Science … and patent offices of countries	1996 – 0,08 1997 – 0,10 1998 – 014 1999 – 0,09	Very small, even compared to other post-socialist countries
Technology Parks		2000 – 1	The plan is to establish more. Several institutions have some of the tech. park activities
Higher education technical schools	Statistical Office of Estonia	2000 – 2	Tallinn Technical University (degrees and diplomas) and Tallinn Higher Technical School (diplomas)
Mobile phones per 100 inhabitants	Estonian Informatics Centre, ESIS (European Survey of Information Society)**	1999 – 27.0 3.2000 – 28.8 end 2000 - 32	The number of users grows constantly.
Computers per 1,000 inhabitants	Estonian Informatics Centre, ESIS	1997 – 114	Unfortunately there is no fresher data
No of personal computers at home per 1,000 inhabit.	BMF* Emor survey 2001 (among people aged 1-74)	1997 – 31 1999 – 69 03.2001 - 200	The number of users grows constantly.
No of computers connected to Internet per 100,000 inhabit.	BMF*	1999 – 28,674 02.2000–30,700	Growing
No of Internet domestic users per 1,000 inhabit.	Estonian Informatics Centre, ESIS	1999 - 83	
Internet users among 15-74 years people	EMOR* survey	01.2000 – 25% 05.2000 – 29% 09.2000 – 32%	The number of users grows constantly
Hostcount by DNS domains per 1,000 inh.	BMF*	1999 – 19,8	
No of domestic (Estonian) web-sites	BMF*	1999 – ca 9,000 2000 – ca 10,000	
No of Internet service providers	BMF*	1999 - 9	The no has been stable till 1997.
No of Internet bank users	BMF*	1999 – 146,000 06.2000-180,000	
Turnover of e-commerce in Estonia	ESIS	1999 – 0.5 mln EUR	Prognosis for 2000 is 6.4 mln EUR

** Both BMF and EMOR are the market survey companies.*

*** www.ispo.cec.be/esis/ , www.esis.ee*

1.2 Main developments in innovation policy

After 1992 the main principles of the economic policy in Estonia regardless of the ruling government have been: 1) the openness of the economy, 2) liberal and non-protective economy policy, 3) privatisation, and 4) favouring the foreign capital. Liberal and non-protective Estonian economy policy has hoped that the investors' and commercial banks' money would go exactly there where it earns better, more and the most certainly. Because of this the Estonian Government (in general) has avoided the subsidies for specific sectors, enterprises or regions in the innovation policy, mainly because it has seemed risky on two reasons: a) in the thoroughly changed economic environment it was impossible to say which fields of activity should dominate in Estonia and how much would it cost to favour their development; b) directing the taxpayer's money to one or another economic field presumes a rather high agreement spirit from the different social and political groups and regions. This also might cause different opinions and accusations. The mistakes in the allocation of the preferences might do more harm than letting things go their own way. Thus the policy has been adopted that the government does not have technological interests. The cause was also that the ruling elite of Estonia did not believe that Estonia needs the innovative vision and/or Estonian R&D are able to provide real profitable results. The situation has somewhat changed in the last years of 90s with a growing understanding that new products and technology development are needed to be successful in the global market. Estonian President Lennart Meri started to talk about the necessity to find an "Estonian Nokia" and Prime Minister Mart Laar started to speak about importance of ICT and bio-technology.

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In 1991, the **Estonian Innovation Foundation** (IF) was founded, which started to provide support and loans for research and development activities in institutes and enterprises. In 1995 the foundation began to issue grants on project basis. Later (1997) the IF was reorganised to be a legal entity in the private law, which is still being financed by the state budget and from the returned loans.

The bigger organisational changes came together with the **Law of Science and Development Coordination** (26.03.1997) in 1997, when state R&D organisations were joined with the public universities. Some state R&D organisations were joined to Estonian Academy of Sciences next year.

The year 1999 was important because of joining the international development programmes. Estonia joined the EU science research and technology development programmes for 1998-2002, and the new version of the Hague agreements on industrial design was signed. In

connection with joining the EU V Frame Programme on June 1, 1999, Estonia has the possibility to join the INTAS without paying the share. In 20th of June 2000 the Parliament ratified the articles of INTAS and approved Estonia's joining with this organisation, which helps to expand the science contacts with new independent states' researchers and participate in the joint projects.

In Estonia the OECD Frascat Manual is used defining the innovation. The first remarkable innovation document was **Estonian National Innovation Programme**, which was even approved by the government in 1998. General priorities of the programme were: *improvement of the quality of products and services; *development of innovative products and manufacturing of them based on local R&D; *development of innovation networks. The programme recommended to increase the science and research financing step by step, especially the R&D financing. The main principles of the project were good, but it did not focus strictly the priority areas and so the document remains somewhat incomplete.

The green paper "**Knowledge centered Estonia**" (1998) composed on the initiative of Academy of Sciences brings out the more concrete priority areas: *Bio- and gene-technology and their appliances; *User-friendly and secure information society technologies – telematics and info-technology and their appliances; *Environment technologies and their appliances; *Material sciences and especially their appliances.

These priorities are made by Science and Research Council's suggestions. Three million EURO were obtained to develop these areas from the Phare programme "*Higher Education & Science Reforms*". During this programme the competence centres on these fields were established by the Tallinn Technical University and the Tartu University. EU Phare project finished in 1998, but these centres have received some finances from the state.

The amended document **"Knowledge centred Estonia. Estonian science and research development strategy 2001-2006",** drafted in cooperation of the Finance and Education ministries, was approved by the government of the republic in May 2001. The strategy determines the goals, opportunities and principles for the promotion of Estonia's R&D activity and innovation and serves as a basis for the next few years' activity in the organisation of that sphere, determining the framework and volume of the public sector supportive measures until 2006. As a result of the implementation of the strategy the level of total expenditures on R&D activities achieved by 2006 will be 1,7% of GDP (see appendix ?). The positions of the strategy will be revised by the Science and Development Council every three years. This document is used as a basis by the Ministry of Economic Affairs

department of innovation and the new Technology Agency ESTAG, which will accordingly draft the annual R&D and innovation promotion plans (concrete programmes and measures).
The strategic goals of the "Knowledge Centred Estonia" are: a) renovation of the base of knowledge, b) improvement of the enterprises' competitiveness. The key areas in Estonia in the realisation of the set goals are:

- User-friendly information society technologies
- Biomedicine
- Material sciences and especially their appliances.

It is difficult to say whether info-technological development itself required more attention or is it after all the Estonian governments priority, but a lot has been done in the field of info-technology and – policy. Although it must be mentioned that the majority of the state's attention has been paid to the public sector, private enterprises are expected to manage themselves. The development of info-technology in the public sector is coordinated by the Estonian Informatics Centre[3]. One of the goals is to make public services available through Internet. As for the first step in the beginning of the 2000 the citizens of Estonia could make their income declaration through Internet.

Tiger's Leap is the organisation that deals with the Estonian educational system development in the technological field. It was established in 1996 and later was reorganised as a foundation. The main purpose of the foundation is to create the suitable learning environment for the information society, it means that Tiger's Leap deals also with teachers training and improvement of curriculum's in addition to the equipping the schools and teachers with the computers and other technology.

In 1998 parliament approved two important documents: **The Basis of the Information Policy** and the **Framework of the Information Policy**. The first one is the document, which describes the society values that are the basis for the administrative policy decisions to help the information society formation. The latter is worked out proceeded from the first one and is the basic document for the government institutions on the bases of what they prepare their concrete proposals (containing time schedule, sources of finance, responsible bodies/persons, etc.) how to achieve the information policy next year.

A new school - IT College - opened its doors in the 1st of September 2000 with 200 students (see also section 2.1.). Two important laws about the info-technological development – Telecommunication Law and Digital Signature Law – were approved in the contemporary year.

[3] Estonian Informatics Centre by the State Chancellery is the successor of the Informatic Council and Informatic Foundation founded in 1992.

The Informatic Centre is coordinating the project of the time stamp service because of the latter law.

Also the Human Gene Researches Law was passed on December 13, 2000. It made available to great the base for the gene- and biotechnology as an economic sector's growth in addition to executing the "Estonian Gene Treasury" project and modernisation of the medical aid. On the 13th March 2001 the Foundation of Estonian Gene Treasury was founded with the Government's regulation. Out of the 2001 state budget, 2,000,000 EEK have been allocated to the gene treasury projects and the first 10,000 blood samples will be taken from volunteers during 2001.

In spite of the fact that the government has confirmed priority fields only recently, more attention has been paid to information technology for some time already and lately also to the biotechnology.

In spite of the fact that the government has confirmed priority fields only recently, more attention has been paid to information technology for some time already and lately also to the biotechnology. On the UN congress in the beginning of the September 2000 Estonian Prime Minister said that the next priority of financing should be ecological technology.

The information society development has got some impulse from the circumstance that the Prime Minister's Counsellor is one of Estonian well-known IT specialist and visionary Linnar Viik, who is also one of the founders of the Tiger's Leap. The considerable impact comes also from Nordic Countries as they are the world's leading info-technology countries. Same goes about the active measures of Estonia's own major IT and telecommunication firms. In early March 2001, seven larger Estonian firms concluded ca 16 million euro funding agreement in that sphere, aimed at educating the Estonian public in ICT and making the Internet accessible to all interested individuals (see also section 2.1.). Biotechnology emergence is probably affected by the good results of Estonian scientists' participation in the international projects (a 14% participation of Estonia in all biotechnology grants of Copernicus in 1997).

Right now the Ministry of Economic Affairs prepares two important strategic documents: 1) **Innovation Part of National Development Plan**[4], and 2) "**Industrial Policy**" document[5], whose first draft should be completed by the end of 2000. The latter is related to the elaboration of the Estonia's position for the EU accession

[4] The National Development Plan 2000-2002 is a strategy document reflecting Estonia's public sector investments in priority areas during the pre-accession period with the European Union (EU) in order to achieve a closer social and economic unity with the latter. Detailed operational programmes will be developed on the basis of the Development Plan. The first of such detailed programmes was the Rural Development Plan, which was completed in 1999.

[5] Industrial Policy document is prepared by the Industry Department and the Department of Economical Development.

negotiations (the document should be ready by the 2nd half of the 2001).

In the realisation of the National Development Plan priority "Fostering of Innovation" strategy the following strategic measures will be concentrated upon in 2001-2004:
Development and implementation of financial instruments supporting innovation

1) Reinforcement of innovation support structures
2) Improvement of efficiency of the innovation system
3) Development of human resources for the management of innovation

As a result of the implementation of the strategy, by the year 2004 the enterprises' R&D expenditures will increase to 0,3% of GDP (in 1998 0,15% of GDP) and total R&D expenditures to 1,6 % of GDP (in 1998 0,65% of GDP). (See appendix A, Table 10).

The Ministry of Economic Affairs Strategic Plan 1999-2003 foresees the creation of a cooperation network between the innovation institutions and entrepreneurs.

The Ministry of Economic Affairs Strategic Plan 1999-2003 foresees the creation of the cooperation network between the innovation institutions and entrepreneurs and coordination role to be played by the **Estonian Technology Agency ESTAG**. In the beginning of the year 2000 the government made a decision about the reorganisation of Estonian Innovation Foundation into the Technology Agency ESTAG and join it together with other foundations into a one large **Estonian Business Development Foundation "Enterprise Estonia"** (BDF) (see section 1.3.). The hope is that this will help to divide small recourses for enterprises development more effectively. There is also a plan to reorganise the Science and Development Council to improve its quality and increase its importance (see section 1.3.).

During the establishment process of the BDF (on the Ministry of Economic Affairs initiative) the creation of the department related to the venture capital investments was discussed. This department would act strictly according to business logic (profit oriented) and would therefore differ from this "softer" issue of grants and loans. The money accumulated to the Compensation Fund was seen as a starting capital for this venture capital system. The proposal was rejected by the Ministry of Finance, who: a) doubted in suitability of this kind of functions to the public sector, and b) decided that if the Compensation Fund is too liquid, all the state budget priorities should be considered when withdrawing money from it.

The amount of venture capital moving through the private sector is considered to be about 9,6–12,8 million euros. Only high technology related companies, which have reached to a kind of growth stage or to the stage of bringing new product to the market have a chance to receive this money, but not the starting firms. To promote development in enterprises, the parliament made changes in the taxation law and from the beginning of 2000 one does not have to pay the enterprise income tax from the sum of the profits re-invested in a company. That measure should increase the firms' interest in investing their profit instead of paying it for dividends.

To promote development in enterprises, the parliament made changes in the taxation law and from the beginning of 2000 providing for tax relief on re-invested profits.

The Round Table of Estonian Republic's President has also discussed the establishment of an enterprise support department (something like Finnish SITRA) by the Bank of Estonia in the beginning of the year 2000, but the bank opposed the idea. The Bank of Estonia, Estonian Chamber of Commerce and Industry, Tartu University and Tallinn Technical University decided to establish a new foundation on June 13, 2001 – **Foundation of Strategic Development Centre SAK**. This foundation will deal with key-problems of the long-term economic development and one part will also be the product and technology innovation and development issues.

In order to help to make connections between business and science/research there is an intention to establish some more technology parks. The only technology park - Tartu Science Park – in Estonia was founded in October 1992. Among the EU finances to Eastern Virumaa - considered the Estonian stagnated industrial region – is the sum appointed for the preparations of industrial and technologic park creation. As a result, as early as in November 1999 the Ida-Virumaa Development Centre was opened as a subsidiary of the Tartu Science Park. In the beginning of 2001 the Jõhvi Business Incubation Centre also started to operate, offering physical infrastructure (approx. 600 m2 of space) with local business development and innovation support services to start-up enterprises. The establishment of technology park to Tallinn or its nearer surrounding has been the theme from the beginning of the 90-s. In the beginning of 2000 Tallinn Technical University started the initiative to establish the park in Tallinn again (see section 3.3.).

In order to help to make connections between business and science/research there is an intention to establish more technology parks.

Table 9 - Main policy documents and consultative papers since 1996

Title of document (and date of approval)	Organisation responsible (Ministry, etc.)	Legal status (government decision, consultative paper, etc.)	Comments (actions foreseen, etc.)
"Raising the quality and competitiveness" programme (1996)	Ministry of Economic Affairs	Consultative paper	In 1996-98 was only a kind of basic document for Innovation Foundation to finance the projects
Estonian State Innovative Programme, June 9, 1998	Ministry of Finance together with Tallinn Technical University	Government decision	Has remained a reference document, providing profound information on indicators describing Estonian innovation system, studies, resolutions etc.
National Development Plan 2000-2002, September 1999	Ministry of Finances	Government decision	All the sub-plans about the development in different areas are not ready yet.
Document on Reform of Business Support Foundations, April, 2000	Ministry of Economic Affairs	Government decision	Is in the implementation process
Knowledge Centered Estonia, May 2001	Ministry of Economic Affairs, Ministry of Education	Government decision	Amended 1998 document, which specifies the priority directions. Serves as a basis for R&D development in Estonia.
The Principles of Information Policy May, 1998	State Chancellery	Parliament decision 13.05.98	The basic document to the action plan
The Action Plan for Information Policy, May, 1998	State Chancellery	Parliament decision 13.05.98	Implementation is going on: IT College, public services to the Internet, etc.
Guidelines for Estonian Spatial Planning, Estonia 2010	Ministry of Environment	Government decision, June 2000	Contains the section about innovation and intellectual infrastructure issues in the spatial development

From the educational and human capital side the important documents are also *Estonian Education Scenarios 2015*, discussed in Parliament in 1998, but no decision was made. The Ministry of Education has recently (June 2001) sent the new education strategy – "Learning Estonia" – to Parliament for reading.

Table 10 - Major government funded programmes and initiatives in favour of innovation

Name of programme/ initiative	Government body responsible	Objectives of programme	Funding available (mention if co-finance by external donor)
"Tiger's Leap"	Ministry of Education	Providing schools and teachers with new technology and increasing people's knowledge about the possibilities of the new technology	Over 50 million EEK from the public sector. The share of finances from the Local Governments has raised constantly. Co-financed by private enterprises and donors.
Project "Küla Tee" (Village Road)	Department of State Information Systems by the State Chancellery	Development of the regional data communication infrastructure	
Development of regional cooperation network for the development of innovative business, pilot project No. 2 of special programme for preparation for the EU structural funds implementation	Ministry of Economic Affairs	To develop information and cooperation network to implement in the Ida-Virumaa and South-eastern Estonian business and education affairs the Tartu Science Part experience in the support of innovation and the Estonian universities' high R&D potential in order to support innovative business in the most problematic regions of Estonia.	1,1 million euros : 748 thousand euros from EU Phare , 275 thousand euros from Estonian state budget, 77 thousand euros from Estonian private sector
Inno-awareness	Ministry of Economic Affairs, Technology Agency ESTAG	Raising knowledge about innovation issues among the whole society and also in different target groups (students, scientists, entrepreneurs, etc) through training courses, seminars, publications, etc.	192,000 euros from Technology Agency's budget in 2001.
Spin-off programme	Ministry of Economic Affairs, Technology Agency ESTAG	The purpose is to identify the new ideas in the universities and help to realise them in two ways: *) on the basis of the researcher's idea the new spin-off firm will be formed, where this researcher is the owner and a managing director is employed; *) the researcher's idea will be licensed and sold to some other firm.	447,000 euros from Technology Agency's budget in 2001.
Raising competence in innovation management	Ministry of Economic Affairs, Technology Agency ESTAG	This programme has also two sides: a) training the development managers of the enterprises: strategic planning and development and technology auditing issues; b) regional orientation: the enterprises can employ the scientist from university or research institute for 2 years and the state pays the 1,5 year salary for the scientist	128,000 euros from Technology Agency's budget in 2001.

1.3 The innovation policy community

At the top level of the National Innovation System (NIS) is the **parliament**, which adopts the necessary laws and accepts the state budget for financing the system. The government prepares the legislation, gives the statues and makes the budget scheme.

The Research and Development Council is a high-level advisory body. The Prime Minister is the president of the body and several other key ministers are also members of the body (Ministries of Education, Economic Affairs, Finance, Culture and Environment). Other members come from universities and from the Science Academy, Science Foundation and Innovation Foundation and only two members represent the business community. The Council is going to live through some reorganisation in a near future (described hereafter).

Since the establishment of a new Technology and Innovation Division, the Ministry of Industry is responsible for planning technology policy, managing technology development and for supervising and controlling the Technology Agency ESTAG.

The Ministry of Economic Affairs has had *de jure* a central position in the NIS by the Law of Government. But since the establishment of a new division called the **Technology and Innovation Division** (3-4 employees) under the Department of Industry in the beginning of 1999, it has *de facto* started to realise this position. This Division is responsible for planning technology policy, managing technology development and for supervising and controlling the technology development agency, i.e. the Innovation Foundation earlier and Technology Agency ESTAG from the beginning of 2001.

It is not quite clear who is responsible for the product and technology development in the agriculture and foodstuff industry development in general. Ministry of Agriculture has begun to establish its own foodstuff industry department. Most probably the situation will be solved in a way, where the Ministry of Agriculture will coordinate the agricultural product and technology development, but the Ministry of Economic Affairs will be responsible for the development in the foodstuff industry. It is possible that the latter begins to coordinate the innovation also in transport and communication sectors, because the Transit Transport Development Foundation (established two years ago by the Ministry of Roads- and Communication) was closed and its functions were divided between the different agencies in the new Estonian Business Development Foundation "Enterprise Estonia" (BDF) by the Ministry of Economic Affairs (more about BDF hereafter).

On the science and education side of the NIS, the **Ministry of Education** is in a key position. The Ministry is assisted by the **Estonian Academy of Sciences** and the **Science Competence Council**. The latter assesses the scientific level of universities and

research institutes. Their basic financing is based on this evaluation. The Estonian Academy of Sciences is comprised of distinguished academic scientists. Scientific societies act under it. The current role of the Academy of Sciences is to give room for discussions and to work as a gray eminent advisor.

There are two main financing bodies in the Estonian Innovation System.

There are two main financing bodies in the Estonian Innovation System. (1) until the beginning of 2001 one of them was **The Innovation Foundation** who was responsible for delivering RTD financing on a project basis to the firms, research institutes and research units in universities. It has also given support to the supporting organisations – to the science parks, competence centres and innovation centres. The Innovation Foundation was reorganised to Technology Agency ESTAG (see hereafter) under the Estonian Business Development Foundation "Enterprise Estonia" "Enterprise Estonia". (2) **The Estonian Science Foundation** provides grants to individual academic researchers. Both foundations are legal entities in private law even though they are totally financed by the public sources.

The Innovation Foundation was established already in 1991. From the 1995 they started to deliver RTD financing on the project basis. And the foundation was reorganised to be the legal entity in private law. In earlier years (1991-1995), loans were mostly given. Nowadays, the banking system is functioning rather well and the interest rate level has declined to near that of the Innovation Foundation. In 1996 and 1997, loan extensions were cut radically and the amount of grants started to increase. In the years 1998 and 1999, the Innovation Foundation has again started to prefer extending loans.

As the resources for financing are small (in 2000 IF gets only 2,4 million euro from the state budget) the bigger enterprises see the foundation as the kind of helper of the small firms and unable to correspond to their needs.

Table 11 - Government funded agencies

Organisation	Status (public body, non-profit foundation, etc.)	Main responsibilities (e.g. managing programme "x", etc.)
Research and Development Council	Public body by Estonian Government	Government counselor
Science Competence Council	Public body by the Ministry of Education	Assesses the scientific level of universities and research institutes
Estonian Academy of Sciences	Public body by the Ministry of Education	to give room for discussions and to work as a eminence grise advisor
Estonian Science Foundation	Non-profit foundation by the Ministry of Education	Provide grants to individual academic researchers
Technology Agency ESTAG	Non-profit foundation, department of the Estonian Business Development Foundation "Enterprise Estonia"	Delivers RTD financing on a project basis to the firms, research institutes, etc. Coordinates different programmes in favour of innovation.
Technology and Innovation Division	Sub-division of the Department of Industry in the Ministry of Economic Affairs	Planning technology policy, managing technology development and supervising and controlling the technology development agency, i.e. the Innovation Foundation
Estonian Informatics Centre	By the State Chancellery	Coordinate the info-technology development in the public sector (in state institutions)
Estonian Regional Development Agency	Department of Estonian Business Development Foundation "Enterprise Estonia"	▪ Coordination of the state finances for regional business development; ▪ Coordination of programs for regional development.
Estonian Investments Agency	Department of Estonian Business Development Foundation "Enterprise Estonia"	▪ Presents investment opportunities to the potential foreign investors; ▪ Composes materials about Estonian economy and investment climate
Estonian Export Agency	Department of Estonian Business Development Foundation "Enterprise Estonia" Additional finances from EU and other foreign aid programmes	▪ info of the foreign markets ▪ info of the priority sectors ▪ market surveys ▪ database of Estonian exporters ▪ export related publication ▪ training programmes on exports
Export Crediting and Guarantee Foundation KredEx	Foundation by Ministry of Economic Affairs Additional finances: loans, grants, own resources, etc.	Developing Estonian export by giving guarantees and credits mainly to SMEs.

The main knowledge providers are centered in Tartu and Tallinn. The Tartu Science Park houses over 30 enterprises and current premises are full. There are activities to start Mustamäe Science Park in Tallinn and some ideas are spread also to the Eastern-Virumaa region (see section 3).

The **University of Tartu** and **Tallinn Technical University** both have innovation centres for commercialising their scientific potential and to increase the number of spin-offs and entrepreneurship among university researchers and graduates. In 1996, **Centres for Strategic Competence** were established at the University of Tartu and Tallinn Technical University in the fields of biotechnology, information technology, materials science and environmental technology.

The EU Innovation Relay Centre (ESTIRC), which acts within the Archimedes foundation in Tartu, distributes information and consults different actors regarding participation in EU projects.

Table 12 - Main knowledge providers

Organisation	Main type of service provided	Commentary (e.g. sources of funding, links with other organisation, membership of networks (EU included), etc.)
Innovation Centre of Tallinn Technical University (TUIC) www.tuic.ee	*marketing of R&D and services of testing and measuring; *commercialising the results of R&D; *international and domestic co-operation of R&D and technology transition; *coordination of university spin-off programme	Foundation, established in 1998; strong relations with TALLINN TECHNICAL UNIVERSITY and Tartu Science Park, Finntech Oy, Innopoli Oy; member of IASP, SPICE Group, BASTIC; participates in EU programmes
Tallinn Technical University, Office for Research and Development	Works out and coordinates the university science and research policy, incl. The creation of better conditions for researchers; initiates scientists to cooperate in domestic and international programmes; coordinating the cooperation between university and spin-off's; etc.	
Tartu University Technology Centre	*co-ordination and effecting of scientific research and innovation or development activities in the area of relevant technology; *initiate and execute national and intl.joint projects in relevant technology area; *transfer of technol.based know-how to the economy, education and other area; *participation in technology transfer of relevant area of technology into the economy of the Republic of Estonia and other areas; *consultations in the area of the relevant technology; *conduct personnel training in the relevant area of technology	Tartu University's R&D institution, established in 1996 Phare within the university education and scientific reform project (HESR).

Organisation	Main type of service provided	Commentary (e.g. sources of funding, links with other organisation, membership of networks (EU included), etc.)
Tartu University, Science and Research Department, Innovation Service	To create a favourable innovation environment in the university and the transfer of the university research results, technologies and know-how to the economy. Coordinates the university spin-off programme.	
Centres of Strategic Competence in Tartu University and Tallinn Technical University	*co-ordination and effecting of scientific research and innovation or development activities in the area of relevant technology; *initiate and execute national and intl. joint projects in relevant technology area; *transfer of technol.based know-how to the economy, education and other area; *participation in technology transfer of relevant area of technology into the economy of the Republic of Estonia and other areas; *consultations in the area of the relevant technology; *conduct personnel training in the relevant area of technology	Institution, established in 1996
Arhimedes Foundation	*information distribution and consulting for possibly successful participation of Estonia within the EU Fifth Framework Programme; *support of international technology transfer; *innovation research and analysis;	Foundation, established in 1997
Tartu Science Park Foundation	*rent of rooms, common utility, incubation discount for beginners; *services of communication, computer network, multiplication, security, etc; *consulting and services of secretary, personnel and accounting work; *assist in finding info., partners or market, investors or financial opportunities; *participation in international networks, presentations at exhibitions and fairs, publishing of an information brochure, information databases and publishing; *organise workshops and info-days, communicate with science institutions; *radar projection (CAD/CAM), training courses and consulting; *services provided by specialised companies (business consulting, etc.); companies and entrepreneurs starting science/technology enterprises.	Foundation, established in 1996, (before it was the municipal enterprise Tartu Science Park, 1992). Member of IASP, East- and Central-European Innovation Centres; direct contacts with ca 20 parks/centres in 14 states. Additional financing from IF, Tartu town, donations etc.
Ida-Virumaa Innovation Center	Coordination and support in Ida-Virumaa of the establishment of new enterprises and innovation activity	Created within the EU SPP industrial pilot project in November 1999

There are 6 state universities: University of Tartu, Tallinn Technical University, Estonian Agricultural University, Tallinn Pedagogical University, Estonian Academy of Arts and Estonian Academy of Music. The majority of scientific research is conducted in the first three universities mentioned above. (Also 8 state professional higher schools.) There are also private universities that focus on higher professional education (8 universities and 11 professional higher

schools in 1999). State universities are legal entities in public law, which means that they have a rather great level of independence. They are financed from the state budget through the Ministry of Education.

There are 34 public research institutes in Estonia. They employ together almost 2,800 persons, one third of them are researchers. 14 of the research institutes are within the universities: 7 within Tallinn Technical University, 4 within Estonian Agricultural University, 2 within Tallinn Pedagogical University and one under TU. These institutes are legal entities in public law.

Another 20 institutes work under different ministries: 7 under Ministry of Education, 5 under Ministry of Agriculture, 4 under ministry of Environment, and 2 under Ministry of Social Affairs. There is one institute operating under each of the Ministry of Economic Affairs and Ministry of Culture. These institutes are state institutions.

Table 13 - Estonian Public Owned Research Institutes

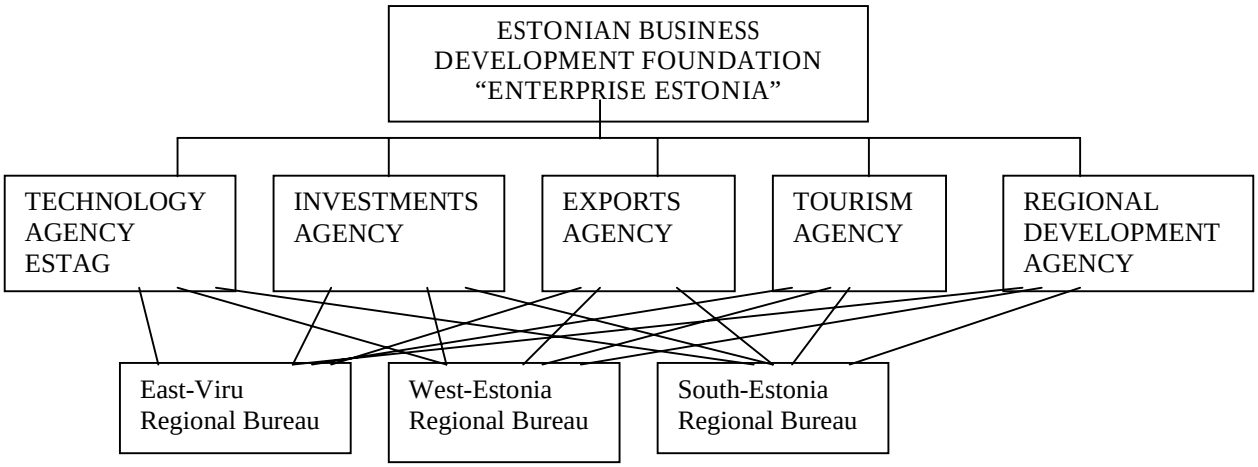
Institute	Administrator	Main location	Personnel	Researcher
Institute of Physics	University of Tartu	Tartu	171	77
Estonian Institute of Economics	Tallinn Technical University	Tallinn	46	28
Institute of Geology	Tallinn Technical University	Tallinn	94	46
Institute of Chemistry	Tallinn Technical University	Tallinn	119	54
Institute of Cybernetics	Tallinn Technical University	Tallinn	75	32
Institute for Islands Development	Tallinn Technical University	Kuressaare	4	1
Institute of Oil Shale	Tallinn Technical University	Kohtla-Järve	55	15
Institute of Intern. and Social Studies	Tallinn Pedagogical Institute	Tallinn	36	21
Institute of Ecology	Tallinn Pedagogical Institute	Tallinn	49	24
Estonian Plant Biotechnical Research Centre EVIKA	Estonian Agricultural Univers.	Saku	27	6
Forest Research Institute	Estonian Agricultural Univers.	Tartu	5	14
Institute of Animal Science	Estonian Agricultural Univers.	Tartu	153	55
Institute of Experimental Biology	Estonian Agricultural Univers.	Harku	103	38
Institute of Zoology and Botany	Estonian Agricultural Univers.	Tartu	114	53
Institute of History	Ministry of Education	Tallinn	62	31
Estonian Biocentre	Ministry of Education	Tartu	71	53
Institute of Estonian Language	Ministry of Education	Tallinn	103	58
Estonian Literature Museum	Ministry of Education	Tartu	59	16
National Institute of Chemical Physics &Biophysics	Ministry of Education	Tallinn	176	104
Tartu Observatory	Ministry of Education	Tartumaa	68	41
Under and Tuglas Literature Centre	Ministry of Education	Tallinn	17	11
Estonian Marine Institute	Ministry of Environment	Tallinn	86	52
LLC Building Research Institute	Ministry of Environment	Tallinn	21	12
Geological Survey of Estonia	Ministry of Environment	Tallinn	115	-
Estonian Meteorological and Hydrological	Ministry of Environment	Tallinn	462	22

Institute	Administrator	Main location	Personnel	Researcher
Institute				
Võru Institute	Ministry of Culture	Võru	5	3
Estonian Energy Research Institute	Ministry of Economic Affairs	Tallinn	54	25
Estonian Institute of Agrarian Economics	Ministry of Agriculture	Saku	21	15
Estonian Agrobiocentre	Ministry of Agriculture	Tartu	39	
Estonian Research Institute of Agriculture	Ministry of Agriculture	Saku	69	34
Estonian Institute of Agriculturel Engineering	Ministry of Agriculture	Saku	20	10
Jõgeva Plant Breeding Institute	Ministry of Agriculture	Jõgeva	117	22
Estonian Institute of Cardiology	Ministry of Social Affairs	Tallinn	32	23
Estonian Institute of Experimental & Clinical Medicine	Ministry of Social Affairs	Tallinn	129	61
34 Institutes	**10 administrators**	**9 location**	**2 777**	**1 057**

The big changes in the Estonian Innovation Policy Community

The most important organisational changes in applying innovation policy is the current reorganisation of the foundations system.

The most important organisational changes in applying the innovation policy is the current reorganisation of the foundations system. According to the reorganisation plan the Innovation Foundation (with new name Technology Agency ESTAG) together with other foundations (Estonian Investments Agency, Estonian Exports Agency, Tourism Agency and Regional Development Agency) will be put into joint **Estonian Business Development Foundation "Enterprise Estonia"**.



Government decision about this foundations alliance was approved in April 2000, in the end of July the Ministry of Economic Affairs legally established a new foundation and proclaimed the contest for the head, in August the council was formed. Several prominent representatives from the business sector are concluded to the council.

The new foundation will assemble several servicing functions (accounting, secretary, inner-audit, IT) for the agencies to the 10 persons (maximum). Agencies are compared to the foundation's departments: first the rights belong to the head of foundation and he will delegate them to the agencies' managers. Interviewers stress that the agencies' autonomy should be guaranteed by the fact that they act in the frames of their yearly budgets (which is fixed by the council). Another question is that is it even possible to hold on to the budget in the condition where the money receiving is hardly prognosed.

The important change will be that there will be no (full-time) council at the agencies, which would decide the grants and loan giving. Instead of the council there will be kind of round tables or advisory bodies of the limited rights business representatives. For example, the Technology Agency ESTAG has Financial Committee (7 members), who decides the giving of grants and loans from 22,369 euros up to 639,117 euros. Project applications exceeding that sum will be referred for decision to the Estonian Business Development Foundation "Enterprise Estonia"'s council (10 members). Projects smaller than 22 thousand euros, shall be decided in Projects Working Groups.

In addition to general servicing functions level and agencies level there are also the regional bureaus level foreseen in the Foundation. These **regional bureaus** should provide integrated information and services about all Foundation activities to the local enterprises. At first the plan

is to form South-Estonia Regional Bureau, West-Estonia Regional Bureau and Eastern-Viru Regional Bureau, later the bureaus will cover all Estonia.

The plusses of the new NIS structure are said to be the following

- Cost reduction of the services as a task is better fulfilled by the large joint foundation.
- The better coordination of the single agencies, because the allocation of money is decided by the civil servants, who will implement the government policy better than the hard-to-manage councils.
- Regional bureaus – providing a complex of services to the local enterprises from one source is practical, but it would be very hard to implement in case of practically independent foundations.

The negative sides of the reorganisation could be the followings

- Some doubts about the agencies abilities to maintain their own "face", speciality and consistency may arise.
- The turn back from the council based decision making to the decision making by the civil servants at the agencies level does not seem very democratic, even if we take those limiting "rules of the game" and supervision into consideration.
- The institutional development is interrupted – the former "narrow" foundations' councils had already developed their institutional experiences, priorities and common knowledge. Now everything has to start from the beginning.

It can also be questioned, whether the joining of the agencies' servicing functions is a sufficient argument for their merger. In fact, there is a possibility to use joint services (e.g. accounting), while remaining independent institutions. But it seems that one serious additional argument in favour of the merger is the insufficiency of the financial resources. The logic is somewhat as follows: if there is not enough money in the first place, why keep up separate structures. It is better to unite them and if necessary centralise the limited resources.

It came out from the interviews that a reason for the Technology Agency ESTAG reorganisation was also a will to change the foundation's activity, ideology and managerial personnel. The foundation's work was not satisfactory in the opinion of Ministry of Economic Affairs. True, the foundation had more or less an average success in granting relatively small-volume loans (a large share of the loans were repaid) and did it so with low administrative costs and a small permanent staff. In reality the foundation was managed by the council. According to the Ministry of Economic Affairs the loan

providing strategy was not clear enough and the foundation's work did not reach outside the extending of loans and grants. Also the cooperation with the ministry was not satisfactory.

The plans of the new Technology Agency ESTAG are rather ambitious.

The plans of the new Technology Agency ESTAG are rather ambitious. Programmes increase the business sector knowledge in innovation and technology areas – information, (consulting), training, etc. – are planned. The Ministry of Economic Affairs have prepared two programmes starting in 2001 under the Technology Agency ESTAG coordination: 1) *Inno-awareness* – the purpose is to raise the knowledge about innovation issues among the whole society and also in different target groups (students, scientists, entrepreneurs, etc) through training courses, seminars, publications, etc. Higher knowledge on innovation related matters makes it better to explain the research and development expenditures from the state budget and also explaining the necessity of applied research among the scientists, and so on; 2) *Spin-off programme* – the purpose is to identify the new ideas in the universities and help to realise them. This programme has two values: *) on the basis of the researcher's idea the new spin-off firm will be formed, where this researcher is the owner and a managing director is employed; *) the researcher's idea will be licensed and sold to some other firm. The coordinator of these programmes will be the Technology Agency ESTAG. From 2002 will start one more programme (first as a pilot): *Raising competence in innovation management*. This programme has also two sides: a) training the development managers of the enterprises: strategic planning and development and technology auditing issues; b) regional orientation: the enterprises can employ the scientist from university or research institute for 2 years and the state pays the 1,5 year salary for the scientist (the medium specialist salary, which is usually higher than the one they get from the university). This should be profitable and interesting to both enterprises and scientists/researches.

The TA's will is to develop more strategically oriented basis for giving loans and grants. Loans and benefits are granted to enterprises and research institutions for the realisation of implementation studies and product development projects. The main scheme is shown in table 14.

Table 14 - Technology Agency ESTAG's financial products

	Research and development institutions		Enterprises		
	Prelimin. study	*Implementat. Study*	*Prelimin. study*	*Implementat. Study*	*Product development*
Financing of support from own sources (special cases)	25%	50% (50-0%)	25%	50% (40-25%)	75% (65-50%)
Financing of loans from own sources	-	-	-	25%	25%
Loan terms: Interest – 1-5% annually on loan residue; Term – maximum 8 years; postponement of payments – maximum 3 years.					

The financing of the Technology Agency ESTAG. The Innovation Foundation got ~2,4 million euro from the state budget in 2000. In addition to that it could operate with the received loans money (~0,6 million euro). Whole new "Enterprise Estonia" will count a bit more than 21 million euro budget for the year 2001 (6,2 million euros from state budget, 4,6 million euros from comes over from the previous year's projects, ca 10 million euro from the privatisation). ESTAG's budget for 2001 is 6,2 million euros. These coming finances from the privatisation are still open as the privatization processes are dragging on. The additional money from the EU Phare 2001 ESC to the project "Institution Building Support to Enterprise Estonia" will be available during the years 2001-2004.

Reorganisations are also taking place in the **Science and Research Council** (SRC). Today's SRC main problem is considered to be its very frequent gatherings, which have biased the council activities towards solving everyday problems (usually science institutions' current problems) and not to make proposals about the development improvements to the government. The plan is to reorganise SRC so that its role as a real long strategic decision-maker would be increased and on the other hand it would be a constant body of the essential work.

SRC's head staff would be smaller: 12 persons instead of the present 23. It would convene twice per year to discuss the important strategic positions and documents. The change would aim at turning the work between the sessions constant. The everyday work on the preparations of the strategic solutions would take place in SRC permanent commissions, which have to prepare the documents for the council sessions. One commission would work at the Ministry of Education (science and education commission – degree studies and

science issues and EU related questions in these areas) and another would work at the Ministry of Economic Affairs (Development and Innovation commission – technological development issues and EU related questions in these areas), because according to the law one is responsible for the science and the other for the technological development issues. The technology commission should work in close cooperation with the ESTAG. The commission by the Ministry of Economy should closely cooperate with the Science Competence Council. Commissions would also be the counsellors of these ministers. Experts from outside are also allowed to participate in SRC commissions work. For better cooperation with other ministries there would be high level contact persons (chancellor) by the Ministry of Finance, Defence, Environment, Social, Transport and Communication, who constantly will be informed about the SRC commissions work and to whom the commissions could turn to with concrete questions.

Staffing the new SRC council more representatives from the business circles are wanted to carry along, because the former one had only two representatives (of 23) from the business sector. The members of the new council will be Prime Minister, Minister of Education and Minister of Economic Affairs, one person named by Prime Minister and 8 members will be named by the Government. The Government fixes the SRC head staff for 3 years.

The reorganisation of Innovation Foundation to the Technology Agency ESTAG and the formation of Estonian Business Development Foundation "Enterprise Estonia" are almost completed for now – June 2001. But the future of the Science and Research Council is still open.

1.4 Assessing innovation potential: data collection, surveys and indicators

There have not been done any surveys based on OECD indicators (like GERD, BERD). The situation of data collection is rather bad, because there is no adequate statistics. The "Enterprise Estonia" has ordered the innovation and technology survey and foresight from the Statistical Office of Estonia based on OECD Oslo Manual European Commission's methodology Community Innovation Survey III (CIS III). The survey will be carried through during 25.06.2001-30.04.2002.

Statistical Office of Estonia gathered the statistics about science and research activities only from the state institutions and research and educational organisations until 1998. Now there are statistics about the private enterprises R&D activities also available and the picture is

starting to look clearer. As the data from the business sector was gathered only first time in 1998, it arose a lot of confusion in the firms. Actually some kind of data was gathered also before, but it was not trustworthy, because the translation of the phrase "research and development" into Estonian gives several possibilities for interpretation (e.g. firms could show the new car purchase costs as the development expenditures). Now the definition of R&D expenditures is more clearly defined. Anyway the first time caused difficulties because their accountant reports does not have to show all the costs so separately and it was hard to them to fill the forms. Another problem with statistic reliability raises from the matter, that grants for the individuals would not be seen in the statistical data unless they have been received through some organisation.

According to the Estonian Law about Science and Development Coordination all the scientific fields should be evaluated after every 7 years. International experts have just finished the reports on info-technology (Institute of Cybernetics and Cybernetica Ltd.) and animal science (animal breeding, nutrition, small animal and poultry production, fish farming, farm technology, chemistry) in Estonia. Soon the evaluation reports on botany, zoology, marine science, ecology and business science will be available. In the fields Information Technology and Automatic Control the situation is good to satisfactory, only the staff is not fully devoted to perform the research tasks within the institute. Evaluation judgement of research fields Cryptography and Data security, Expert Systems Technology, Balancing Dynamics in Cybernetica Ltd. is good. The research staff forms a healthy organisation and the company has created motivation conditions for productive work e.g. friendly atmosphere, excellent working conditions, relevant and challenging research problems and adequate salaries. In Animal Sciences the overall research rating is satisfactory. Animal nutrition and diary research can be estimated in some parts even better, but assessing team finds the present quality and quantity in the department of small animals and poultry production as unsatisfactory.

Archimedes Foundation has annual reports about the Estonian participations in projects financed by EU 5th Framework programme.

In 1996 Science and Research Council composed the material "The short overview of Estonian science". By the end of the year the council publishes a more detailed and thorough material about the situation of Estonian science. Anyway the main conclusions promise to be the same as in previous report according to the SRC secretary's opinion.

On the procurement of Estonian Science and development Council and Estonian State Chancellery in 1996 Estonian Institute for Futures Studies carried out a survey on functioning of production and technological development systems in Estonia. The study gave an overview of the development activities and development related problems in science and research institutes and in the production companies. Also the role of the state institutions in the procurement and coordination of the product and development work was discussed. The situation in machinery and electronics industry were brought more thoroughly. The main results were: * that the main weakness of the R&D chain is in the enterprises' little interest in new science based solutions; * that the turnover of Estonian development organisations is small. They are rather successful (as exporters), but they are small and grow slowly; * that there are only few state's procured developmental projects, except on info-technology.

Marianne Paasi (researcher in ETLA, The Research Institute of the Finnish Economy) has written several articles about the Estonian prospects for growth on the data gathered in 1996 from the Estonian enterprises. The study presents the results about the firms capacities in the electronics and electromechanical industry, foodstuff industry and technology-intensive service firms in Tallinn. The study admitted that the general framework for market economy growth like the patent legislation, privatisation policy, legislation for foreign investment or regulations for functioning capital market are rather well-advanced. According to the results of the survey the firms in the electromechanical and electronics industry showed both the highest past accumulation of the knowledge and absorvative capacities and, since 1992 the highest R&D and learning intensity and therefore the highest emerging absorvative capacities. The moderate learning intensity in the R&D intensive service firms also indicate an important role in the future growth. All the three groups seem to be promising industries. The foodstuff industry – with low learning intensity – seems to play different role in Estonian growth (the sample of the study was not sufficient to make strong conclusions).

Coopers&Lybrand N.V. have studied Estonian innovation system in 1997 (the EU project no. 447899.01; the Hague, 16.10.97): "Estonia – Extended management summary". The document gives a short overview of a) the economic context for RTD in Estonia, b) performance of the RTD system and c) the main problem issues. The assessing team considered that: *the present RTD structure insufficiently supports the industry; *a national strategy should be developed to strengthen the links between RTD institutes and industry; *the industry itself need support to raise the qualifications of their workforce; *support for R&D in industry should be set up;

*R&D strategy should be operationalised; *internationalism is strong, but limited to basic and applied research.

"Evaluation of Estonian Innovation System", study carried out on the request of the Estonian Minister of Economy by Hannu Hernesniemi, Finnish Economic Research Institute Etlatieto Ltd., financed by Phare within the framework of Support to European Integration Process in Estonia (NoES 9620.01.01). The document gives a rather good overview of the Estonian Innovation System in the beginning of the year 2000. H.Hernesniemi finds, that 3 biggest problems of Estonian innovation system (besides the lack of money), that should be solved at first, are the following: a) politicians have to realise the importance of the RTD investments and the key role of the government in boosting these investments; b) more experts are needed for preparing and implementing technology policy – so the education programme should start immediately; c) awareness that R&D is one of the most important growth factors has to rise among business leaders and in entrepreneurial organisations.

Estonian Innovation Foundation has published 2 books "Technology Foresight I and II – the analysis of technological level of Estonian economy", that are edited by the professor of the Tallinn Technical University, Rein Küttner. The first one was published in 1999 and another in 2000. The books look upon the development tendencies according to the interests of main economic/industrial fields in Estonia. *Technology Foresight* evaluates the technological renewal of the Estonian industry rather positively, but is critical on the product innovation issues. In the manufacturing of machinery and apparatus there are only few examples of the new high technology products (e.g. Satellites and some road machines, etc). Estonian original products form an insignificant share in electricity and electronic industry. In info-technology industry, which has been rather successful sector in Estonian economy, the main orientation has been to the foreign computer systems assembling and compiling. Cybernetics Ltd. could be mentioned as the exceptional example in this sector as they deal with original product development in the data security, cryptology and some *real time control (guiding) systems* fields in cooperation with several universities. Estonian scientists have good achievements in gene and bio-technology (certain molecular diagnostic services development), but the way to the applications in international medicine production and other fields is still foggy/vague. Estonian transport, especially the transit transportation, promises to change relatively high technology centered, but there also prevails the foreign solutions take into use instead of creating own original solutions.

European Survey of Information Society – ESIS, 1999 noticed that according to the mobile phone and computer owners and the using of

Internet Estonia is very well advanced. Among the other post-soviet countries the better indicators can be found only from Slovenia.

BMF Gallup Media (market and media research company) has carried out research on computer and Internet usage since spring 1996 regularly. The data gathered in autumn 1999 showed that 17% of population (age 15-74) has computer at home and 7% is connected to Internet from home. The usage of Internet reached 21% of population. Most probably the numbers are increased for today. The data from survey carried out in May 2000 show that the computer owners' % has raised to 18.

1.5 Legislative and administrative environment for innovation

As mentioned before the Estonian kroon is bound to Deutch mark and through the latter to EURO. There is relatively stable business environment in Estonia to support business activities, but Estonian laws foresee no differences in the registration or taxation of enterprises; not even concerning New Technology Based Firms. Moreover, the issue has never been raised. There are also no exceptions concerning the activities of foreign investors. The respondents were unable to point out particular shortcomings or obstructions concerning (innovative) business caused by laws or bureaucracy. The reasons are more the lack of capital in the firms and their concentration at the matters happening tomorrow rather than in 5-10 years. According to Marek Tiits, head of the EU V framework programme information society working team, the reason for the lack of success of the Estonian entrepreneurs' and researchers' participation in R&D, besides the above, is the lack of information about what is going on in the world, limitation to Estonia's scale only and attempts to invent already existing things. There is also a serious lack of know-how about how to appeal for funding. Those, who have reached the signing of contracts also face problems with the protection of their rights in international projects – but this is more the legal side of conclusion of contracts rather than an obstruction caused by legislation.

There is a relatively stable business environment, but Estonian laws foresee no differences in the registration or taxation of enterprises; not even concerning New Technology Based Firms.

The strength of the Estonia legislation is also its weakness as far as the promotion of innovation is concerned. The laws and taxes are equal to all, resulting in a clear and simple business environment. On the other hand, as no priority economic sectors have been defined at the national level, the public sector has never taken advantage of the opportunity to influence the Estonian business to develop in the high-tech directions by regulating (and financing) it. The R&D activities strategy "Knowledge Centred Estonia", approved by the government

in May 2001, declared three directions as priorities in Estonia: infotechnology, biomedicine and material technologies, but it is too soon to say anything about its impact to the real economy.

If the funds from the state budget for the support of (innovative) business will increase, the introduction of some advantages should be brought up. As one of the options, the Ministry of Economic Affairs innovation service and the Technology Agency ESTAG specialists have discussed social tax deductions to enterprises hiring R&D staff. But this is still a thought.

Table 15 - Legislative measures in favour of innovation

Title of legislative acts or regulations	Date of adoption[6]	Date of applicat.	Specific measures in favour of innovation	Comments
Research and development activities organisation act	RKs 26.03.97	15.04.97	Several state-financed research institutes were merged with the universities. Closer ties between research and development should be ensured.	The law practically addresses research; it is effectively indifferent regarding innovation and technological development.
Terms for granting state support to R&D activities[1] **[1]European Community framework document on state subsidies to R&D activities (EÜT C 45, 17.2.1996, lk 5)**	VVm 20.09.00		Enables entrepreneurs to apply to the state to meet expenses on R&D	
Terms for state subsides to small and medium sized enterprises	VVm 10.05.00		Enables to make investments in immaterial property (e.g.: purchase of patents, licenses, know-how). State support to R&D is up to 10% higher than the one available to other businesses.	Gross support does not exceed 15% in case of small business or 7,5% in case of medium-sized.
Patent Act	RKs 16.03.94	23.04.94	Regulates relations developing in connection with legal protection of patented inventions in the Republic of Estonia	

[6] RKs = Parlament act; VVm = Government regulation; VVk = Government order; MJMm = Ministry of Economic Affairs' regulation.

Title of legislative acts or regulations	Date of adoption[7]	Date of applicat.	Specific measures in favour of innovation	Comments
Accession to the European convention on the issue of patents	VVk 21.11.97		Ensures legal protection of Estonian patented inventions in Europe	
Establishment of data bank of international patent claims and their processing	MJMm 09.11.98		Processes and protects patent claim information in process. Enables to release data to the public.	
Industrial design protection act	RKs 18.11.97		Ensures legal protection of industrial design solutions in the Republic of Estonia	
Establishment of national register of industrial design solutions	VVm 10.06.98		Enables to release data to the public.	
Estonian Academy of Sciences Act	RKs 16.04.97		Stipulates the legal status of the Estonian Academy of Sciences, the status of the members, the organisation of management and the tasks	
EU and Republic of Estonia association council Resolution 2/99 of May 31, 1999 (UE-EE 802/99) on the approval of terms for Estonia's participation in EC research, technologies development and promotion programmes (1998–2002)	EÜEVAN o 31.05.99		Grants Estonia the right to participate in the 5th framework programme special programmes	
Income Tax Act **Value Added Tax Act**	RKs 15.12.99 RKs 25.08.93	01.01.00 01.01.94	Reinvested corporate profit is taxed at 0% rate Export of goods is exempted from VAT	

The administrative procedure for the establishing of enterprises is same for everybody. Business associations, natural persons entrepreneurs, subsidiaries of foreign business corporations, non-profit organisations and foundations and commercial banks are registered in the registry departments of four territorial Estonian courts. Documents necessary for entering an enterprise in the commercial register are submitted to the secretary of the registry department. The submitted documents shall be reviewed usually within 15 days. A certain time shall be granted for the liquidation of faults if such are found. After the decision to approve the application has been made, an entry shall be made in the A section of the commercial register within five days. The applicant shall be informed

[7] RKs = Parlament act; VVm = Government regulation; VVk = Government order; MJMm = Ministry of Economic Affairs' regulation.

of the making of the entry within ten days. The state fee shall be 32 euros plus the fees for publications, of the notary, etc. In some (limited number of) cases national operating licenses or permits shall be required (e.g. for founding a private school). Besides entering an enterprise in the commercial register it shall be required to apply for an operating or trading license from the local government for operating in the given administrative territory. The operating license need not be obtained before the registration of the enterprise in the commercial register. The operating license may be of a specified or unspecified term or temporary; a fee may also be required. In some cases the approval of local environmental, health protection or other agencies shall be required.

Acquisition of land depends on who owns the land. Is it in private hands or under the state ownership. It is more complicated and time consuming then it is state property. At the beginning of the privatization process there was a problem with land acquisition under the plants (and other buildings), but after the land privatization procedure was ready, it became easy and for now most of the companies own the land under their buildings.

To get building and site development approvals depend on different things and could vary in towns and rural areas. For example: If you want to build something to the place, which does not have the detailed planning scheme, then you first have to apply for this planning. If the planning is ready it will be put up in a public place for two months and if there won't be any claims, you could start to apply for building approval from the local government's architecture department. So it takes a lot of time. If the detailed planning is already available, you only have to apply for building approval from the local government's architecture department. The time to get it could vary from town to town. And also the demands for the building vary: you want to build something to the Old Town area or to the industrial region. The problem is also that the planning law says that all the counterparts have to agree with each other, but there is no regulations for the agreement procedures and so it is very hard to find the consensus. Another thing is that the local governments do not have needful ressources for the detailed plannings and so the entrepreneurs very often have to do the detailed plan themselve.

The application of patents, significant from the position of innovative activities, is also rather costly and time-consuming process. The fee for applying a patent for a product/service in Estonia equals 224 euros plus 13 euros per every claim above 10 (i.e. no extra fee shall be required for up to ten claims). An international patent will cost approximately 38,000 euros with an only 192 euros exemption from the state fee. The minimum term for approving a patent application is

roughly three years. The registration of a useful model takes approximately two months and costs the applicant about 100 euro. The Estonian Patent Act and other legal acts regulating the protection of intellectual and industrial property have been drafted in accordance with the agreements regulated by the Paris convention on the protection of industrial property, the trade aspects agreement of intellectual property of the World Trade Organisation (WTO) (TRIPS agreement) and the World Intellectual Property Organisation (WIPO), as well as the stipulations of the EU legal acts. The Estonian Patent Board is making preparations for joining the Europatent in July 2002.

The Estonian Standards Board aims at becoming a full member of the European Standards Committee (CEN) by 2002. The Estonian entrepreneurs[8] in general consider the standardising, evaluation of correspondence, certification, etc. quite costly, but generally necessary for exporting to Europe.

Protection of commercial intellectual property rights and other legal conditions for technology transfer needs to be better regulated by Estonian law

Issues connected with intellectual property are not adequately correctly regulated in case of the universities and spin-off firms developed from them. A leading principle of the EU R&D management - all innovations created in a joint university-industry activities (projects, programmes, etc.) access right should be granted to all partners royalty free both for scientific and commercial use. According to the Estonian copyright act the author's personal non-material and material rights are initially the property of the author. Personal non-material rights are unalienable. The author of a work created in the performance of the author's immediate duties according to the labour contract will have the copyright on the work, but the author's material rights for the use of the work for the goals determined by his duties and within its limits shall be transferred to the employer unless otherwise stipulated in the contract. Since the universities proceed from the above laws the universities shall own the property rights on the work created within the performance of duties. The sharing of royalty for instance in the Tartu University is effected as follows: 65% to the author, 15% to the faculty development projects, 20% for meeting the university's central general expenditures. The Tartu University has also developed a procedure for cooperating with the spin-off firms (July 1999). The spin-off firms shall be granted the right to use technologies developed by the university according to term licenses. The granting of license is defined in the technology transfer or other contract.

The Tallinn Technical University is also developing a concrete procedure for dealing with University's spin-off firms (the use of space, material assets and infrastructure, as well as the use of non-

[8] "Evaluation of state of quality and prospects for development of quality activities in Estonia", 2000, Estonian Ministry of Economic Affairs

material assets – technologies developed in the University, programs etc; the University trade mark, etc.). As for the use of intellectual property rights there are considerable problems in Estonia concerning the authors themselves – the protection of copyright is not considered necessary or is not properly valued. The round table of specialists and entrepreneurs (Appendix B) stated that more information and training is needed about how and why to protect one's rights, to apply for patents, etc.

The new Income Tax Act (2000) of Estonia has been primarily aimed at promoting investments and developing business.

Comparatively simple and transparent taxation system is part of the quite favourable business environment in Estonia. Although the corporate income tax has been relatively low compared to other countries (26%), a remarkable recent development was that from January 1, 2000 it has been reduced to 0% on all revenues re-invested in the business. The new Income Tax Act (2000) of Estonia has been primarily aimed at promoting investments and developing business. Several articles expressing disappointment were published in the press as the law was approved and the introduction of some amendments was started. The impact of the new law on the investments activities of Finnish businessmen in Estonia is being analysed.[9] According to the preliminary data it seems that the new income tax act does not particularly increase the Finnish investments in Estonia. Estonian interviewees, however, considered the opportunity for tax-free investments a positive change.[10]

The rate of the VAT in Estonia is also average as compared to the level of the other countries – 18%. Estonia's peculiarity concerning VAT is it's broad tax base, i.e. there are very few exceptions. A lower rate – 5% – is imposed on printed matter only. Export is promoted by the 0 percent VAT rate imposed on export. Small enterprises shall not be required to register as subjects to the VAT if their monthly turnover is below 14,700 euro. However, a number of small firms still register themselves as subjects to the VAT as this enables them to reclaim the VAT paid in the purchase of services and goods.

Exporting enterprises may face obstructions with the customs. The Estonian customs processing requirements are stricter than those of the EU. The VAT on purchased goods has to be paid before receipt of the goods from the customs.

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[9] Estonian Institute for Futures Studies (2001), « The Impact of Estonian Corporate Tax Law to the Finnish Entrepreneurs » , Helsinki-Tallinn Euregio Publication Series No. 1

[10] The statistics has shown a little increase in investments in fixed assets among Estonian enterprises.

Section 2 - Measures to foster innovation in business

2.1 Training and human resources related programmes for innovation

The high educational level of the Estonian population and its receptivity to innovation are considered the most significant advantages of Estonian labour.

The high educational level of the Estonian population and its receptivity to innovation are considered the most significant advantages of the Estonian labour. In Estonia, in all working age groups, the share of people who have not completed secondary education is two times lower than in the European Union countries on the average.[11] The question has also been posed of whether Estonia needs so many specialists with higher education? The qualification intensity of Estonia's economy and especially export have been relatively low until now, therefore Estonia has not been able to take advantage of the high education level of its residents. A problem is also seen in the possibility of "brain drain" after joining the EU.[12]

Table 16 - Indicators on skills levels in companies and industry

Education level of those involved, %	Below upper secondary	Upper secondary	Non-university tertiary	University level
Total	12	57	12	20
In industry sector	16	63	10	11
Timber industry *	35	42	15	7
Furniture industry *	31	41	23	5

*Source: Estonian Labour Force Survey 1999[13] (1998 II quarter); * Timber & Furniture Sector Survey 1999*

[11] At the same time, the share of people with primary and basic education in Estonia is the highest among the 20-29 age group, unlike EU and the other post-socialist countries. Estonian Human Development Report 2000.

[12] E.Saar "Eesti Euroopast ees!?", *Postimees, 19.12.2000.*

[13] The labour research according to the EU methodics is held in the second quarter of every year since 1997. Starting from the 1st quarter of 2000, the labour study will be held in every quarter with the sample involving 2,000 households.

Table 17 - Correspondence of education to work

	% of those involved
Educational level corresponds to the job	82
The job requires higher educational level	4
Employed person's educ.level is higher	15

Source: Estonian Labour Force Survey 1999 (1998 II quarter)

The lack of qualified labour was cited by experts as the main factor obstructing economic development for the first time since 1992 in September 2000

According to the data of the Estonian Institute of Economic Research, the lack of qualified labour was cited by the experts as the main factor obstructing economic development for the first time since 1992 in September 2000.[14] The biggest problem is the mismatch between the demand and supply of labour, characterised by a high unemployment rate (12.8% in 3rd quarter 2000) and a shortage of qualified labour at the same time. Unemployment in Estonia is mainly structural unemployment, which means that the knowledge and skills of people are at variance with the requirements of the economy and there are large regional discrepancies. [15] At the same time the labour force is not mobile enough.

Ministry of social Affair organises the training of unemplyed from the state side through the regional Labour Market Boards. About 7-8 thousand people get free training in a year. In Estonian labour traninig system defines 3 types of training: a) psychological aid; b) counseling; c) training. The length of the courses vary from 2-5 days to 2 weeks and 2-3-6 months.

14 The same tendency was also observed in Western Europe and North America.

15 In the 1st half-year of 1998, out of the vacations offered by Estonia's labour boards 1,8% were those of top managers and specialists, 6,2% technicians and medium-level specialists, 0,9% officials, 24,3% services and commerce staff, 1,0% skilled workers in agriculture and fishing, 35% skilled workers and mechanics, 16,8% equipment and machine operators, drivers and 13,8% ordinary workers. The higher qualification is called for by the post, the less frequently are candidates searched for via the labour Board.

Table 18 – Recipients of labour market benefits and services

Recipients of labour market benefits and services (in year), thousands	**1995**	**1997**	**1998**	**1999**
- unemployment benefit	39,8	46,7	48,4	63,6
- employment training	**9,8**	**8,2**	**8,0**	**7,0**
- community placements	5,7	4,7	3,8	3,7
- employment subsidy for unemployed	0,5	0,4	0,4	0,4
- employment subsidy for employer	0,12	0,22	0,14	0,26
Vacancies received (in year), thousands	15,1	13,6	14,6	12,6
Employed persons (in year)*, thousands	15	13,4	15,2	18,7

** Employed in other vacancies included*

Source:: Labour Market Board

Table 19 – Expenditure on social protection in case of unemployment (million euros)

Type of expenditure	Total expenditure				Structure of expenditures (%)	
	1995	*1997*	*1998*	*1999*	*1995*	*1999*
Total	**3,5**	**5,8**	**6,1**	**10,7**	**100**	**100**
- unemployment benefit	1,8	3,2	3,7	7,7	50.0	71.7
- employment training costs	1,1	1,8	1,8	2,1	32.2	19.1
- employment training stipends	0,3	0,3	0,3	0,4	8.6	3.6
- community placements	0,07	0,1	0,1	0,2	2.0	2.0
- employment subsidy for starting a business	0,2	0,3	0,2	0,3	6.6	2.5
- employment subsidy for employer	0,02	0,06	0,07	0,1	0.6	1.1
Expenditure* as % of GDP	0.13	0.17	0.15	0.22		
Labour Market Board (administrative costs)	0,2	0,2	0,1	0,1		
Regional Employment Office (administrative costs)	0,6	0,8	1,1**	0,9		

** Administrative costs not included; ** incl 4.7 million EEK for development of labour market information system.*

Data from Ministry of Social Affairs

In addition to the presented expenditures, in 1999 the social tax for the unemployed was paid from state budget (5 million euros). In 1999 the expenditure on passive labour market policies (the unemployment

benefit) has increased significantly. If in previous years the expenditure on unemployment benefits made up half of the total costs, then in 1999 the share of unemployment benefits was approximately 70 per cent of total costs. The reason for such change was the rapid growth of unemployment and 6,4 euro rise of unemployment benefit.

When observing the structure of the Estonia labour, the greatest number of people is employed in the services sector - 59% of the working age population (3rd quarter 2000). Tourism has been a rapidly growing sector here. As tourism is a comparatively new business area in newly independent Estonia, the level of supporting training and consultation services is insufficient yet. Although almost 15 schools provide training in tourism and hotel management, their level is uneven as there are no national curricula and almost no trainers with suitable in-service and academic background.

Agriculture has traditionally been one of the most important sectors in the Estonian economy. Employment in agriculture has reduced nearly two times from 1993, and is currently 6.5%, but the labour efficiency is much lower than in developed European agricultural countries. The main reasons for such a low labour efficiency are obsolete technology and equipment. But accessibility of information and training about new technologies, methods and opportunities in agriculture are also insufficient.

Human resources difficulties faced by Estonian industry concern amongst others shortcomings in management skills (incl. marketing, cost estimation, communication and technology management skills, etc.). Unfortunately, no studies concerning the need for and correspondence of labour have not been conducted in most sectors of industry. The round table of specialists and entrepreneurs (Appendix B) stated that there is considerable lack of marketing and promotion knowledge and skills in particular. Even if an enterprise has a very good product, it cannot market it in the world as on the one hand it lacks the skill of selling and on the other hand the finances for bringing the product to the market..

Human resources difficulties faced by Estonian industry concern amongst others shortcomings in management skills (incl. marketing, cost estimation, communication and technology management skills, etc.).

At the commission of the Ministry for Economic Affairs, the study "Estonian Food Industry in the Framework of the EU Integration" has been conducted. Although the food industry provides a small share of the added value produced, it is a very labour-intensive sector, which covers approximately four percent of Estonia's employment. Together with the decrease of production volume, the number of people employed in the food industry has also declined (1994 - 28 000 employees; 1999 - 17 000). It is likely that the contraction of the food industry is reflected primarily in the number of the enterprises and

employees rather than production or consumption. In case of a pessimistic scenario, a 40-50-percent decrease of employment in the daily, meat and fish industries in Estonia could be considered.

The share of industrial employees is the highest in the traditionally labour-intense light industry (21% - 1999.a.), which is based on the cost advantage connected with the lower wages. The lack of qualified labour for the enterprises of this sector is estimated as less serious than in the electronics industry, for example. The greatest lack concerns seamstresses and cutters, as well as mechanics/line mechanics, who are practically not trained at all. To improve the situation the Estonian Association of Clothing and Textile applied the Ministry of Education requirement and harmonised the vocational schools' 2001/02 pupils admission applications with the actual needs of the sector.

The sectoral study of the Estonian timber and furniture industry in 1999 showed that as of the 2nd quarter of 1998, the wood processing industry employed more than 22,000 and the furniture industry approximately 18,000 people (respectively 16% and 18% of the employment in the manufacturing industry). In the professional structure of labour in the furniture industry the greatest share belongs to the group of skilled workers and mechanics (46%), in wood processing industry to the equipment and machines operators (32%) – mostly people with secondary and specialised secondary education. The share of management is approximately 13%. Out of the timber and furniture industry managers, 64-67% considered the qualification of their labour satisfactory. It is not planned to increase significantly the number of timber specialists. The plans mainly concern the improvement of the qualification of the existing staff in connection with more efficient equipment becoming available. As the study analysed the enterprises' need for employees and the number of school-leavers, it concluded that the graduates' number is sufficient to meet the needs of the sector. However, it is necessary to improve cooperation between industry and the educational institutions in order to improve the quality of training.

There is an urgent need to improve engineering education focusing it more directly on enhancing the ability of engineering graduates to contribute to the industrial competitiveness of Estonia

While the preceding sectors involve a large share of the labour, but are not too innovative or high-technology, the electronics industry[16] should be one of the sectors, which the state should pay particular attention to if it wishes to improve Estonia's competitiveness in the world market. The report of Professor Toomas Rang[17] at the

[16] A study by Pwpartners, "Estonian metal and mechanics sector study", is in progress, providing an overview of the labour requirements and training in the sector.

[17] Head of the Chair of Electronics Design Tallinn Technical University; Association of Estonian Electronics and Instrumentation Industries

conference "Baltic Dynamics '99" showed that the situation in the Estonian electronics industry in 1998 was as follows: about 260 enterprises with about 9,000 employees and with turnover about 140,6 thousand euro. In industry the R&D activities are underdeveloped at the moment. There are about 5 R&D institutions about 200-300 researchers. The activity character of the industry was in majority subcontracting oriented. Today there are some positive examples: the computer assemblers Microlink, Osborne are looking development engineers. Also Elcoteq (see section 1.1.) and Fabec Plus and new manufacturing companies are widening their activities and new engineers are needed. In the present situation, there is an urgent need to improve engineering education focusing it more directly on enhancing the ability of engineering graduates to contribute to the industrial competitiveness of Estonia, especially, considering small and medium industry in today's technological key areas like microelectronics and microsystems technology. The greatest problem is the age of the scientists and professors in electronics field. According to Prof. Rang the most critical situation in Estonia is the lack of well-educated workers today and engineers tomorrow.

The Estonian Association of Information Technology has also made some calculations concerning the necessary number of IT specialists. According to the estimate of the Association president Mr. Jaan Oruaas[18] there will be the need in two years for 1,200 people in the IT industry and 12,000 IT specialists in all other spheres from government to agriculture.[19] As of now Estonia needs ~31,000 IT specialists, ~10,000 of whom should have higher education, (according to experts' opinion, the latter figure has been met and even exceeded. The structure concerning the remaining 20,000 specialists is still unclear – how many users should receive extra training to the support person level and how many technicians with professional education will be needed). If the number of specialists undergoing training remains at the present level, no full-blooded IT society in Estonia can be considered in the future. If the training of IT specialists should be increased to 2,500 per years the requirement can be met in 2025. The opening of the IT College with 200 students in Sept. 2000 provides some relief. But it is necessary to increase training both at the vocational and university level. The lack of lecturers is another important obstructive factor here.

There will be the need in two years for 1,200 people in the IT industry and 12,000 IT specialists in all other spheres from government to agriculture

[18] based on the prognosis for the need for IT specialists in the UK.
[19] Initial conditions, structural deficit, growth rates, etc. have not been detailed here.

The Estonian Information Technology College is one of the good examples where private initiative of ICT firms has worked out in the coopearation with the public sector. On March 29, 1999, the Estonian Information Technology Foundation (EITF) was founded by the Estonian State represented by the Ministry of Education, Tartu University and Tallinn Technical University, Estonian Telecom and The Estonian Computer Companies Association. On May 22 the Ministry of Education granted a teaching permit for the College. First 140 students were immatriculated by Sept. 1, 2000. **Study time is 3 years.** Student receives a diploma upon graduation. There is an option to continue **the degree studies** at Tallinn Technical University and Tartu University. **Majors:** IT Systems Development and IT Systems Administration.

As was shown in the preceding chapters, the R&D activities are not too frequent in the Estonian enterprises. On the average, 2,2% (i.e. 786 employees) out of the total staff of enterprises (only the firms who said having R&D activities) in Estonia is connected with R&D activity. But these data are not quite reliable as it is not entirely clear, what R&D means here. E.g. in the furniture industry development activities largely mean design, while in the timer industry the improvement of the level of services. Therefore this is not a high technologically innovative activity.

Table 20 - Number of personnel engaged in R&D in industry sectors

Kind of activity	Number of personnel engaged in R&D		
		% of employees	scientists & engineers
Manuf. of food products & beverages	16	0,82	15
Manuf. of textiles	13	1,44	6
Manuf. of wood & wood products	9	8,26	7
Manuf. of electrical and optical instruments	24	3,63	15
Manuf. of furniture	35	1,89	16
Computer services	109	82,58	43
Research and development	72	86,75	57

Data: Statistical Office of Estonia, 2/00

The Ministry of Economic Affairs has drafted the pilot project "Raising competence in innovation management", (project consists of two parts – see section 1.3.) in order to promote the hiring of researchers by enterprises, which involves the support of the enterprises in hiring researchers: the state will pay the researcher's 1,5

year's wages. The project should be launched in 2002. The project also has a regional aspect, i.e. it primarily supports the hiring of R&D specialists by the firms of the more backward regions, so as to reduce the regional differences in Estonia's business landscape.

Since Estonia's population is expected to decline in the near future (a reduction of population by at least 100,000 is predicted by 2015) and to grow older as well, the skills of every working-age individual should be developed to the maximum and put to use. In such conditions, economic success will be contributed to primarily by an orientation at technological modernisation and corresponding increase of production of added value. But this would mean increases emphasis on exact sciences. The shortage of good engineers is considered the main drawback in Estonia. The studying of physics, chemistry and technical specialities has declined as compared to the beginning of the 1990s.

Table 21 - University graduates

	1992		1995		1999	
	D & B	**Ma & Doc**	**D & B**	**Ma & Doc**	**D & B**	**Ma & Doc**
Natural sciences	145	198	100	41	91	63
Mathematics & computer sciences	44	64	64	15	56	20
Engineering	57	191	381	20	485	72

D – diploma courses; B – bachelor courses; Ma – master courses; Doc – doctor courses.
Source: Statistical Office of Estonia

According to the estimate of the Estonian Association of Engineers president Professor Leo Mõtus and other specialists of the field, Estonia trains seven times less engineers than necessary. The master-level engineer training is in an especially bad shape. Only every fifth student of technical and technological specialities, admitted to bachelor's course, can graduate to the master's course (on the average every second in the EU countries). The master's courses have been steadily: while 9.3% of students of the technical specialities continued in the master's course in 1995, the figure had gone down to 6.9% by 1998. The admission to the master's courses in the technical specialities was slightly increased in 1999 as in other forms of study.

Estonia trains seven times less engineers than necessary. The master-level engineer training is in an especially bad shape.

Table 22 - Admitted and graduated students in mathematics and engineering courses

	Mathematics and computer sciences			Engineering		
	1995	**1998**	**1999**	**1995**	**1998**	**1999**
Admitted higher education students:						
- diploma courses	-	54	188	209	457	541
- bachelor courses	90	179	214	1055	1055	1358
- master courses	16	28	57	114	80	155
- doctor courses	7	13	14	23	23	41
Higher education graduates:						
- diploma courses	-	-	-	14	58	82
- bachelor courses	64	36	56	367	342	403
- master courses	15	14	14	17	44	63
- doctor courses	-	-	6	3	4	9
Admittance to professional secondary courses[20]						
	157	166	-	783	885	99
Graduates of professional secondary courses:						
	4	20	35	217	403	494
Admittance to vocational secondary and vocational courses:						
	-	7	720*	-	90	769
Graduates of vocational courses:						
	-	11	31	-	-	-

** Usually one-year elementary computer use courses.*

Data from Statistical Yearbook of Estonia 2000

The number of PhDs in technical sciences is modest and it has received criticism also in the Estonian national innovation programme. It is estimated that Estonia should prepare 150-160 new PhDs per year in order to develop industry.

[20] In connection with the vocational education reform there was no admittance to professional secondary courses starting from 1999. Admission to higher professional courses was started later.

One of the reasons for the imbalance between the labour market and education is also that as the result of the approval of the University Act a number of various (private) universities emerged (there are 41 universities in Estonia, but only 10 of them issue recognised academic degrees), which mainly teach social sciences with economic specialities prevailing. In 1999 nearly one-tenth of secondary school graduates did not continue studies in tertiary education.[21] The results of the higher education expansion will probably become apparent in the coming years. The vocational education system is in a bad shape. In the area of secondary education, general secondary education prevails in Estonia (2/3 of the pupils) rather than vocational secondary education (1/3 of the pupils) as in most of the EU and EU associated countries.

The development concept for the Estonian education system drafted by the Estonian Ministry of Education considers the greatest drawback of the Estonian education system its closeness and the inability to flexibly react to the rapidly changing needs of the society, including the labour market. Too little attention has been paid to the mechanisms for the reinforcement of the quality of education; as a result the contents of the education provided do not meet the expectations of the pupils/students and the society.

A two-branch – academic and non-academic – university education system is developing. The opposition of these branches in the institutional field is increasing. The development of the system is weakly tied to the vocational qualification system, which is being developed. The current network of educational institutions does not consider the demographic, social-economic and regional peculiarities of Estonia. Consequently, the components of the educational system do not operate efficiently and the resources are not used in practical manner.

National Development Plan (NDP) chapter of Employment and Training foresees the strengthening of the connection and information flows between the labour market and education system in order to match workforce skills with labour market needs. As one of the steps, the Education Ministry, the Social Ministry, the Ministry of Economic Affairs, the Confederation of Employers and Industry and the Confederation of Trade Unions signed in the beginning of December 2000 a cooperation agreement, which determined the parties' obligations and action plans for the years 2001-2004. In order to improve the quality of education, the Tartu University and the Tallinn Technical University have signed cooperation agreements with large enterprises like the Silmet Group and Elcoteq Tallinn. The latter is also cooperating with the vocational educational institutions like the

[21] Estonian Human Development Report 2000

Tallinn Communications School. Therefore the first steps for the improvement of the correspondence of labour quality and market requirements have been made.

AS Silmet Group is a firm producing rare metals, rare earth metals and their alloys and compounds, which was privatised in 1997. The firm has become successful by this year and is paying considerable attention to R&D activities. Agreements on research cooperation with the Tartu University and the Tallinn Technical University were signed in 2000. The agreement foresees lectures by Silmet employees in these universities and the firm will also finance masters', doctors' and other research work on subjects offered by Silmet.

The Presidential Academic Council, the Education Forum and the Education Ministry drafted the document "Learning Estonia" in 1997, which explains the importance of education and lifelong study for Estonia. The document was also presented to the government. The new and improved version of "Learning Estonia" was sent to Parliament in June 1, 2001. This document contains of the concept of Estonian education system 2010 and of the concrete appliance strategy up to 2004, how to improve Estonian education system. It also has some wider ideas about the necessity of lifelong study, but in general does not consider this sphere to be one of its tasks .

Regarding innovation and technology management training Estonia still has a long way to go. The subjects are taught in the major universities, but usually as lecture courses and not as a degree.

Regarding the innovation and technology management training Estonia still has a long way to go. The subjects are taught in the major universities, but usually as lecture courses and not as courses providing a degree. Both the Tartu University and the Tallinn Technical University are taking measures to improve the situation. The first graduates, who have received some more detailed technology management training should graduate from the Concordia International University in the spring of 2001. The shortage primarily concerns competent lecturers as well as study aids. The Tartu University has been negotiating with Finland on the hiring of lecturers and German universities have also promised some support. Private consultation firms provide technology management consultations and also hold courses on quality management and product development.

Table 23 - Main organisations involved in human resource development for innovation

Higher or further education organisations	Main type of innovation related training or advisory services	Commentary (e.g. efforts made to re-design courses in partnership with industry, etc.)
Concordia International University in Estonia	Technology management	First graduates will be 2001?
University of Tartu	Innovation and technology management separate courses	The plans are to make technology management a separate curriculum from the next academic year
Tallinn Technical University	Some courses: technology management, innovation policy etc.	The plans are to make technology management a separate curriculum
Archimedes Foundations, ESTIRC	Technology transfer consultations	Provide consultations and address seminars, but do not hold seminars themselves.

Raising the awareness of the larger public and involving those concerned has been conducted through the annual fair and conference "Innovaatika", held in Tartu, that brings together universities, scientific, educational and development institutions innovative companies, institutions and organisations and covers topics in the fields of R&D, new ideas, inventions, know-how, technology transfer, innovative products, etc. A similar activity is the "Technology Fair" held by TALLINN TECHNICAL UNIVERSITY Innovation Centre that in year 2000 discussed R&D institutions, spin-offs and technology transfer and brought together German and Estonian firms. The new project "Inno-Awareness" will start from 2001 under Technology Agency ESTAG coordination (see section 1.3.).

One of the remarkable projects of training people is project "Look at the World". It is the biggest cooperation project between public and private sector, where the initiative came from seven major ICT companies in Estonia. They are financing the programme with 16 million euros during 3 years. The mission is to support Internet usage, to raise the living quality of Estonian inhabitants and the country's competitiveness in the world. The main incentives are: *to provide people more opportunities for access to Internet; *to help public sector to improve its reach by making the usage of public services easy and convinient by Internet; *to help private sector to provide it's services by Internet; *to promote Internet as the channel for getting information and using services by changing the people's attitudes and organizing Internet-training. The ambitious plan is to make Estonia the number one country in the world as to the number of Internet users by the year 2003.

An important support to the SMEs in the general as well as innovative development of the enterprises is the SMELINK project, which is primarily meant for firms in rural areas, but is useful and available also for all other firms. The Link contains information on the legal acts, methods, training opportunities etc. connected with the starting, development and winding up of business, as well as information about finding partners and funding opportunities.

Table 24 - Main initiatives taken in favour of human resources development for innovation

Organisations responsible (the initiator and management structure if different)	Objectives (e.g. retraining in new technologies, placement of researchers in SMEs)	Target public (e.g. workers, researchers, etc.)	Funding (level of funding, source: public / private)
Technology Agency ESTAG, The Ministry of Economic Affairs	"Inno-Awareness" programme: raise awareness of R&D and innovation part in the economic growth and maintaining the welfare of the inhabitants.	Whole society and enterprises in general as well as specific critical target groups for innovation	Public funding from the state budget
Project SmeLink.ee – "Entrepreneur's Information Gateway" Co-ordinator – Rapla county government; compiler and developer of the information gateway Estonian Foundation for Regional Development; initiators: Rapla MV and Jönköping county government of Sweden	- to enable rural eras small enterprises to develop faster and earn more by using the Internet and IT.	Rural areas small enterprises .	Financing from the EU Phare cross-border cooperation Baltic small projects programme.
Conference "Innovation" organised by Tartu University, Tartu Science Park, Tartu City government etc.	Covers topics: R&D, new ideas, inventions, know-how, technology transfer, innovative products, etc.	Universities, scientific, educational and development institutions innovative companies, institutions and organisations	State has participated as provider of funds.
Technology Fair Held by Tallinn Technical University Innovation Centre Foundation	This year discusses: R&D institutions, spin-offs, technology transfer and bring together German and Estonian firms.	Same as previous.	State has participated as provider of funds.

The High-Tech Baltics 2001 – annual international conference. Organised by science and technology parks.	To improve the business environment & innovation culture, increase competitiveness & technological capacity of the high-tech innovative companies in the Baltic Sea Region.	S&T parks, innovation centres, policy makers, but also high-tech firms.	
"Computer" – annual information and telecommunication technologies conference and fair. Main organiser Estonian Computer Firms Association.	To provide overview of new products and services in ICT, seminars on opportunities for the use of ICT in businesses	ICT firms and specialists, firms interested in the use of ICT solutions/opportunities (for the development of the firm)	Private funding mainly, attendance fee
"Look at the World" – the biggest cooperation project between public and private sector (7 ICT firms involved). Main coordinator is Hansapank.	To support Internet usage and make it available to everybody to raise the quality of life of Estonians and the country's competitiveness.	All inhabitants in Estonia.	7 biggest ICT firms give together 9,6 million euros and thousand voluteers.

2.2 Awareness of innovation management techniques and their use

The level of awareness of the importance of technological development in achieving of international competitiveness is still low.

No studies have been conducted concerning the use of IMT in the enterprises.

There is a general understanding about the innovation management among the economic circles in Estonia according to specialists from international training firms. Especially due to the rather long traditions of the management education in Estonia. But the level of awareness of the importance of technological development in achieving of international competitiveness is still low, in the society in general, in business as well as among the decision-makers. On the one hand this is considered the reason why the R&D intensity in Estonia is so low, the corresponding expenditures are limited and the state measures have not yielded the desired results. On the other hand, due to the fact that the enterprises have not had the opportunity to concentrate on product/service development (shortage of free capital, etc.), no attention has been paid to the innovation management. This means that since the R&D activities in business are limited, awareness of IMT, let alone their use, is also low. Most probably the reason isn't the absolute suspense of the importance of innovation management, but the fact that the today's economical situation does not consider it the top priority area for raising the effectiveness, profit, etc.

No studies have been conducted concerning the use of IMT in the enterprises. One of the reasons is again the virtual absence of the use of IMT. Therefore, the first step should be the training and providing acquaintance with the techniques. Something is being done already. Besides various private training firms (EM International, EKE Ariko, Invicta), which provide some consultations and training concerning product development, quality and technologies management (although these courses don't belong to the popular ones), the programme "Raising competence in innovation management" shall be launched from 2002 at the initiative of the Technology Agency ESTAG, with one of its components concerning the training of development managers of the enterprises: strategic planning and development and technology auditing issues (see section 1.3.).

A programme "Raising competence in innovation management" will be launched from 2002 at the initiative of the Technology Agency ESTAG

Table 25 – Main initiatives taken in favour of IMT diffusion

Organisations responsible (the initiator and management structure if different)	Objectives (e.g. awareness-raising, training in techniques, etc.)	Target public (e.g. SMEs, specific sectors, etc.)	Funding (level of funding, source: public/ private)
Technology Agency ESTAG, regional agencies, universities, enterprise organisations, innovation support structures	Raising competence in R&D and innovation management (starting 2002)	Enterprises from less developed regions, students, scientists	128,000 euros from ESTAG's 2001 budget.
Ministry of Economic Affairs in cooperation with the Estonian Export Agency and Estonian Quality Association	Estonian Quality Award pilot project 2000/2001 – the goal: to present the principles of organisational perfection model, successfully used in Europe and elsewhere in the world to the Estonian organisations and therefore support Estonia's competitiveness as a whole	Estonian enterprises and organisations.	Public funding + attendance fee

The most available information concerns quality management activities. At the request of the Ministry of Economic Affairs industrial department, the study "Quality assessment and development prospects of quality management activities in Estonia" was held in spring, 2000. The study involved a poll[22] held among the Estonian enterprises, quality infrastructure institutions and among quality experts and an assessment of the development of quality management activities in Estonia. The results of the study are used in the drafting of the national quality programme.

[22] 52 enterprises and 37 quality-related infrastructure institutions responded to the questionnaire.

It emerged as a main result that the enterprises value quality very highly. The typical attitude is that quality is the basis and a key issue of the enterprise's competitiveness, determining its survival and chances in the market. As the most important quality-related problems and obstructing factors the following were listed: absence of (quality)system (38% of respondents), the relatively high cost of certification service (31%), outdated equipment/technology (29%), low-quality raw materials (27%), lack of training (27%), low qualification of the workforce (25%), insufficient information about quality requirements (21%). Among the interviewed firms, a quality system had been created in 35% and in more than half of the cases it was based on the ISO 9000 series standards[23].

Table 26 - Innovation Management Techniques and diffusion of new technologies

Type of technique/ technology	Source of data (studies and ad hoc surveys)	Description of data
Standards	Certificates held by Estonian enterprises as of December 2000 according to Ministry of Economic Affairs data	ISO 9000 – 97 enterprises; ISO 14000 – 10 enterprises; QS 9000 – 2; EN 46000 – 1 enterprises.
Accredited institutions	Estonian Accrediting Centre data 28.11.00	Accredited: 37 testing labs, 3 calibration labs, 3 inspection bodies, 2 quality systems certification bodies, 1 personnel certification body, 5 product certification bodies.
TQM	Quality state evaluation and development prospects in quality-related activities in Estonia. Min of Econ. Aff. Study	Episodic use reported by enterprises. In 4% of cases the use of EFQM was reported. (52 enterprises were questioned).

[23] A corresponding certification and consultation firms network is relatively developed, but is mainly based on foreign capital, which partly explains the relatively high cost of the services.

The subjective general rating by the study of the state of quality promotion in Estonia is 'weak' – progress has been made in some areas, but development has bogged down in a number of spheres.. Therefore the Ministry of Economic Affairs was making preparations this year for the drafting of a quality programme within the administrative sphere of Ministry of Economic Affairs[24], with its results becoming a basis for systematic and coordinated quality promotion in Estonian business. At the same time the Estonian quality promotion centre was being planned, which would actively support the enterprises and quality infrastructure institutions with various services.

The general rating by the the state of quality promotion in Estonia is 'weak' – progress has been made in some areas, but development is bogged down in a number of spheres.

The timber sector study revealed that management problems in the enterprises are actually quite serious, but the enterprises are not yet aware of them. It is mainly the large enterprises, which face the ISO 9000 standards. Minor firms are not informed of the management standards and consider the ISO 9000 standard only a production standard. Other standards (TQM) are not used and their existence is not well known. The absence of the standards is not a problem for many timber firms as they resell their products to mediators, which declare these standards.

[24] Ministry of Economic Affairs project commissioned from the PHARE programme; January-November 2000

Section 3 - Business innovation interfaces and support measures

3.1 Research community - Industry co-operation

It was found in M. Paasi survey "Inherited and emerging absorvative capacities of the firms and growth prospects of Estonia"[25] (1996) that less than 14% of the firms in Estonia used knowledge of the universities and R&D institutions. R. Küttner, the professor at Tallinn Technical University, finds that several Business Advisory Services and new Entrepreneurship Centres, established with the help of international programmes in different places in Estonia, are concentrated onto general business type consulting and advisory services, and thus only partially fulfil the supportive role of technology transfer and innovation. They have practically no relations to the universities.

Some information about the research-industry cooperation is available about Tartu, the second biggest innovation area in Estonia. The survey "Entrepreneurship in Tartu 1998"[26] also studied the relations of the enterprises with the universities and research institutions of the university city. It emerged that more than 4/5 of the enterprises do not conduct any projects connected with research institutions and more than half do not use opportunities for consultations with researchers. The polled managers view the opportunities of the university city from the viewpoint of their firms primarily as those of recruitment of staff. The comparison of firms finding the use of Tartu's research potential significant for their enterprises showed that these were primarily more successful firms with greater development potential (greater balance volume, longer-term planning of economic indicators, higher requirements of success, plans for opening subsidiaries, more intensive relations with university staff, etc.). It was therefore concluded that more active presentation of the opportunities of the universities and research institutions could be a realistic support to the development of the city.

[25] Conducted by sociologists of Tartu University and commissioned by the Tartu municipality

One of the best examples of the regional innovation cooperation comes also from Tartu, (the region has also possibilities for that: universities, science park, industry, etc). The regular round table meetings of all parties interested in a Tartu county regional innovation support system began from the end of 1999 (usually every month). This regional innovation support development cooperation network was named CARIN and was signed by participants[27] in March 2000. The main goals of CARIN are: a) to develop and implement the Tartu county regional innovation strategy; b) to prepare and realise the participation of Tartu and South Estonia in the corresponding international programmes; c) to improve the competitiveness of the region's business and to increase the implementation of the local innovation potential for that purpose. By now the following issues have been discussed, agreed upon and/or decided: * common projects within EU Phare 2000+, Phare 2001 and corresponding technical assistance programmes; * an analysis of the existing support network in Tartu: the functions of the different parties, existing gaps, necessities and ways of further development; * a common project of development of Tartu, South and East Estonia regional innovation strategy for submitting to a corresponding EU programme; * the promotion of the region's university education system.

Table 27 - Main initiatives taken in favour of research – industry co-operation

Organisations responsible (initiator and management structure if different)	Objectives (e.g. interface structures, co-operative research programmes, spin-off schemes, etc.)	Target public (e.g. SMEs, specific sectors, etc.)	Funding (level of funding, source: public/private)
Tallinn Technical University Innovation Center	Spin-off scheme	University researchers	1/3 TT University, 1/3 innovation centre, 1/3 the company
Tartu University	Spin-off scheme	University researchers	
Technology Agency ESTAG	Spin-off programme (see section 1.3.)	University researchers	447,000 euros from 2001 budget.
Technology Agency ESTAG	"Raising competence in innovation management" – to help enterprises to hire researcher. State pays 1,5 year specialist salary to employed researcher in the firm.	Enterprises in lacking regions	128,000 euros from 2001 budget.

[27] The participants of the projects: Tartu University, Estonian Agricultural University, Tartu County Government, EVEA – Estonian Small Businesses Association, Tartu Science Park, Tartu Business Consultation Office, Chamber of Commerce and Industry, Estonian Business Development Foundation "Enterprise Estonia"'s South-Estonia Bureau and the Archimedes Foundation.

The volumes of R&D contracts of Estonia's major state universities (Tartu University, Tallinn Technical University, Tallinn Pedagogical University, Estonian Agricultural University) (even in the absence of numerical growth of contracts) have increased in the recent years, both regarding the volumes of domestic and foreign contracts. It means that they have grown in size. It was much higher during the Soviet Period when enterprises had the "soft budgetary constraints"[28], but it fell down in the beginning of the 90-ties. The greatest number of contracts have been signed with the Tallinn Technical University. In 2000, the Tallinn Technical University (without its subsidiary institutions) had signed 78 contracts with Estonian enterprises and the Innovation Fund, plus services and consultations provided. The most contracts between business enterprises and Tallinn Technical University have been concluded in the mechanical faculty (42.6% of total in 2000), followed by the construction faculty (18.8%), and various institutions of the university with 17.6%. Tartu University (TU) had 66 domestic (539,5 thousand euro) and 75 foreign contracts (1,147,2 thousand euro) in 2000. In case of TU the volume of foreign contracts has almost tripled in three years (415,4 thousand euro in 1998). Estonian Agricultural University (EAU) had 88 domestic contracts of which 66 were made with its 7 subsidiary institutions.

[28] Socialist enterprises were not interested in efficency of the firm or money saving, but bargaining for more subsidy to cover its excess expenditure. See: Janos Kornai (1992), The Socialist System. The Political Economy of Communism. Princeton University Press, New Jersey.

Table 28 - R&D incomes in universities and R&D enterprise in 2000 (thousand euro)

Type of data	Tallinn Technical University	TU	TPU (without institutes)	EAU	AS Cybernetica
Income of:	3,191,7	3,521,7	278,8	1,878,6	15,9
- **state budget funds for R&D activity**					
- **business enterprises' repayments for orders, contracts, expertise, etc.**	1,205,8	539,5	15,3[29]	555,3[30]	-
- **from government funds, agencies, (Innovation Foundation)**	338,7	432,2	-	…	-
- **Science Foundation**	822,7	1,839,6	108,8	366,2	-
- **from patents, licences and similar**	-	-	-	-	-
- **Income from sale of goods and services**	-	-	-	-	2,173,0
- **Other income**	129,6	-	-	-	-
- **Income from contracts from abroad**	939,4	1,147,2	2,7	34,5	-

To develop the transfer of high level technology, the technology competence centres have been established at Tallinn Technical University and the University of Tartu. The main areas for these centres are: material engineering, information technology, environmental technology, and biotechnology and genetics. The idea behind these centres is to build a solid and long-lasting bridge between the universities and industrial world. The extent and intensity of industrial participation in the Competence Centres is not in planned level and must be strengthen. According to an estimation by A. Kamratov, director of the Tallinn Technical University R&D department, the university practically is not providing technology transfer services. In some isolated cases it has provided consultations and support to firms introducing new technologies.

The Testing Centre has been re-established at beginning of the 1990s (a similar State Testing Centre functioned at the university before the 1940s). The main objective of the Testing Centre is an effective use of university laboratories and testing facilities.

[29] None of TPU's contracts are made with industrial sector.

[30] Includes also the finances from Innovation Foundation.

One of the significant organisations responsible for technology transfer service is the Archimedes Foundation with its **ESTIRC** project. **Estonian Innovation Relay Centre**[31] objectives are: a) promoting and facilitating technology inflow from other EU/EFTA and CEEC countries to the Estonian companies; b) facilitating technology potential originating from research community and SMEs in Estonia; c) increasing the technological capacity of local SMEs to absorb new technologies; d) supporting the exploitation of research results; e) supporting local innovation system structure and integrating it with the EU-level initiatives.[32]

The role of foreign investments in technology transfer has been studied by K. Männik (Ministry of Economic Affairs, Innovation Division) in his master's paper (2001), where he concluded as a result of analysis that the probability of emergence of technology transfer effects in Estonia's manufacturing industry is more likely in the branches where the share of foreign ownership is greater as compared to the other branches of industry. Since the backwardness of the local enterprises as compared to those with foreign ownership was greater in the high-technology branches in the beginning of the period 1996-1998, but the faster development has taken place in the high technology sector as compared to low technology branches, it can be concluded that direct foreign investments have influenced the emergence of direct technology transfer effects in Estonia's manufacturing industry.

A significant means for the tranbsfer of skills and technologies to industry are the spin-off firms grown out of research institutions. According to the estimate of the A. Kamratov there are approximately 50-70 spin-off firms at Tallinn Technical University (Tallinn Technical University) and its institutes. But nobody has studied them and therefore there is no concrete review of their activities. Tallinn Technical University started to develop "University spin-off Program" in March 1999. Tallinn Technical University Innovation Centre (TUIC) was considered to be an instrument to support this programme. Eleven enterprises have joined the TUIC spin-off programme. The programme is intended to offer assisstance for establishing technology-based enterprises. For each proposal, the proposed idea, business plan and market possibilities are to be evaluated. For potential entrepreneurs a training and consulting

[31] ESTIRC belongs to the network of Innovation Relay Centres and is financed by the European Commission.

[32] Partners in the project are Estonian Technology Agency ESTAG, Foundation Tartu Science Park and Tallinn Technical University Innovation Centre Foundation.

programme is proposed, focused on the development of a business plan, new venture management, economic issues, marketing, law, licensing, etc. The programme also involves the specialists of the Finnish technology centre INNOPOL, who are mentors for the resarchers participating in the programme in the drafting of business plans.

The Tallinn Technical University has reached an understanding by now that they must themselves gather more information about the firms operating at the university. The university is currently developing a set of rules about the relations of the university and spin-off firms (incl. the use of University rooms, infrastructure, intellectual property etc.). It is planned to be completed this year so that the supplement to the 2001 annual report could list the spin-off firms operating at the university. This could reveal the actual R&D potential of the university.

The number of (known) spin-off firms at the Tartu University (TU) is smaller, e.g. during the 1998 five spin-off companies started their activities under the technology licences of the TU. The University spin-off programme was launched in 1999, joining 11 firms and technological projects. The spin-off programme operated in two spheres: a) the training of spin-off firms and technological project managers, which provided primary knowledge of economy and law, project and business management, marketing and intellectual property etc.; b) consulting and support of spin-off firms in the drafting and realisation of business plans, in the development of management and marketing strategies.
Tartu University concentrates mainly on the following strategic activities in supporting more efficient implementation of the TU research achievements.:

- Spin-off programme – training and consultancy services for scientist/researchers
- Promotion and commercialization research results to the Estonian entrepreneurs
- Development of innovation support services.

The main services of the TU Innovation service are: * the drafting of technological projects, project management; * market research, financial plans, feasibility analysis, marketing; * determination of technical level – patent research in the Internet; * license agreements, negotiations; * intellectual property – patents, trade marks, copyright.

From July 2001 Estonian Technology Agency ESTAG (TA) starts coordination of supporting the university spin-offs by identifying the new ideas in the universities and helping to realise them mainly in two ways: a) formation of new spin-off firms on the bases of researchers' ideas, where this researchers are the owners and managers are

employed; b) licensing the researchers' ideas and selling them to other firms.
One of the financing priorities of the TA is also the cooperation projects between research institutions and business sector. The main method is to support projects, which involve as parties the research institutions and business enterprises and the research institutions are represented by the spin-off, (which may be created for that particular project).

In order to promote fresh research potential coming from the universities and new ideas, the Tartu Science Park Foundation, Ericsson Eesti AS and AS Regio[33] announced on April 2, 2001, the students-oriented "Competition of business ideas and plans for the use of new opportunities of cellular communications." It is not just good ideas expected to be submitted to the business plans competition, but the forming of an efficient group for the realisation of the idea. The formed teams will receive advice via the Internet web page of the contest by IT and teamwork specialists, while workshops conducted by Regio and Ericsson specialists will point out drawbacks in the ideas. The main award of the competition has been provided by Ericsson Eesti and this is a contact trip to the Kista science park in Stockholm.

3.2 Support for start-ups and new technology based firms

Average new business creation rate is 17.6% of all firms in Estonia. The average rate of formation of new firms in IT sector was 21% in 1998-99 (Kukk Grönbjerg, 2000). According to Mr. J. Oruaas (Director of Estonian Infotechnology Association) about 50 new firms start every year in the IT sector, but the whole sum of enterprises remains same. It means that several firms unite with each other, are bought by bigger corporations or just finish their activities. The consolidation is also a trend in other sectors.

The liberal economic policy of Estonia does not include direct support to SMEs or NTBFs among its priorities. Estonian small and medium industrial firms practically have no venture capital in the Estonian finance market. Commercial banks have preferred the financing of the services sector due to its higher profitability and lower risks.

[33] AS Regio is recently registrated as R&D institution, which operates in three main spheres – cartography, production of geographical information and the development of information systems. The firm is also providing GIS-related training and consultation services. It is further the Estonian dealer of software of three major GIS-programs – Mapinfo, Bentley, Intergraph since summer 1998. It is also a partner of Oracle.

As recently as in 1999 seed and venture capital were generally not available for long-term, technology based projects. The existing venture capital offers tended to be directed towards projects with relatively low risk. Self-investments by Estonian enterprises into R&D is quite rare yet (Tammkivi, 2000).

As said before (section 1.2.) the amount of venture capital moving through the private sector is considered to be about 9,6–12,8 million euros. Responses from Estonian financial enterprises (three firms) showed also that venture capital services are not applied to pure R&D projects. Financing is extended to, e.g., timber industry or "new economy" (projects positioned to exploit and capitalise the spreading of the Internet and new technologies) projects, which have great potential for rapid growth. Early stage financing of projects with clear business output, where a considerable part of the initial investment would be effectively used by R&D could be considered. In such cases it is wished to see a clear path to the product or service and the risk is attempted to be shared with the other parties. In such situation, too, it is preferred to be a creditor rather than an investor.

According to Mr. K. Hallik from KredEx (Export Crediting and Guaranteeing Fund), the problem is not just the absence of money. If good projects were submitted, finances could be found, but the applicants' interests are in most cases not connected with the development and production of new products. (see appendix B).

The Technology Agency ESTAG in cooperation with the Estonian Ministry of Economy department of innovation has developed principles for the establishment of a state venture capital fund. The goals of the fund and the financing principles have been drafted by now and wait for the government's decision. Therefore the state venture capital fund will certainly not begin operating before 2002.

The Tartu Science Park (see section 3.3.) and AS Cybernetica in Tallinn are the examples of successful environments for incubation of technology-based SME-s.

In 2000 the *Stardiabifond* (Start-up fund) was founded on the EU Phare pilot project frames. The implementing body is Foundation Tartu Science Park. Stardiabifond is of the fixed date fund (ended for now) for supporting the start-up small firms in Eastern Viru, Tartu, Põlva, Valga and Võru Counties. The maximum sum which could be applied for was 6,390 euros.

Estonia's first and, for a long time, the only private R&D institution is AS Cybernetica. More than 70 small firms have gathered around it,

most of them active in information technology. Some firms perform subcontract work for AS Cybernetica itself, others cooperate between themselves, etc. AS Cybernetica provides the firms operating at it with space, proper communications and an opportunity for holding conferences and seminars. It therefore has several features typical of a technology park. Nevertheless it does not operate as a classical incubation centre – the favourable environment has just provided fertile ground for the emergence of new firms. According to Ü. Jaaksoo, board chairman of AS Cybernetica, there is actually a line of applicants for space.

Table 29 - Main initiatives taken in favour of start-ups

Organisations responsible (initiator and management structure if different)	Objectives (e.g. venture capital funds, management support schemes, incubators.	Target public (e.g. type of SMEs, specific sectors, etc.)	Funding (level of funding, source: public/private)
Tartu Science Park Foundation	Start-up fond (preferably for producing or servicing start-ups)	Private firm or entrepreneur (starting or acted less than 2 year) in Tartu, East-Viru, Põlva, Valga, Võru regions can apply for 3,200 euro support, (some cases even 6,400 euro).	EU Phare, about 120,000 euro
Tartu Science Park Foundation	Incubation Centre	New technology based firms	Cost about 400,000 euro (EU, Estonian state, Tartu Science Park)
Jõhvi Business Incubation Centre (started January 2001)	Incubation Centre (ca 600 m2)	For start-up businesses and SMEs in Ida-Virumaa (former soviet industrial region)	Created within an EU pilot project. Further financing from Estonian Business Development Foundation "Enterprise Estonia" and the Jõhvi city government.

Major universities have their centres taking care for the commercialisation of the researchers' work. At the Technical University there is the Technical University Innovation Centre. Tartu University has developed its Innovation Office as a consultancy service for meeting researchers need in new society (see section 3.1.). In order to promote the commercialisation of the researchers' ideas the TU has been awarding the Innovation Award since 1997.

3.3 Business networks for innovation

Availability of pools of factors, such as forest and woodwork traditions, has over several centuries contributed to the formation of Estonian wood processing cluster. Estonia's trade location is the cause for a vital transportation cluster. M. Kukk Grönbjerg (2000) finds that attention should be paid to three areas in the further development of the emerged cluster: a) intensity of local competition; b) location's overall environment for new business formation; c) efficacy of formal and informal mechanisms for bringing cluster participants together. She finds the first two areas as satisfactory in Estonia whereas the cooperation mechanisms are far too few and weak.

There are four national main business organisations in Estonia: 1) Estonian Chamber of Commerce and Industry represents the interests of entrepreneurs in the issues of shaping of economic policy, legislation and stable business climate; 2) Estonian Confederation of Employers and Industry ETTK represents the interests of the entrepreneurs[34] in the tripartite negotiations with the government and the employees' federations; 3) Estonian Big Enterprises Association has the goals of creating an advantageous background for foreign economic relations and the development of a favourable business environment in Estonia; 4) Small- and Medium-sized Enterprises Association EVEA provide to its members favourable consulting, marketing and other services and protects their interests in the Estonian legislation. Beside these there are several sectoral organisations. But the development of innovation is not generally among these organisations' priorities. But some increase of interest and cooperation with innovation support structures can be observed (e.g. Chamber of Commerce and Industry and EVEA are involved in regional innovation cooperation network CARIN in Tartu county).

Responses from the sectoral associations[35] show that cooperation between firms is quite different in different sectors, from a near absence of any cooperation (except for trade) to very extensive. The main form of cooperation is subcontract work. Common supply and marketing also happens quite frequently. Cooperation in R&D is very rare. Mainly there are common courses, seminars and conferences aiming at obtaining and sharing know-how. There have been some

[34] ETTK represents 32 branch organisations who join more than 1300 companies and 33 single large enterprises who employ 35 % of private sector employees of Estonia.

[35] Estonian Confederation of Sewing and Textile Industry, Estonian Association of Information Technology, Estonian Association of Printing Industry, Estonian Dairies Federation, The Federation of Estonian Chemical Industry

experimental common marker studies. Common R&D will probably happen in the future.

The more active enterprises in Estonia are certainly the information and telecommunication firms (see also section 2.1. about the cooperation agreement for developing Estonian human resource in IT usage). We could consider the whole IT sector in Estonia as one cluster. And 90% of this sector is in Tallinn area. But the Estonia's IT cluster is very fluid and even defining cluster participants is by far not clear. Characteristic to the IT sector is combination of several different competence areas even by small firms. IT sector illustrates the dramatic effect "cluster creation hot-beds", such as research institutes and science parks, have on sector development. From 183 firms in Tallinn 25% are located in Mustamäe region and of these 43% are virtually on the same address that happens to be the location of Tallinn Institute of Cybernetics and very close to the Tallinn Technical University. There is also notable concentration on other addresses that are either close to client bases or innovation centres (Kukk Grönbjerg, 2000).

All the innovation centres in Estonia have close contacts with each other, but unfortunately no close ties with production associations. According to Tammkivi's estimate (Sept. 2000) the various innovation and technology transfer support facilities in Estonia (science/technology parks, innovation and incubation centres, universities development units) have been created for a variety of motives (mainly at the initiative of the universities or local governments) and have developed in a rather unstable environment. But the ties between enterprises and research institutions can work best through science and technology parks, innovation and incubation centres. Since the environments are totally different, it is often problematic to find a common language and it is more practical to use mediators.

In order to help to make connections between business and science/research and also business to business there is an intention to establish some technology parks. The only technology park – Tartu Science Park – in Estonia was founded in October 1992. In the beginning of January 2001 the Tartu Science Park opened a 6 million kroon incubation centre[36], which supports the entry of young research firms to the Estonian and foreign markets. A total of 25 firms are operating in the Tartu Science Park building, to which the incubation centre provides free consultation and training service for 1-3 years together with the use of telephones, faxes, computers and

[36] The building of the incubation centre 6 million kroon infrastructure was equally financed by the EU, the Estonian state, Tartu Science Park and incubation firm AS Clifton.

copiers. The leasing cost of space is also held as low as possible. The science park holds a public tender every year for the rooms vacated due to rotation, offering space for one or two companies. The science park has a total of 4,500 square metres of space, 1,500 of that was included with the founding of the incubation centre.

Among the EU special programme ES9803.04 for the use of structural funds, pilot project No.2 : « Creating of regional cooperation network for development of innovative business »[37] finances to Eastern Virumaa – considered the Estonian stagnated industrial region – is the sum appointed for the preparations of industrial and technologic park creation, which is also coordinated by Tartu Science Park. As a result of that the Eastern-Viru Innovation Centre was opened in November 1999 with 4 membered team. In January 2001 started its activities Jõhvi Business Incubation Centre (ca 600 m2).

The same EU pilot project also foresaw the preparations for the opening of incubators in three South-East Estonian counties. By the beginning of 2001 the Räpina Business Support Centre Foundation was registered, which operates as a sort of «pre-incubator». The centre has 85m² spece with computerised workplaces, beginning enprepreneurs are offered a training class, accounting and business consulting services. The other two incubatsion centres will be based in Otepää and Võru, but are still in the initial stage.

The establishment of technology park to Tallinn or its nearer surrounding has been the theme from the beginning of the 90-s. most preferred area for execution of this idea is considered Tallinn suburb Mustamäe, where situates Tallinn Technical University and several other science institutions : former institutes of Academy of Sciences. Also the natural surroundings of the quarter are suitable and there is good connection to the Tallinn international airport. Until today the attempts to establish the technology park have failed. The first attempt in the beginning of the 90s ended with the repairing of the former Soviet Union half-military research building and renting it to the Estonian SME-s. But it never became the technical innovation centre. On the second half of the 90s a kind of spontaneous tech.-park was formed on the territory of the two former institutes of Academy of Sciences (Institute of Cybernetics and Institute of Chemical and Biological Physics) : several spin-offs (on the field of applied research and technological development) from these research institutes became viable. As the institutes were closely related to the technical university (located in the neighbourhood), this development

[37] Two years project 1999-2001 was coordinated by Estonian Ministry of Economic Affairs. Project costs – 1,1 million euros : 748 thousand euros from EU Phare , 275 thousand euros from Estonian state budget, 77 thousand euros from Estonian private sector.

could be considered rather promising. But the clear functions of the technology park did not take shape. In the beginning of 2000 Tallinn Technical University start the initiative to establish the park. The spatial planning and business plan of the park have been completed and gained support of the Ministry of Economy. The business plan foresees that the state and the city will contribute territory, some buildings and a certain amount of money (1,3-1,9 million euro) in the founding of the technology park. But the realization of this idea is still open.

Table 30 – Domestic business and innovation networks

Science parks, innovation centres, etc.	Source of data: associations, studies, ad hoc surveys	Description
Tartu Science Park Foundation	Director Enn Erme www.park.tartu.ee	4,500 m2 for start-up firms for 1-3 years + communication and office equipment + consultancy, etc. There are about … firms in the territory plus several associated members. Close contacts with Estonian, Baltic, Finnish and other innovation centres and science parks.
Tallinn Technical University Innovation Centre Foundation	Director Raivo Tammkivi www.tuic.ee	Organizes the founding of the incubation centre and technology park in Tallinn. Realizes the spin-off program for TALLINN TECHNICAL UNIVERSITY scientist (11 firms) + consults the 15 associated member scientist regularly. Promotes the TALLINN TECHNICAL UNIVERSITY R&D projects in Estonia and outside.
Archimedes Foundation	www.euedu.ee	Coordinator of EU (cooperation) programmes in Estonia. Representative of the 5th framework program, FEMIRC, etc.
Tartu University R&D department **Tallinn Technical University R&D department** **Estonian Agricultural University R&D department**	www.ut.ee/ta/ Department's director – Mr. Ardo Kamratov Department's director -	Coordination of the university's science policy, coordinating and developing it. Analysing and planning of the R&D activities. Organizing the closer contacts with business organisations, other universities, international organisations. Forming and directing the university's large development projects.
Tartu University Technology centre	Director – Mr. Mati Karelson	Commercialisation of research activity. Staff of ~40, most engaged primarily in development work. Financing mainly state target financing. Framework agreement with AS Silmet Grupp: cooperation in rare metals.
Ida-Virumaa Innovation Centre	Mr. E.Erme – Director of Tartu Science Park Foundation	As a Tartu Science Park project to activate the new businesses in the old industrial region. Four members team started the activities in November 1999.

Tallinn Technical University Development Centre EAK		Being liquidated, hopefully soon reorganised as the Mustamäe Technology Park.
AS Cybernetica	Board chairman - Mr. Ülo Jaaksoo	AS provides space for over 70 enterprises, mostly IT firms. AS provides rooms, communication, conference halls etc. Several firms are subcontractors on AS. This is not a science park.

Cooperation with foreign countries in case of the Estonian firms is also rather based on subcontract relations. Any R&D together with technology has been imported by the parent firms or cooperation partners and in most cases no development work is conducted locally. At the same time the initial results of the Estonian organisations' participation in the EU 5th framework programme refer to successful participation. Nevertheless, Estonia's participation as to various programmes differs widely. The small participation of enterprises, primarily SMEs, is evident.

Estonian Technology Agency ESTAG has objective to involve more foreign research and business organisations into the cooperation projects with Estonian researchers. ESTAG has launched two projects to stimulate the international cooperation:

- ESTAG net-cooperation project. The project forsees the identification of existing business cooperation networks and by using ESTAG's incentives develop the technological cooperation there.
- ESTAG partner search project. Projects object is to find the additional partners to EUREKA projects, which need the additional partners.

Table 31 - Access and participation in foreign innovation networks

Type of network	Source of data	Description
IRC Estonia	ESTIRC, Mr. Marek Tiits www.irc.ee	Has several new cooperation projects (table 3.6.) to promote the EU innovation actions and possibilities. Does also some seminars and lectures on these issues.
EU V Framework	1999 annual report	Participation in programme: 324 projects were submitted, 26% were successful. 2 projects were in the "Innovation & SMEs" sub-programme. Estonia's participation fee in 1999 was 0.7 million EURO and via the successful projects approx. 5 million EURO were directed to Estonia.
Network of Organisations for the Promotion of Energy Technology, OPET Estonia	www.irc.ee/opet.htm	One of the more successful one of 39 OPET-centres is in Estonia. Closer cooperation is conducted with Finland, Denmark, Poland, Latvian and Lithuanian centres. (For examples in areas like: bioenergy, timber energetic use chain, energy audits, etc.)
European Cooperation in the field of Scientific and Technical Research, COST		Estonia is one of the 32 memberstates.
EUREKA	www.estag.ee	Estonia has participated in 3 EUREKA projects, but right now is not involved in any.

According to M. Tiits (EU Innovation Centre in Estonia) the interest of business organisations in the EU R&D activities has been modest so far. There have also been problems with the inability to draft projects correctly. The situation here should improve as a result of the ESTINFONET and other projects. The project ESTINFONET (01.03.2001-28.02.2002) has been launched, with its activities involving a) the development of a contact information network of Estonian universities and business support organisations for more efficient distribution of information about the framework programmes; b) the conducting of two trainings (1. for the universities' R&D departments, 2. for business support organisations) on 5th framework programmes and project drafting; c) the expansion of the EU Innovation Relay Centre information booklet, the creation of thematic mailing-lists, the publication of booklets on the 5th framework programme and EU R&D activity. The Estonian EU Innovation Relay Centre is also a partner for a number of other ongoing projects financed via the 5th framework programme. Such as INBANKSS[38], PROGRESS[39], WOMENCRAFT[40]. All are meant to raise the participation in international cooperation for innovation.

[38] The goal of the project is to promote the participation of SMEs providing services to the financial sector in the EU 5th framework programme. The development of virtual banking has opened several new opportunities for SMEs and the project has been founded for their better realisation. One of the sub-goals of the project is the channelling of cooperation between units operating in different sectors – participants are research centres, technology providers, various market agents, SMEs and institutional organisations.

[39] The goal is an analysis of success and failure of participation in the 5th framework programme, enhancement of awareness, improvement of knowledge, expertise and skills for successful participation in the framework programmes. A three-day seminar is held for that purpose and a conference report is published, presenting the reports and projects.

[40] The goal is to increase the quantity and quality of SMEs owned or managed by women in the EU development programmes. A contact data base on SMEs owned/managed by women is compiled, their participation in the EU R&D is studies and information is spread about participation opportunities, as well as consultation about submitting project applications is provided.

Some conclusions

Estonia's liberal economic policy, rapid reforms and successful privatisation have been a favourable ground for the relatively successful economic development. At the same time the support to research and development activities and the implementation of Estonia's own research potential and educated labour in the development of the economy and social life of the country have been underestimated. Expenses on R&D have been small (less than 0.8% from the GDP), the number of ISO certificates and patents as well, the education system does not meet the requirements of the labour market, etc. Various innovation and business support structures have emerged and developed on their own, without proper cooperation with each other.

In order to develop R&D policy in the state, proper information on the R&D situation in Estonia would be necessary, but such data do not exist. The National Statistical office has been gathering data only on the R&D activities in the research institutions and government institutions and has been recording the enterprises' expenditures only since 1998. A study based on internationally recognised indicators will be held at the call of Estonian Technology Agency ESTAG ESTAG in 2001 by the National Statistical Office and its results will enable to rate the R&D situation only in April 2002.

According to the currently available information, Estonia's R&D indicators (expenditures, patents, etc.) are not very good as compared to the EU countries and even the other Central and Eastern European countries. It would be incorrect to claim that the legislation obstructs R&D activities, but there are relatively few supportive mechanisms. There are no separate laws supporting SMEs, start-up businesses, NTBFs or other sectorally preferred undertakings. Since Estonia's enterprises are usually small and lack opportunities to invest in development from their own assets, the granting of supports and loans is also limited by the small amount of equity. The main organisation granting loans and support to innovative projects has been the Innovation Foundation (reorganised as ESTAG) until 2000, but its opportunities have been limited (due to the limitations of the state funds). Now the main financing bodies are ESTAG and KredEx. As of now several enterprises offering investment services are operating in Estonia, but they offer a very limited amount of venture capital. **The system of financing the various levels of innovation is faulty. In particular, the development of a system of start-up supportive measures would be necessary.** A positive sign is provided by the spin-off programmes launched at the major universities in the recent years and by ESTAG in 2001.

The problem is not only limited to financing – awareness of and willingness for innovation are also low. There are few people with engineer's education, who could create new products and from the other side where are very few entrepreneurs with initiator's and managerial skills to put the engineers' work into practice. This also reveals the weak link in Estonia's education system – the humanities education is dominating and there is a lack of technical education. **The lack of engineers** and in a broader sense the absence of active researchers' communities are considered **one of the greatest weakness of Estonia's innovation system.** The other is that **skills and knowledge are also rather limited in technology management and the promotion and sale of new products/services internationally**. In order to promote awareness, ESTAG launched in 2001 the programme "Inno-awareness", which could be expected to have a positive effect on the increase of the enterprises' R&D activity.

A relict of the Soviet period is the indifferent attitude towards the protection of intellectual property rights, which is one of the reasons (together with the high cost of international patents) of the small number of patents in Estonia. Training programmes should also be launched in that area.

Several changes have taken place among the innovation support structures in the years 2000-2001. The state business support organisations were reorganised into one large foundation "Enterprise Estonia", the government's R&D advisory council is also undergoing reorganisation. Several local innovation centres and a couple of incubation centres (mostly as the result of the Tartu Science Park's activity) have emerged. It is hoped that the Tallinn technology park activity will also be launched in the coming years. Therefore **a lot of efforts has been made in the creation/improvement of support structures in the recent years**, but naturally **they will need further reinforcement and organisation, to operate as an integrated whole in the supporting of the enterprises.**.

As a positive note in Estonia's innovation policy can be considered the fact that the attention paid to R&D has significantly increased in the recent 2-3 years, but all the programmes of activity of that sphere have just been launched (or are being launched) and it is impossible to rate their impact of Estonia's business and the development of economy.

References

Appendix A

Table 1 - Volumes of export

	1998		1999		Growth
	million kroons	share in %	million kroons	Share in %	%
Manufacture of machinery and equipment	8 309	23.6	8 462	24.7	1.8
Wood (incl. furniture) and paper industry	5 663	16.1	6 122	17.8	8.1
Textile and clothing industry	5 051	14.3	4 891	14.2	-3.2
Miscellaneous manufactured articles	2 360	6.7	2 732	7.9	15.8
Manufacturing of metal product	2 739	7.8	2 593	7.5	-5.3
Manufacture of chemicals and chemical products	1 748	5.0	1 390	4.0	-20.5
Production of meet and meet products	1 745	5.0	1 390	4.0	-22.2
Manufacture of transport equipment	1 203	3.4	1 030	3.0	-14.4
Manufacturing of food products	1 358	3.9	969	2.8	-28.7
Manufacture of mineral products	969	2.8	869	2.5	-10.4

Table 2 - Manufacturing industry output 1995–1999, billion kroons and % (previous year = 100)

	Manuf. ind output, 1995, billion kroons	1995	1996	1997	1998	1999 (estimate)
Manufacturing industry	21.4	102.9	102.2	116.9	102.9	103
Food	7.5	96.7	91.8	118.6	93.9	100
Light	2.7	117.0	119.5	112.4	101.8	104
Forest	3.2	121.4	126.7	128.2	116.9	110
Chemical	2.4	108.2	101.7	101.9	86.7	96
Construction materials	1.0	91.0	97.2	133.6	117.9	105
Machine and apparatus	3.3	99.8	104.6	117.1	122.1	107

Source: ESA current data based on monthly sales of products

Table 3 - R&D expenditures by kind of R&D activity, 1992–1998, thousand EKK

	Total expenditures	Basic Research	%	Applied Research	%	Experimental Development	%
1992	100 122	79 508	79.4	18 796	18.8	1 818	1.8
1993	130 155	80 343	61.7	38 705	29.8	11 107	8.5
1994	216 460	121 281	56.0	78 917	36.5	16 262	7.5
1995	250 604	132 014	52.7	89 042	35.5	29 548	11.8
1996	299 656	168 553	56.3	90 556	30.2	40 547	13.5
1997	379 741	188 144	49.5	141 272	37.2	50 325	13.3
1998	375 734	180 398	48.0	147 463	39.2	47 873	12.8

Source: Statistical Office of Estonia: Science 1998

Table 4 - State R&D financing by activity fields in Estonia in 1998, % of state financing

	Grants	Direct financing	Total
Health care and medicine	17	12	14
Social sciences	10	9	9
Agricultural production, -technology and –sciences	11	11	11
Industrial production, -technology and –sciences	17	22	20
Natural sciences (incl. Physics, mathematics)	35	37	36
Humanitarian sciences	10	9	10
Defence	-	-	-

Data from Ministry of Education and Science Foundation

Table 5 - R&D financing through the Innovation Foundation (thousand kroons)

Year	Received money		No of financed projects		Paid to projects		
	State budget	*Received loans*	*Total*	*New of them*	*Grants*	*Loans*	*Total*
1996	9000	8933	32	28	4093	10300	14393
1997	20000	10358	51	43	15674	4769	20443
1998	30000	11208	60	53	28024	17742	45766
1999	27641	12169	62	42	27399	17428	44827
Total	**86641**	**42668**	**205**	**166**	**75190**	**50239**	**125429**

Data from the Innovation Foundation.

Table 6 - Intramural research and development expenditures of institutions, 1996-1999

Year	Government sector	Higher education sector	Private non-profit sector	Business enterprise sector	Total
Expenditures, million kroons					
1996	192,6	103,3	2,0	…	…
1997	139,6	220,2	1,9	…	…
1998	107,4	252,7	2,0	88,8	450,9
1999	141,6	291,7	2,5	…	…
financed by government funds, %					
1996	69	75	9	…	…
1997	55	75	58	…	…
1998	71	77	36	7	62
1999	77	80	31	…	…

Statistical Yearbook of Estonia 2000, Statistical Office of Estonia

Table 7 - Research and development expenditures in enterprises by sources of funds and by number of employees, 1998, 1999

Enterprise's number of employees	Research and development expenditures, thousand euros				Sources of funds, %							
	intramural		extramural		Government funds		Enterprises' funds		Higher education sector's funds		Foreign funds	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
0-19	497	2,477	2,368	300	2	32	29	42	-	-	69	27
20-49	605	797	73	309	19	21	80	77	-	-	1	2
50-199	1,841	2,519	1,357	1,058	13	24	76	73	6	0.6	5	2
>199	2,730	2,965	5,815	2,531	-	0.5	87	99	-	-	13	-
Total	5,673	8,759	9,613	4,198	4	15	74	78	1	0.3	21	7

Statistical Yearbook of Estonia 2000, Estonian Statistics 2/01, Statistical Office of Estonia

Table 8 - Intramural research and development expenditures by type and by economic activity, 1998, 1999 (percentages)

Economic activity	Basic research		Applied research		Experimental development					
					Product, material, service		Technological process or system		other	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Agriculture, hunting, forestry, mining	-	-	1	-	1	76	-	-	98	24
Manufacture of food products and beverages	-	-	10	22	61	40	21	36	8	2
Manufacture of textiles	-	-	-	6	75	69	25	25	-	-
Manuf. of wood and wood products	-	6	2	8	95	24	3	38	-	24
Manuf. of chemicals and chemical products	-	-	-	2	51	56	25	35	24	7
Manuf. of rubber and plastic products	…	1	…	24	…	45	…	30	…	-
Manuf. of other nonmetallic mineral products	…	9	…	17	…	36	…	38	…	-
Manuf. of metal and metal products	-	-	-	4	100	92	-	4	-	-
Manuf. of machinery and equipment not classified elsewhere	…	-	…	20	…	50	…	27	…	3
Manuf. of electrical and optical instruments	-	-	3	1	57	83	32	7	8	9
Manuf. of transport equipment	-	-	3	5	4	70	1	25	92	-
Manuf. of furniture; other manuf. not elsewhere classified	-	-	10	-	66	75	24	25	-	-
Electricity, gas and water supply	…	-	…	60	…	25	…	15	…	-
Construction	…	-	…	15	…	78	…	7	…	-
Transport, storage, communication	2	-	-	3	89	55	9	42	-	-
Computer services	-	-	40	30	2	10	58	60	-	-

Research and development	1	3	38	32	13	2	7	60	41	3
Other business activities	-	-	100	59	-	9	-	30	-	2
Education	14	…	86	…	-	…	-	…	-	…
Other economic activity	-	4	35	52	10	10	24	19	31	15
Total		0		24		41		33		2

Statistical Yearbook of Estonia 2000, Estonian Statistics 2/01, Statistical Office of Estonia

Table 9 - The number of students in master's and doctoral courses in 1999

	Master's courses			**Doctoral courses**		
	Enrolment	Admittance	Graduates	Enrolment	Admittance	Graduates
Teacher training	377	191	70	23	9	-
Fine and applied arts	179	49	17	8	1	-
Humanities	322	99	46	121	35	5
Religion and theology	37	17	15	13	3	-
Social and behavioural science	390	198	39	75	21	3
Commercial and business administration	928	338	153	56	30	2
Law and jurisprudence	81	50	7	15	4	-
Natural science	224	83	39	221	51	24
Mathematics and computer science	115	57	14	47	14	6
Medicine and public health	136	112	164	457	149	78
Engineering	346	155	63	135	41	9
Architecture and town-planning	19	3	2	-	-	-
Agriculture, forestry and fishery	147	53	19	52	22	7
Domestic science	2	1	1	-	-	-
Mass communication and documentation	47	10	9	11	1	1
Other	97	46	14	17	5	-
TOTAL	**3 447**	**1 462**	**672**	**1 251**	**386**	**135**

Note: enrolment, admittance, graduates — 1999

Source: Statistical Office of Estonia: Statistical Yearbook of Estonia 2000

Table – Strategy for financing Science and Development during 1998-2004[41]

Indicator	1998	1999	2000	2001	2002	2003	2004
Total expenditures for science and development, mln euro	28,8	36,6	42,8	47,3	78,5	100,3	125,8
Total expenditures for science and development, % of GDP	0,61	0,76	0,79	**0,80**	**1,20**	**1,40**	**1,60**
Public sector's share in total expenditures for science and development, (mln euro)	23,0	27,7	30,0	**35,5**	**62,8**	**80,3**	**94,3**
Public sector's share in total expenditures for science and development, %	80	76	70	**75**	**80**	**80**	**75**
Public sector's share in total expenditures for science and development, % of GDP	0,49	0,57	0,57	0,60	0,96	1,12	1,20
Government's share in financing science and development, mln euro	19,7	22,9	23,4	25,9	56,9	66,7	78,9
- for science	17,8	21,2	21,0	20,0	37,7	41,5	47,8
- for development	1,9	1,8	2,4	5,9	19,2	25,0	31,1
Government's share in financing science and development, % of GDP	0,42	0,48	0,43	0,44	0,87	0,93	1,0
- for science	0,38	0,44	0,39	0,34	0,58	0,58	0,61
- for development	0,04	0,04	0,04	0,10	0,29	0,35	0,40
Government's share in financing science and development, % of the budget	2,05	1,99	1,28	1,36	2,80	3,04	3,32
- for science	1,85	1,84	1,15	1,05	1,85	1,90	2,01
- for development	0,20	0,16	0,13	0,31	0,94	1,15	1,31

[41] As to the years 2002-2004 these are the planned numbers for science and development according to the strategy's objectives; government's 2001 finances for development include also the resources from the privatisation in addition to the budget; state budget and GDP absolute volumes are based on the March 2001 prognosis of the Estonian Ministery of Finance.

Appendix B

Estonian Roundtable discussion: "Innovation in Estonia"

May 9, 2001, time: 15.00-17.00
34 Lai street, Tallinn

Organised by Erik Terk and Silja Kurik, Estonian Institute for Futures Studies

Participants:

1. Alar Kolk – General Director, Estonian Technology Agency ESTAG
2. Ardo Kamratov – Head of Tallinn Technical University Office for Research and Development
3. Boris Tamm –The Head of Estonian Academy of Sciences; Professor in Tallinn Technical University; Foreign Member of the Finnish Academy of Technology, Foreign Member of the Royal Swedish Academy of Engineering Sciences
4. Enn Erme – Director, Tartu Science Park Foundation
5. Jaan Jagomägi – Regio AS. Rapidly developing firm, lately registered as R&D enterprise.
6. Jüri Käosaar – Director, Käosaar & Co Patent Bureau. Deals with patents, utility models, industrial designs, trademarks.
7. Kalmar Hallik – KredEx. A Foundation of Export Credits and Guarantees.
8. Katrin Männik – Ministry of Economic Affairs, Technology and Innovation Division
9. Krista Loogma – Estonian Institute for Future Studies
10. Mehis Pilv – Member of the supervisory board, AS Silmet Group. The firm produces the rare earth metals.
11. R. Ruubel – Tallinn Technical University Innovation Centre
12. Raivo Vilu – Professor, Basic and Applied Chemistry Institute, Tallinn Technical University. Also involved in several spin-off firms.
13. Riho Sõber – Director of Production, Saku Brewery
14. Toomas Peek – Chairman of cellular phone operator Levicom
15. Toomas Rang – Professor, Director of Institute of Electronics, Tallinn Technical University
16. Ülle Must – SA Archimedes
17. Ülo Jaaksoo – Head of the Board, Cybernetica AS. AS Cybernetica is the first private R&D institute in Estonia.

The round table meeting was based on two parts. It opened with a comparative review by Erik Terk about Estonia's place to the background of other countries based on Slavo Radosevic's materials (the participants had been provided with ADE abbreviated synthesis reports). This was followed by a discussion.[42]

[42] Discussion was recorded.

The following main problems were raised:

- The enterprises do not invest in innovation because of lack of money?
- The patents unattractiveness to the Estonians.
- There is a need for engineers and their (and others') sustainable communities.
- There is a need for training in innovation management.

We here provide the opinions of the participants about the above items:

(*Tamm*) There are 41% of people with university education in Estonia. All this is humanities. When establishing an institution you may find 100 directors and a single engineer. But the engineers are the foundation of innovation. All the other matters derive from this – the low level of ISO certificates, the very small number of patents, etc.

(*Jaaksoo*) The question is – why is the R&D financing low? Is the level of science so low that there is nothing to finance or are the enterprises interested of something else;

(*Loogma*) The study of the timber sector showed that the enterprises are in the building stage, they direct their finances into new technologies and there are no resources left to invest in development.

(*Peek*) The Estonian enterprises are not as strong as to do anything in the telecom sphere. Development in that sphere takes place in the large firms of the world and their syndicates, which are able to invest hundreds of millions in it. I think that in the situation where the Estonian state has ignored development, the enterprises lack resources and the schools of researchers, who could advance such development, have disappeared as well, the talented engineers and researchers have the only chance to participate in R&D teams of some large foreign firms. In the area like telecom, where R&D activity takes place in minutes, the figures showed by the statistics for 1998 are total nonsense. Therefore to speak about innovation to the background of historical data is nonsense.

(*Terk*) Business develops in hours etc. But if we observe the trends and shares per countries, they do not change all that rapidly – see R&D expenses out of GDP.

(*Peek*) The question also concerns recognition. We can do here something unique. E.g. that parking system via cellular telephone is unique in the world, but to bring it to the world marker from here is very difficult for a small firm like us. There are no resources or experience for putting the product to the global market. This is the trouble of a small country and the lack of name and recognition.

(*Tamm*) I counter that if one wants to achieve something, he need not run away from Estonia. On the other hand we are not creating a new Ericsson or Nokia. The answer is proper globalisation. To merge in a profitable and smart manner with the work of large corporations. E.g. Nokia, which starts to produce wap-computers. They are open. So we could earn from our brains. Major matters have to be done through major corporations.

(*Peek*) As was said that there is one engineer per 100 humanities specialists. Yes, some 20 graduate every year, but how many of them are Engineers with a capital E, maybe 1-2. What I mean is that our castes are not yet ready – we have not the engineers caste, the officers caste, the lawyers caste. Being an

engineer is philosophy and one needs to be born to that caste. There is nothing to do with 1-2 engineers.

(*Pilv*) Silmet invested in development 32 million last year, 8 million the year before last. Production is high-technology mass production. Silmet hires 750 people, out of that 26 deal with R&D (in 1999 there were 18). The number of workforce is increasing in the enterprise and in R&D. And some 7% was directed to development last year, before that 2.5%. Output went up 70% within last year. This was thanks to the high technological value added. In the use of the R&D potential we cooperate with Japanese, US, Western European, Russian institutes, but we have also found research potential in Estonia. On November 13 last year we signed framework agreements with the Tartu University and TALLINN TECHNICAL UNIVERSITY. We have some more advanced cooperation with the TU chemistry specialists. And I am glad to point out that the Technology Agency ESTAG is ready to support that cooperation. Two concrete examples: we needed to glaze certain materials – we were seeking for a specialist of that sphere: we found a highly talented engineer in AS Tarbijaklaas. Another case: the TALLINN TECHNICAL UNIVERSITY has high-standard powder metallurgy, as well as the successor of the former Desintegraator, a firm with 6-7 members, but they have very high standard separation of fine powders. We have determined the levels of innovation in our firm: a) from where we could receive applied sciences as fast and as cheaply as possible; b) determined the possible partners of Estonia, e.g. Estonian R&D institutions which in turn are in the following networks. Therefore I have a call for the entrepreneurs: it is possible to find good researchers in Estonia and not in the known IT and gene technology fields, but also in thermal technology etc. As for innovation in the enterprises, we as the new owners restored the Technical council, where there is more liberated technological thought. We have been operating as the new owners for 3.5 years, two of which were used on saving the firm, then the results and the rapid development have come especially from R&D activities and cooperation in that sphere both home and abroad, especially with Japanese, but also with Austrian, US, Russian institutes. This is real cooperation, with concrete framework agreements, projects, where we hire new researchers.

(*Terk*) The Silmet case shows that one can scrape something together with careful searching, but it is obvious that this will not work for long. Unless we receive fresh blood from universities.

(*Jaaksoo*) The Silmet case is good, but its HQ is here. But the head offices of most enterprises are in Stockholm or elsewhere and the R&D activity is there as well. Here there are only subsidiaries or branches and the local owners somehow are not interested or cannot organise development here. This also shows what has happened here with the privatisation to foreign firms – value added development takes place outside Estonia. And here is one of the answers why the private sector does not invest in R&D – in foreign-owned firms the R&D activity takes place outside Estonia.

(*Erme*) A large part of development does take place in the Estonian SMEs. As for engineers, we lack them, but there are almost no innovation managers, although this has become a speciality in the world. This should be taught. And third – the private entrepreneur invests money in something he hopes to earn from. Innovation would provide more money, but it has also higher risk level. A proper support system should be created, which would help the entrepreneurs to neutralise these risks.

(*Hallik*) As a representative of Kredex I can see these SMEs, which appeal for money for their projects, as well as their economic reports. The contents are as follows: the enterprise has been created by the owners scraping together their last funds, have made large loans and are interested in buying rapidly

and cheaply already existing technologies to start providing services, earn profit and repay the loans. None of them thinks that they could do something on their own. The main interest is very rapid turnover. Another aspect is – who are these people who make up our entrepreneurs. They are not engineers, who would form their own firm for an idea or product. Usually they are businessmen interested in percentage, not people with a mission, who for example would like to drive an Estonian car etc.

(*?*) The enterprises have no "fat", which would enable them to deal with innovation. Only firms the size of Silmet can afford to innovate in Estonia.

(*Tamm*) The world is varied and nothing is impossible. E.g., three Estonian men are included in the military industry catalogue. With their original ideas. But this is not enough, we need a salesman. 80 percent of the world's best salesmen are engineers. They all have later received training – management, public relations etc. But one needs to know the essence of the matter to sell it, just selling skill is not enough. Both poles together are needed.

(*Pilv*) Small enterprises can do a lot. Cooperation mechanisms should be developed for this. E.g. Silmet has due to its framework agreements with the universities created contacts with several of their spin-offs and we have also written in out framework agreement the idea of establishing a spin-off. An enterprising engineer can make his first millions that way. A large enterprise will not make some small thing itself, but cooperation with small firms for the improvement of its products is very much welcome. A successful large enterprise can thus involve a number of small ones.

(*?*) Estonia's problem is that the number of the "locomotives" to pull on that progress is very small.

(*Tamm*) If I should now appeal to the Tartu Science Park or Technology Agency ESTAG that I immediately need half a million, would you provide such a service?

(*Erme*) Yes and no. In principle, the science park is a support institution in the structure, which should support the entrepreneur and start-ups. We also mediate in a way risk capital to firms by making contacts. But the starting firm is poor and if they want to lease space with us, we have an opportunity to lease space at a lower rate, yet at that case we shall harm ourselves. There is a support system in Finland, where a start-up firm can apply for sums from a government special fund for leasing rooms for two years and even the salaries of the start-up firm are paid in some cases. We cannot do all that so far. But the matter is that a sort of sharing of work is necessary – one park cannot solve everything.

(*Kolk*) If we are talking about the development of new technologies, I think there will be no problem with the finding of money in Estonia. Now there is the Finnish Sitra fund Estonian office for the venture capital. I believe there are some ten groups currently offering that service in Estonia. The structure is not strong yet, but some first phenomena already exist. The state venture capital fund is also being developed now – this has been included in the national strategy document. And the financing of this fund has been included in the budget planning. In 2003 we shall already be able to consider the EU PHARE funds to reinforce the support structures created by the Technology Agency ESTAG ESTAG.

(*Rang*) We have a quite good product and now we need some 60 million dollars to take this product to the world. You just don't find that sort of money anywhere in Estonia.

(*Peek*) If we look at how money is granted in the world, we see that it is not given to projects – there are millions of projects. Money is actually given to people. And all these patents etc. are just an attractive attribute. The issue is recognition and this what Estonia hasn't got yet. Big bucks are always given to persons.

(*Rang*) ten years has been too short a time for that image to emerge.

(*Käosaar*) Estonia has retained the old mentality regarding patents. In the Soviet time we just took someone's idea from somewhere and that was it. It has not yet been understood that the patent is a commodity to be sold. This is not that expensive in Estonia.

(*Jaaksoo*) A patent is expensive if you apply for an international patent. There is nearly no use for an Estonian patent.

(*Pilv*) Training regarding these patents etc. is highly necessary. Because if there are many new technologies and ideas in our firms and only ten patents applications per year, something is wrong somewhere – maybe in training or possibly the defining of mission. Maybe a support system should be set up, which would help the engineers to form their patents, to develop motivation to do this.

(*Jaaksoo*) We expended on patents because the first thing the venture capitalists ask is – do you have an international patent. Then they look at what the idea behind the patent is and what is the possible market. The third stage is the management. And if you lack one stage, that patent, then you will make this expenditure of several thousand dollars in the hope that it will yield a multi-million dollar profit. Therefore the patent is one of the most important components in attracting venture capital to the enterprise.

(*Must*) I have made five studies of the participants in the framework programme and received the impression that the Estonian researchers are totally indifferent about their intellectual property. The enterprises are more far-sighted in that respect, some 40% of them negotiate with their partners before participating in the project. But more than half never even thinks about it. This is a matter for concern. The state should lay more emphasis on the intellectual property issue.

To sum up:

(*Tamm*) The support structures are all experiencing their birth pains and do not operate the way they should. It is important to support concrete matters and then the private capital will come along. This is the usual problem of the developing capitalism that money is initially used for oneself and the others start getting it only later. We have survived the first ten years, maybe now things will improve. We have to act in that direction. But statistics can be trusted only at certain terms.

(*Ruubel*) We have been talking about the development of marketable product in Estonia. There is one way to support the tops, through which the money would be accumulated, cooperation with research facilities and spin-offs would develop. On the other hand there will never be too many of them. The question is, hoc can these small firms, which survive from one payment date till another, create anything new? They would need support to start up, to create an image, to develop organisational culture etc. The enterprise needs a change of culture of thought, which would breed innovation and constant development of its products. And this growing of mentality does not start with the enterprise,

but should start from school and university. Therefore the schools' programmes would need significant reorganisation. Education is one of the basic factors for progress together with all these support measures currently being developed.

(*Erme*) Innovation is a complicated phenomenon and therefore the systems supporting it must also be complex. If we saw here that there is one image of the state systems and another of the so-called third sector, by the time we meet again it would be nice if these two images were drawn together and it were explained which functions are performed by who and how these cogwheels interact. Because now they function separately like shown on the images; if we could make them interact we would have made the next step forward.

(*Kolk*) Quite often that technology is only 2 components – knowledge and skills. I am somewhat more optimistic about the part concerning our smallness, we are talking about creativity – knowledge and skills. I think that the development of all technology starts from small sums, not many millions, many millions are invested in the complete products. The development of instruments is also important. If we look at the EU activities, two activities have increased: cluster politics and the support to start-ups. The cluster politics or cooperation of industry both horizontally and vertically should also be launched in Estonia and receive support from the state.

(*Kolk*) The top managers' awareness of innovation management is low. We have a number of firms with a turnover of 100 million. Their product development has probably cost dozens of millions, but their balance does not reflect this, because they have not accounted this separately. They even do not have the corresponding item in the accounting.

(*Sõber*) If one asks from a majority of managers of successful Estonian firms, what is innovation, most of them link it to marketing activity. If the understanding changes that innovation is not marketing but engineering, the situation will improve. The more industry we have, the more would we have engineers and need for them. I do not see that innovation should be a goal for itself. I strongly support the idea that Estonia should develop a strong industry. Regarding science – I would expect somewhat more results to see some shifts and developments, so as to have faith for investing in it. But how much new technology we import and adopt is a value of its own, we need not invent everything here on our own. Launching new and efficient technology may yield better result than just filing for patents.

(*Jagomägi*) I would stress the viewpoint of small enterprises. Why the SMEs do not invest – no money. There are ideas. At the same time an investor can be found if you have an idea marketable outside Estonia – we found one. Our experience shows that we could find the investor and money, but the results of the first half-year show that we lack experience of selling an idea. There are good ideas in Estonia, but this selling know-how equals zero and this is the reason why we joined a foreign firm. Since this is a commercial activity we probably have to learn it like capitalism and only time and experience help here.

(*Vilu*) It is clear that all kinds of support structures cannot be underestimated, it is vital that they can be launched. But I believe that if we think of sustainable innovation, there must be sustainable communities of inventors/innovators for that. The engineers and researchers communities in Estonia are very small. And if we look at which communities are suitable in the intellectual and sustainability sense there are only molecular-biologists and bio-technicians, who are slowly developing. Hopefully also the information technology specialists with electronics experts. These communities should be declared a priority and be provided with all kind of support so that they could become sustainable.