Promoting university interaction with industry: Understanding the Finnish Model

Jakob Vestergaard

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Department of Management, Politics and Philosophy
Copenhagen Business School
Blaagaardsgade 23B
DK-2200 Copenhagen N
Phone: +45 38 15 36 30
Fax: +45 38 15 36 35
www.mpp.cbs.dk

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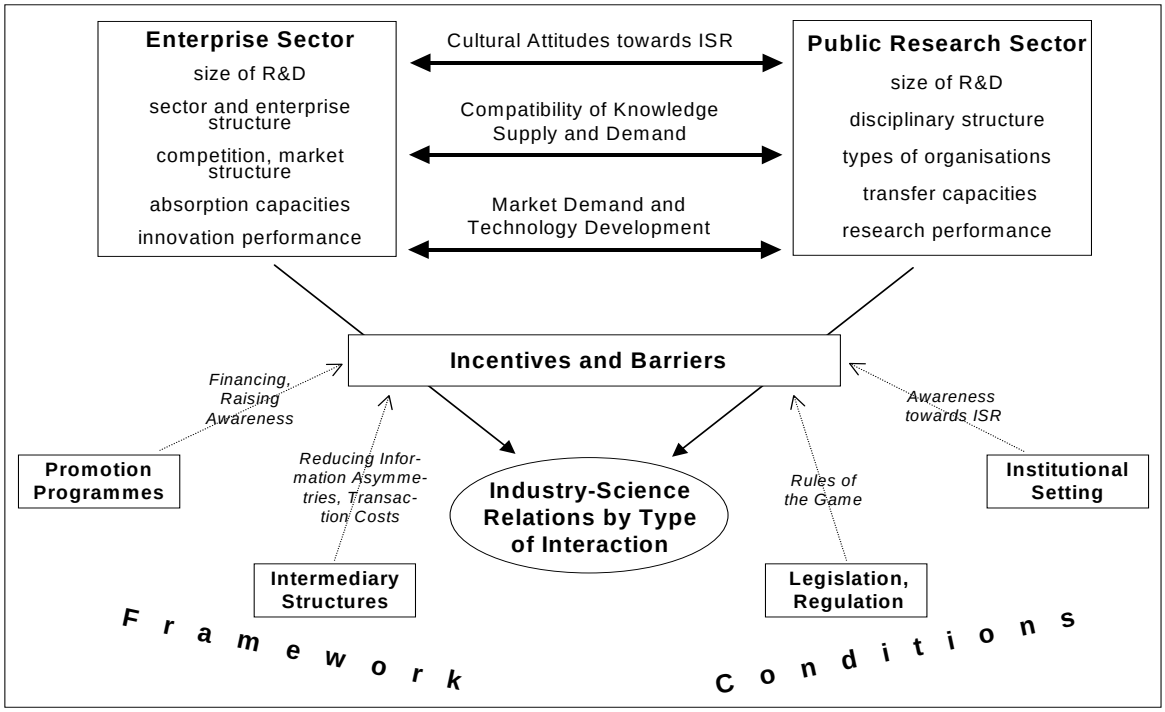
1. Introduction

The present working paper reports the results of a study of experiences with the agenda of promoting science-based economic growth in Finland. With the objective of gathering information on *best practices*, the overall research question of this study was dual: (1) Which institutions, rules and policies have been introduced to stimulate university interaction with industry? (2) Which of these seem, so far, to have been the most successful ones?

The research project drew upon two recently completed benchmarking projects, by the EC (2001) the OECD (2002) respectively. In the EC report, considerable effort was expended in developing a conceptual model for the analysis of the role of framework conditions in promoting industry-science relations.

Figure 1 A Conceptual Model for Analysing Industry-Science Relations



Source: EC 2001

This conceptualisation was adopted as the organising structure for the present research also.[1] While adopting the overall conceptual structure of the EC benchmarking project, the research design differs substantially in its focus on university-level case studies, and in its attempt to provide in-depth interviews specifically focused on identifying most enabling framework conditions in the

[1] In addition to the study on Finland, the research project consisted of two further country studies (Sweden and UK).

respective countries. More specifically, the overall research design consists in combining the following three elements:

- Collection and systematisation of national data on performance with regard to industry-science relations, and with regard to policy-related framework conditions
- Validation of these national data by interviewing national experts (academic as well as governmental), with a particular emphasis on areas with learning potential for Denmark
- Interviews with top representatives at four entrepreneurial universities on their strategies and initiatives for interacting with local industry, as well as on what they see as most enabling national framework conditions

The present working paper is based, in other words, on a combination of desk research and interviews with key experts at the national policy level, and at the university level. More specifically, the following experts were interviewed:
Esko-Olavi Seppälä & Kimmo Halme (Science & Technology Policy Council, Chief Planning Officers); Jari Romanainen (Tekes, Director) & Kari Komulainen (Tekes, Head of Internationalisation Services Unit); Pekka Ylä-Anttila (The Research Insitute of the Finnish Economy, Research Director) & Terttu Luukonen (The Research Insitute of the Finnish Economy, Head of Unit); (Petteri Kauppinen (Ministry of Education, Science Policy Division); Tarmo Lemola (Ministry of Trade & Industry, Director of ProACT Technology Programme); Erkki Ormala (Nokia, Director of Technology Policy), Eero Holstila (Managing Director, Helsinki Region Centre of Expertise); Heikki Mäkipää (University of Helsinki, Director of Research and International Services); Marja Häyrinen-Alestalo (University of Helsinki, Research Director), Aaro Tupasela, Antti Pelkonen & Karoliina Snell (University of Helsinki, Doctoral Students); Camilla Elander (University of Helsinki, Director for Economic Planning); Markuu Tinnilä (Helsinki School of Economics, Research Director), Arto Hakkarainen (Helsinki School of Economics, Innovation Manager) & Mari Paloheimo (Helsinki School of Economics, Partnership & Corporate Relations Manager).[2]

The interviews were *appreciative* in the sense that the effort was to identify key elements of successful university interactions with industry. Further, the interviews were *policy-focused*, in the sense that there was a particular emphasis on the facilitating role of framework conditions in successful interactions. And thirdly, the interviews were *change-oriented*, in the sense that all

[2] On behalf of the Copenhagen Business School, I should like to warmly thank all of the above experts for their extremely open and helpful attitude, which made the research project an extremely rewarding experience.

interviewees were asked to identify possible future reforms that they believed would further stimulate university interaction with industry.

The remainder of this working paper consists of the following main sections:

- A brief history of science and technology policy in Finland
- An overview of framework conditions for university interaction with industry in Finland
- A case study of the formation of a spinout company at the University of Helsinki
- A discussion of best practices and future challenges for Finland's science and technology policies

2. Science and technology policies in Finland

Although Finland may be considered a latecomer in the early phases of science and technology policy development (Kaukonen & Nieminen 1999), concerted political effort over the past two decades have made Finland a much cited success-story of strategic science and technology policy. A key comparative strength of the Finnish national system of innovation is the high degree of cooperation among universities, companies and research institutes. As late as in the 1970s universities were not *permitted* to cooperate with industry (Romanainen 1999). The transformation that took place during the 1980s and the 1990s was to a high degree the outcome of a determined and well-coordinated science and technology policy.

The 1980s say a shift of emphasis from science to technology in overall Finnish policy-making. The establishment in 1983 of the National Technology Agency (Tekes) was one notable expression of this shift. The focus of Tekes was on technology development in key sectors of the economy. The key sectors of the Finnish economy by the early 1980s were the forestry and metals industries. Industrial and economic policies very much focused on the interests and needs of these export-oriented industries. There was, however, a tendency to consider only larger companies as an issue for national policy, leaving the concerns and interests of small- and medium sized enterprises to be dealt with by regional authorities. This changed radically during the 1980s. Policy began recognising the importance of linkages within and between sectors, and in Tekes technology programmes the development of such linkages and networks became a key objective. From these technology programmes by Tekes grew by the early 1990s what has been termed 'the cluster approach' (Romanainen 1999, Rouvinen & Ylä-Anttila 1999). In 1993, the National Industrial Strategy stressed the paramount importance of clusters as the fundamental basis of national

competitiveness. Previously, industrial policy was focused on very specific industries. Now the new policy emphasised the importance of facilitating the economic growth of all clusters, rather than targeting a few industries. This was in part an expression of a general shift in policy that took place during the late 1980s from intervention to facilitation. This shift was closely related to the establishment in 1987 of the Science and Technology Policy Council (STP Council). The STP Council replaced the Science Council that had been operating since 1963. Not only did the STP Council mark a strong political emphasis on integrating science and technology policies that had previously been formulated separately and with little coordination. It marked also the beginning of an era in Finnish policy-making where science and technology policy became a strategic core in the formulation of a whole range of other policies, including educational policy, economic policy, fiscal policy, industrial policy, regional policy and technology policy. The concept of a 'national innovation system' soon became the organising and unifying concept of this new coordination of policies. The 1993 policy review from the STP council read as follows:

> In summer 1991, the Government decided to adopt the [STP] Council's review 1990, which was based on the development of the national system of innovation, as its overall programme for the development of knowledge and know-how. In summer 1992, the Cabinet Economic Policy Committee defined the national system of innovation as a central development target in the preparation and pursuit of economic policy. These decisions created conditions for the systematic development of the national system of innovation in the future (STPC 1993: 7).

Along with the national innovation system as the overall, guiding concept of policy-making in Finland during the 1990s came a focus on 'networking', which developed to become an "all-encompassing perspective on Science, Technology and Industry policy" (Nieminen & Kaukonen 2001).

The fact that there was a general political consensus on the strategic importance of science and technology policy for the international competitiveness and economic performance of the country, was crucial for the way in which the political system responded to the severe economic crisis that hit the country in the early 1990s. In the late 1980s, Finland saw a major economic boom resulting from the liberalisation of financial markets. This boom soon turned into severe banking crisis, however. In combination with the collapse of the socialist markets, this produced a severe economic crisis. Though the public sector budget was in crisis, the commitment to progressive science and technology policy remained. In the near absence of a private venture capital market, public money was invested to provide this (Romanainen 1999). Furthermore, instead of adjusting target levels for public and private investments in R&D downwards, according to the overall economic trend, the STP council adjusted target levels upwards, aiming to reach a R&D share of GDP at 2,45 pct. by

1995 and 2,7 pct. in 2000. This policy was fully aligned with industrial policy. The 1993 National Industrial Strategy stressed that in the face of the economic recession, industrial policy should focus not on reallocating current resources, but on influencing the "quantity and quality of resources emerging in the future" through investments in the national system of innovation (cited in STPC 1993). As a result of this emphasis on the strategic importance of strengthening the national system of innovation by investing in research, the government policy of balancing the public budget by cutting expenditures was not applied to the overall level of public funding of *research*.

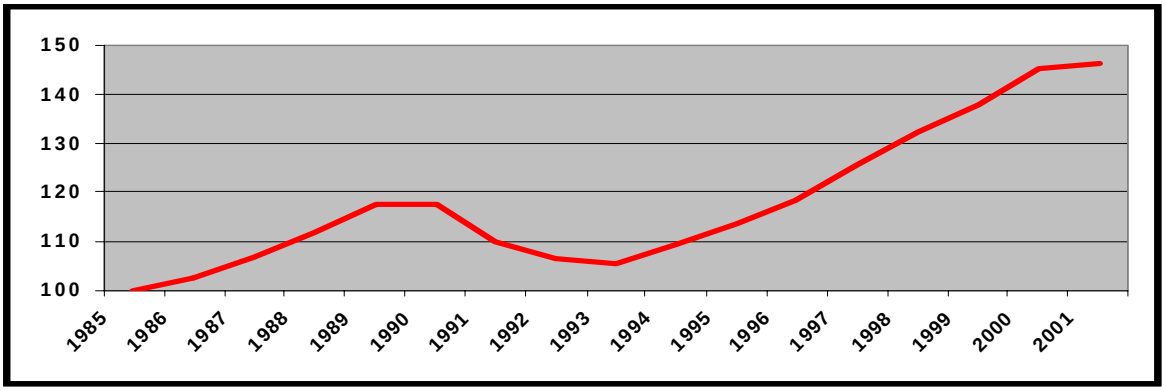
Table 1 Government research appropriations by organisations 1991-93 (FIM million)

	1991	1992	1993	Real change (in pct.) 1991-93
Universities	1513	1541	1481	-5.3
Academy of Finland	449	450	449	-3.2
Tekes	930	1040	1347	+40.2
Research institutes	1580	1624	1560	-4.5
Other funding	790	836	897	+9.9
Total	5262	5491	5734	+5.5

Source: STPC 1993

By the late 1990s, the Finnish economy had more than fully recovered from the crisis. In fact, a quite unusual economic growth had been achieved, and the remarkable success was noticed across the world.

Figure 2 GDP in Finland 1985-2001



Source: Seppälä 2003

In the late 1990s the emphasis of Finnish science and technology policy shifted from promoting R&D, to promoting R&D, *internationalisation and commercialisation*. The country has achieved a remarkable economic growth and international competitiveness during the course of the 1990s, but there is a widespread recognition in the country that weaknesses remain, that need to be addressed, if this strong position is to be withheld in the future. To these issues, we shall return in the section on *future challenges*.

3. Framework conditions in Finland

The overall cultural attitude toward university interaction with business is heavily influenced by the general that notion that it is of paramount importance that public science contributes to industrial innovation. This attitude is seen to be the result, more than anything, of a coherent science, education and technology policy during the 1980s and 1990s (EC 2001: 99). Further, observers emphasise the 'sense of urgency' that the economic recession in Finland in the early 1990s brought about – a progressive science and technology policy was widely recognised by the public to be absolutely crucial for recovering for the prospects of recovering from recession (Seppälä 2002; Tuurkonen 2002). Despite this generally favourable cultural attitude in the Finnish society toward UB interaction, universities themselves seem very divided on the issue, with some researchers being quite sceptical, if not hostile, towards the political pressures to increase interaction with business. Finland has a strong tradition of autonomy in research and education, and some researchers feel that independent, basic research is endangered by this political agenda of increased interaction with industry. In fact, the achievements of Finland in the area of industry-science relations are even more remarkable in view of this scepticism. A key to understanding Finland's success in the field of stimulating industry-science relations is no doubt the restructuring of Finnish public R&D funding that took place from the mid-1980s onwards. To this we shall return shortly. The remainder of this chapter describes the framework conditions for university interaction with business in Finland. The description is divided in the following sub-sections: Legislation; Institutional setting; and Public promotion programmes.

3.1 Legislation

Generally, actors in the Finnish national system of innovation share the notion that legislation has not played a very significant role, not negative nor positive, in relation to the intensification of industry-science relations over the past decade. Thus, IPR regulations, civil servants law and

mobility regulations are regarded by most experts as having neither a positive nor a negative affect on industry-science relations (EC 2001: 102). There is an exception, however, and it concerns public science institutions. Experts mention legislation with regard to extra earnings for public science researchers and regulation on equity investment by public science institutions in enterprises as the two most important barriers to industry-science interaction (EC 2001: 102). The regulation concerning investment by public science institutions state that "a government organisation receiving funding (even partly) directly from the state budget, may not invest in the private sector without the specific consent of the Parliament" (EC 2001: 101). Only by such specific parliamentary consent are equity investments in, for instance joint research labs, possible. Such investments are rare, and instead several universities have set up foundations, through which they are able to make equity investments. With regard to the other barrier mentioned by experts, legislation with regard to extra earnings for public science researchers, the Act on Civil Servants limits the right of a civil servant to hold secondary occupations, by which is understood any waged work or task. In practice, sporadic occupational tasks are not subject to limitations, while for instance being member of board of a company is indeed considered a secondary occupation, and thus requires that the researcher apply for a permission to hold this position. In granting permission or not, the researcher's employer must reflect on whether the researcher will be more challenged in his office or in any way be bothered in the appropriate execution of his tasks, whether the secondary occupation will compromise the confidence in his impartiality, and finally whether the secondary occupation as a competing activity may potentially damage the employer. If the researcher, on these conditions, is given permission to hold a secondary occupation, there are no restrictions as to the amount of remuneration.[3] In addition to the two above-mentioned barriers, it must be stressed that actors share the view that legislation has, and does indeed still 'lag behind'. Industry-science relations have intensified enormously during the past decade, but there have been few legal guidelines for these interactions. Particularly on the university side of the relation, actors call for clearer legal ground rules for their interactions with business.[4]

The legal framework in which universities operate is defined primarily by the Constitution of Finland, which states the freedom of sciences. The Higher Education Development Act states provisions on the objectives of the higher education system, appropriations and their allocation,

[3] If a researcher in a public science institution wishes a leave of absence this procedure of applying to management for permission will apply as well.

[4] With regard to fees for contract research, this is regulated by 'The Act of the Principles of State Fees', the basic principle being that contract research must "be provided on market conditions" (EC 2001: 101).

whereas the Universities Act ensures the autonomy of universities, prescribing their operations and objectives only in very general terms. During the 1990s, the Finnish government has reformed its mode of regulation with regard to the university system. Generally, the policy of the Ministry of Education through the 1990s was to increase the administrative autonomy of universities, and to replace budgetary and regulatory control with 'management by results', through evaluation and consultation procedures. These new principles of higher education governance were part of a general movement in the direction of 'new public management' in the Finnish public sector. These developments were reflected also in a significant change in the overall patterns of public research funding.

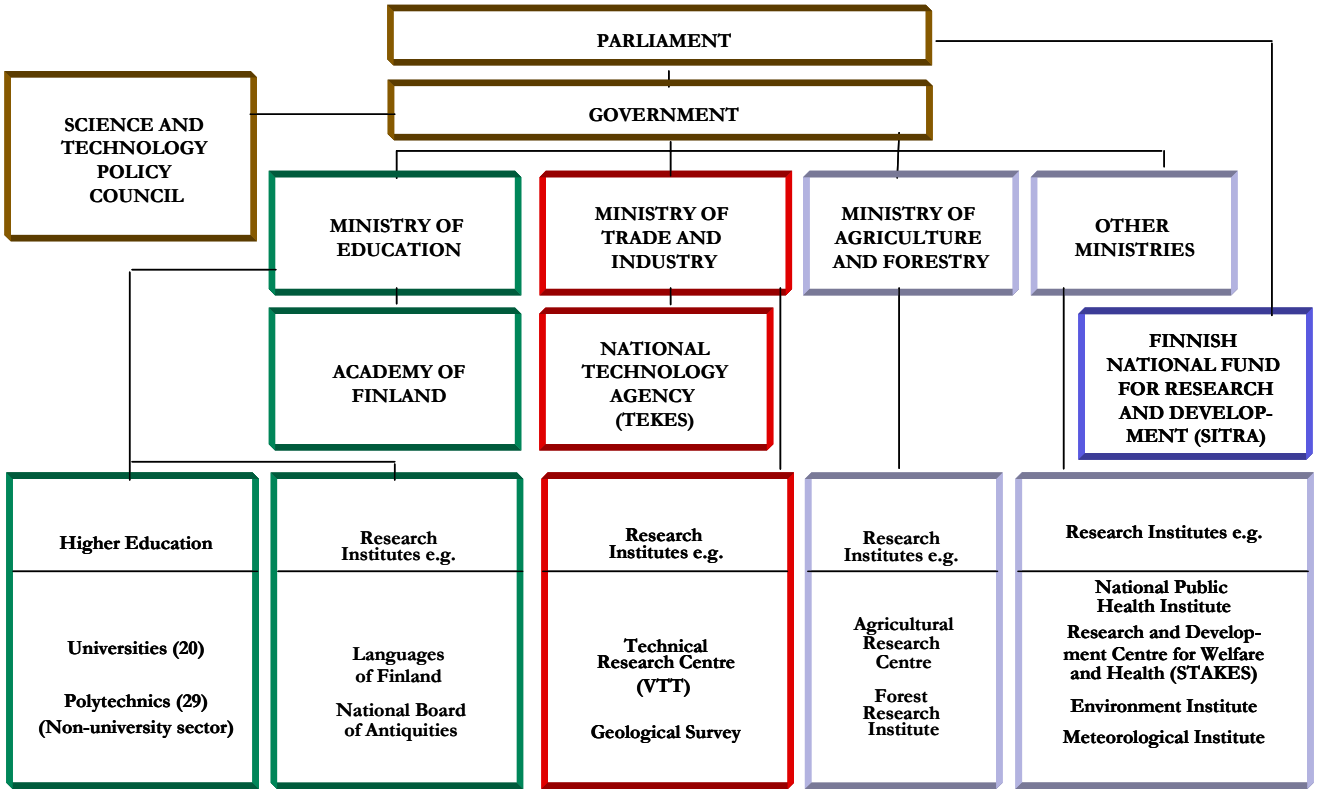
> Public funding was increasingly channelled through competitive funding mechanisms and the criteria for funding from extra-budgetary sources increasingly presupposed cooperation (cooperation within the university system, international cooperation, university industry cooperation) as a condition for funding (Nieminen & Kaukonen 2001: 32)

With regard to the regulation of universities, the increased emphasis on competition and cooperation was the two most significant changes during the 1990s. It must be stressed that the shift in the distribution of government research funding was substantial. In the period from 1990 to 1996 alone, the balance shifted dramatically. In 1990, 58 pct. of government funding was given directly to research-performing organizations (universities and research institutes), and only 42 pct. was distributed through funding organizations (Tekes, Academy of Finland, etc.). In 1996, funding distributed through funding organizations had increased to 52 pct. of total government research funding, and the share of direct budget funding to the research-performing organizations correspondingly decreased to 48 pct (Nieminen & Kaukonen: 33). By means of this shift, the relative balance between budget funding and competitive funding changed significantly in favour of competitive funding. From the perspective of the universities, this has meant a radical change in the composition of its research funding. The share of budget funding decreased from 67 pct. in 1991 to 53 pct. in 1998, with a corresponding rise in the share of competitive and other external funding from 33 pct. to 47 pct. (Nieminen & Kaukonen 2001: 38).

3.2 Institutional setting

The below figure gives a graphical overview of the organisation of research and its funding in Finland.

Figure 3 Research policy and research funding in Finland



Source: Kauppinen 2002

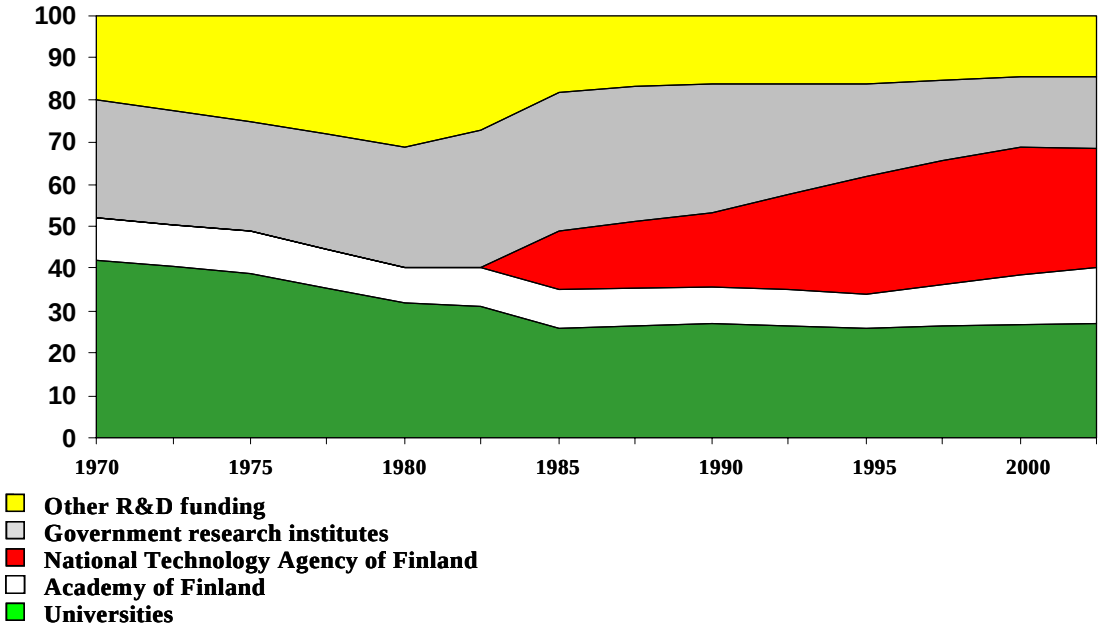
The main public funders of R&D in Finland are the National Technology Agency (Tekes) and the Academy of Finland. As is shown in figure 3, these are not the only government agencies involved in public funding of R&D, however. In what follows Tekes, the Academy of Finland, and the Finnish National Fund for Research and Development (Sitra) will be described briefly. Moreover, the Centre for Expertise Programme will be described, to exemplify the involvement of ministries other than the Ministry of Education and the Ministry of Trade and Industry in public funding of R&D (see section 2.2.5). After having described Tekes, Sitra, and the Academy of Finland, follows a brief description of the governmental body that has formulated the science and technology policies of Finland since its foundation in 1987; namely the Science and Technology Policy Council.

a) Tekes

In Finland, funding has been used strategically as a change agent. This strategy has had two components: introducing new conditions and procedures for competitive funding, and increasing the overall level of funding. In this process, The National Technology Agency (Tekes) has played a

particularly central role. Since its foundation in 1983, Tekes has grown to be the principal promoter of R&D in Finland. The below figure shows this development in the form of the relative distribution of government funds for R&D, in the period 1970 to 2002.

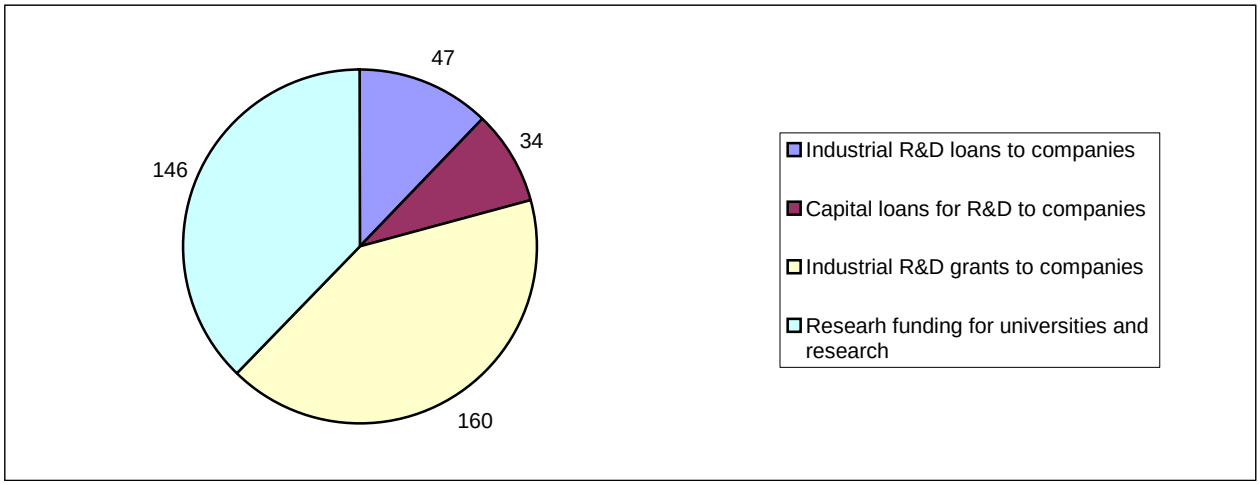
Figure 4 Relative distribution of public funds for R&D, 1970-2002 (pct.)



Source: Seppälä 2002

Tekes provides funding both to research projects at universities, to long-term R&D projects in companies, and to business R&D projects aiming at developing new products, production methods or services. Today, total R&D funding from Tekes amounts to 387 million euros, spread over 2.261 co-financed projects. The fact that Tekes stresses co-financing of the projects and programmes it engages in is a very central aspect of its approach to R&D funding. The overall distribution of Tekes funding in 2001 was as follows:

Figure 5 Composition of TEKES funding 2001 (million euros)



Source: Tekes 2001

Through its extensive funding of R&D in universities and companies, Tekes has taken a central role in strengthening the technological competencies and economic productivity of the Finnish economy. Tekes will be further described in and through some of the public promotion programmes it is in charge of (cf. discussion below). Though the focus in this report is on universities, and not public sector research establishments, the Technical Research Centre of Finland (VTT) should at least be mentioned briefly, for its close relation with Tekes. VTT employs more than 2,850 R&D personnel and has a turnover of more than 200 million Euro. VTT develops technologies in order to improve both the competitiveness of companies and the basic infrastructure of society, and to foster the creation of new businesses. VTT has eight Research Institutes – Electronics, Information Technology, Automation, Chemical Technology, Biotechnology and Food Research, Energy, Manufacturing Technology, and Building Technology – as well as an information service and a technology studies group.

b) Academy of Finland

The Academy of Finland constitutes the Finnish research council system. The Academy states that its overall function is "to enhance the quality and prestige of basic research in Finland by providing funding allocated on a competitive basis, by carrying out systematic evaluation and by influencing science policy" (Academy of Finland 2003). The Academy further states, that its funding of a wide range of basic research is intended to "provide a solid foundation for innovative applied research and for using the new knowledge in the best interests of culture, welfare and the economy"

(Academy of Finland 2003). The Academy of Finland's operation covers all scientific disciplines. The Academy operates within the administrative sector of the Ministry of Education and is funded through the state budget. In 2002, over 13 per cent of all government research funding was channelled through the Academy. The objectives for the Academy's operation and the resources made available to the Academy are decided on an annual basis in talks between the Academy of Finland and the Ministry of Education.

c) SITRA

Sitra, the Finnish National Fund for Research and Development, is an independent public foundation under the supervision of the Finnish Parliament. The Fund aims to promote Finland's economic prosperity by encouraging research, backing innovative projects, organising training programmes, and by providing venture capital. The Fund was set up in conjunction with the Bank of Finland in 1967 in honour of the 50th anniversary of Finnish independence. The Fund was transferred to the Finnish Parliament in 1991. Sitra describes its aim as that of furthering the economic prosperity of Finland by the following three overall means: (i) developing new and successful business operations; (ii) financing the commercial exploitation of expertise; and (iii) by promoting international competitiveness and co-operation. By these means, Sitra endeavours to develop new, competitive business activities and new societal models. The emphasis lies on those kinds of projects that are unlikely to be set in motion by companies or organisations independently and that do not directly constitute the responsibility of any public-sector organisation. In more specific terms, Sitra seeks to identify and help further developing Finnish enterprises that are internationally competitive and profitable. To such companies Sitra offers funding and services that will advance their progress. The focus of Sitra's corporate funding is directed towards enterprises that are at the start-up stage. Besides its funding activities Sitra follows closely trends in venture-capital investment both in Finland and on international markets. If necessary, new forms of funding together with conditions and operations may be adopted. Sitra's corporate funding activities includes PreSeed funding, and Network Development Funding. Sitra's *PreSeed service package* has been created to accelerate the emergence of new technology-based business, to improve capital management and to introduce companies to the providers of further funding. The PreSeed service has two arms: LIKSA and INTRO. LIKSA is a joint funding service operated by Sitra and Tekes that can be used to obtain knowledge and services related to the commercialisation of technology. The aim is to evolve a good business plan more swiftly than hitherto using continuous assessment.

The INTRO service takes care of the efficient presentation of start-up enterprises so that they can find both institutional and private investors who will be prepared to provide simple straightforward funding in the future. Sitra has the skills to assess start-up companies as possible recipients of funding especially in those cases where Sitra's joint investment encourages private capital to allocate resources to such start-up companies. A new form of funding for Sitra is the *Network Development and Finance* scheme. In this scheme new types and concepts of business are set up in collaboration with small and medium-sized enterprises. The aim is to combine traditional know-how with new technology. Sitra encourages SMEs to network by investing in the development of such networks. Sitra will invest mainly in existing networks and their flagship companies but may also invest in new networks. In addition to providing funding, Sitra also cooperates closely with such actors as the National Technology Agency, Employment and Economic Development Centres, and Finpro (Finnish Business Solutions Worldwide). The purpose of this wider cooperation is to agree on joint projects and measures to help traditional SMEs to develop, and go international. Sitra enjoys economic independence. Its operations are mainly financed through income from endowment investments and project finance (STPC 2000).

d) Science and Technology Policy Council

The main actor in designing science and technology policy is the Science and Technology Policy Council. The Science and Technology Policy Council of Finland was established in March 1987, to assist the Council of State and its Ministries in questions relating to science and technology. In more concrete terms, the Council has been assigned the following tasks:

- To direct S&T policy and make it nationally compatible, and to prepare relevant plans and proposals for the Council of State.
- To deal with the overall development of scientific research and education, to prepare relevant plans and reviews for the Council of State, and to follow up the development and the need of research in the various fields.
- To deal with, follow up and assess measures taken to develop and apply technology, and to prevent or solve eventual problems involved in this.
- To deal with important issues relating to Finland's participation in international scientific and technological co-operation.
- To issue statements on the allocation of public science and technology funds to the various ministries, and on the allocation of these funds to the various fields.

- To handle the most important legislative matters pertaining to the organisation and prerequisites of research and the promotion and implementation of technology.
- To take initiative and make proposals in matters under its competence for the Council of State and its ministries.

The Science and Technology Policy Council is chaired by the Prime Minister. Other members include the Minister of Education and Science, the Minister of Trade and Industry, the Minister of Finance, and up to four other ministers. In addition to them, the council consist of ten other members well versed in science and technology. These must include representatives of the Academy of Finland, Tekes, universities and industry, as well as employers' and employees' organisations. The Council has an executive committee and a science policy subcommittee and a technology policy subcommittee with preparatory tasks. These are chaired by the Minister of Education and Science and by the Minister of Trade and Industry, respectively. The Council's Secretariat consists of two full-time chief planning officers.

The representation in the STP council of all key stakeholders makes its statements and proposals on science and technology policy a strong basis for subsequent policy-making. Another characteristic of the policy process in Finland is the level of decision-making. The Council discusses main policy challenges in its triennial policy reviews, and makes general suggestions concerning all actors. This usually includes suggestion on how resources for public funding of R&D should be allocated. The actual implementation of these suggestions is left to the ministries and agencies. Individual research or technology programmes are not decided by the Council, nor by the ministries, but at the level of the implementing agencies. Since the key actors are few and easily contacted, a great deal of informal interaction takes place between different actors at all times. Important issues are continuously discussed in an informal way, and major documents such as the policy outline originate from these discussions. Thus, the main purpose of the outline is not so much to identify new issues, but rather to discuss and set priorities and help communicate these to a wider audience and to decision makers (Romanainen 1999).

3.3 Public promotion programmes

In the following the main public promotion programmes in Finland will be described. Particular emphasis will be given to Technology Programmes and Cluster Programmes.

(a)Technology Programmes

Approximately half of Tekes' funding takes the form of *Technology Programmes*.[5] These are devised to promote R&D in specific sectors of technology or industry, and to pass on research results to business in an efficient way. These programmes have proved to be a very effective instrument in promoting cooperation and networking among companies and the research sector. Technology programmes are planned in cooperation by companies, research institutes, and Tekes. The planning takes place in workgroups and open preparatory seminars. The final decision of launching a programme is made by the board of Tekes. Each technology programme will then have a steering group, a co-ordinator and a responsible person at Tekes. The duration of the programmes ranges from three to five years; their volumes range from EUR 6 million even to hundreds of millions of euros. Tekes usually finances about half of the costs of programmes. The second half comes from participating companies. It is important to understand that Tekes funding is not *either* for companies *or* for universities. Thus in 2001, companies were involved in virtually all Tekes-funded university research projects, in and through their participation in project implementation, monitoring and utilisation of results. Similarly, in 6 out of 10 Tekes-funded business projects, companies ordered research services from universities, academic institutions or research institutions. This cooperation and networking is built into Tekes operations from the initial formulation of a technology programme. Tekes technology programmes are seen as a tool with which to make strategic choices and steer research and development. In the words of Tekes, the technology programmes seek to "strengthen the key technologies and expertise from the perspective of Finland's future and provide a foundation for related business operations" (Tekes annual report 2001). These strategic choices and overall technology priorities are worked out in cooperation with industrial cooperations and unions, companies, universities, and actors un the public administration, under the leadership of Tekes. In fact, this procedure of identifying the needs of industry and society, and design technology programmes to meet those needs, may be said to be the essence of Tekes activities. The currently ongoing technology programmes are listed in table 2.2 below. A

[5] In 2001, Tekes provided EUR 185 million to financing technology programmes, out of a total of 387.

brief description of one these will serve the purpose of conveying by illustration the mode of operation of Tekes technology programmes.

The Drug 2000 Technology Programme – Biomedicine, Drug Development and Pharmaceutical Industry

The goal of the Drug 2000 programme is to contribute to the development of a strong pharmaceutical industry, operating internationally, by developing current and create new research networks, and by conceiving new international business operations for the pharmaceutical sector. The programme began in January 2001 and has been planned for implementation in two periods of three years each. The annual budget of the programme is EUR 17-25 million, of which Tekes finances approximately 60 pct. In addition to Tekes, the Academy of Finland, Sitra, Finnish Bioindustries, and a wide group of enterprises and researchers in the field have taken part in programme planning. The application process started in May 2000. More than 200 preliminary project presentations were received, of which 174 from academic institutions. On the basis of the preliminary project presentations, Tekes invited 85 and the Academy of Finland 21 projects to the second round of applications in September 2000. In January 2001, Tekes decided to fund 41 research projects and in March, the Academy of Finland announced their funding decisions for 11 projects. Eight company projects were accepted in the programme as well, funded by Tekes. There is no deadline for companies' R&D project funding applications, and they can be submitted any time. According to the standard policy of Tekes, the projects in the Drug 2000 programme comply with a Code of Conduct. The Code of Conduct defines the objectives, organization, and activities of the programme. A brief description of programme organization may be instructive. The programme as a whole is run by a steering committee appointed by Tekes. Its members include representatives of companies, Tekes, the Academy of Finland, universities and research institutes, and observers from Sitra, Pharma Industry Finland, and Finnish Bioindustries. The steering committee meets at least twice a year. Its responsibilities relate to monitoring the programme strategy and progress, and ensuring committed and active participation by industry. In addition, the steering committee will coordinate programme assessment. Tekes has appointed a programme coordinator, who is responsible for activating the programme and its day-to-day routines, for communication between the various groups involved, and for external communications. In addition, the coordinator acts as a secretary at meetings of the Technology Teams and the steering committee. Projects submit a report on their progress to the executive committee every year by the end of January. These annual reports are made available to the steering group as a way of assessing the progress of the programme.

Source: Tekes 2003

Table 2 Ongoing technology programmes

Bio- and Chemical Technology	Diagnostics 2000 Drug 2000 – Biomedicine, drug development and pharmaceutical technology Innovation in Foods Life 2000 – Biological functions NeoBio – Novel biotechnology Potra – Polymers for building the future Process integration Staha – Managing static electricity dynamically
Energy and Environment Technology	Climtech – Technology and climate change programme Code – Modelling tools for combustion process development Environmental cluster research programme Ffusion 2 – Fusion energy research programme FINE Particles – technology, environment and health Process integration technology programme Promotor – Engine technology programme Streams – Recycling technologies and waste management Wood energy
Construction Technology	CUBE – Space research programme Infra – Construction and services technology programme Rembrand – Real estate management and services Value added wood chain
Information and Communications Technology	Antares – Space research programme ELMO – Minituarizing electronics EXSITE – Explorative system-integrated technologies Intelligent Automation Systems iWell – Turning wellbeing technology into a success story NETS – Networks of the future Presto – Future products, added value with micro technologies SPIN – Software products, a launch pad for global success USIX – User-oriented information technology
Product and Production Technology	Clean surfaces DESIGN 2005 E-business logistics Frontiers in metallurgy Kenno – Lightweight panels MASINA – Technology program for mechanical engineering UTT – Business concepts for industries Väre – Control of Vibration and Sound

In addition to these, Tekes funds one other programme, which Tekes lists under the rubric 'Other technology', namely *ProACT - The research programme for advanced technology policy*. This programme will be described briefly in section 2.4.

(b) Technology clinics

A technology clinic is a service to help a company test new methods and new know-how quickly and flexibly.[6] Technology clinics are thus intended to facilitate and speed up the transfer of technologies from technology providers to technology users. The main goal of the initiative is to promote the adaptation of specified technologies for problem solving in Small and Medium Scale Enterprises (SMEs) in order to introduce new technological possibilities and to raise their awareness of external R&D resources. The client of a technology clinic is a SME in need of know how and technology, and the typical assignment for the clinic is a problem that the client cannot solve alone, but which is too small to justify launching a R&D project. Thus, the typical cost is less than 20.000 euros. The core idea is to provide lines of communication between SMEs with specific technological problems, and the leading research experts in the country. An additional outcome of the technology clinics is that SMEs that use their services gain experience in cooperating with universities and research institutions. Moreover, through this interaction with a technology clinic, the external network of the company is expanded with key researchers working in fields relating to the products of the company, and with the employees of the technology clinic, which provides companies with a person-to-person relation to the public R&D funding and services system.

There are 6 different generic types of TCs: *technology-based clinics* that focus on a specific technology; *theme-based* clinics that aim towards promoting awareness and technology development in relation to a particular theme or problem; *cutting-edge clinics* that aim at keeping Finnish SMEs at the forefront of technological development in particular areas of technology; *catching-up clinics* that aim to help Finnish SMEs catch up with international standards in selected areas of technology; *methodology clinics* that aim to disseminate good management practices and methodologies in the SME sector; and *demonstration clinics* that aim to offer demonstration services to a selected group of customers in a particular sector. Four stakeholders are involved in each technology clinic: A customer SME; TEKES; a clinic co-ordinator; and the technological service provider. The latter is usually a public science institution, but can also in some instances be a private company with particularly relevant R&D expertise in the field. The role of TEKES is

[6] The following description of technology clinics are based on EC 2001 and Komulainen 2002a, 2002b.

primarily that of providing funds – up to 60 pct of the costs can be covered by TEKES, and the remaining part must be covered by the SME. SMEs do not apply to TEKES for financing, but directly to the TC coordinator who have been authorized by contract to accept and fund assignments on behalf of TEKES. In 2002, there were 16 TCs in operation, covering areas such as Intelligent Materials; Wood Fuel; Technology Strategy Clinic for Building and Construction Industries, to name a few. The Technology Clinic initiative was initiated in 1992, and by 2001 TEKES funding for TCs was at approximately 1 million euros.

(c) The Cluster Programmes

The overall goal of the Cluster Programmes was to "generate new innovations, businesses and employment", by transferring and accumulating knowledge in and across chosen fields, and by improving co-operation between authorities, public funding sources, legislators, and the private sector (EC 2001). The original initiative to the cluster programme came from the STP council. The Council noted in 1996, that successful efforts to increase collaboration in and among different actors in the industrial sectors of telecommunications and wellbeing, should be extended to other sectors. The Council further noted that this would be best done by means of an inter-ministerial programme, which would then seek to increase not just collaboration within the targeted sectors, but also collaboration among public authorities in different policy sectors.

Thus, when the Cluster Programme came into being, a handful of different ministries were involved: the Ministry of Trade and Industry; the Ministry of Education and Science; the Ministry of Agriculture; the Ministry of Transport and Communications; the Ministry of Social and Health; the Ministry of Labour; and the Ministry of Environment.

> The novelty was to gather all the stakeholders – not only universities, research institutes, and companies, but also sectoral government research laboratories and the most relevant users – together to plan and execute joint projects aimed at increasing the competitiveness of the whole cluster (Romanainen 1999).

The Cluster Programmes started in 1997-98 and were designed to run for 3-4 year periods. They consisted of eight programmes: *the Wood Wisdom* cluster (forestry), *the Well-being cluster*, *the Food Cluster*, *the KETJU cluster* (Logistics), *the TETRA cluster* (Transportation), *the NetMate cluster* (the use of information networks in SME business), *the Workplace Development cluster* and *the Environmental Cluster*. Each programme was organised under a sectoral ministry, and each programme had its own publicly assigned and funded co-ordination. Moreover, there were several steering groups in each cluster, typically involving enterprises, public authorities, funding institutions and public science institutions. 'Earmarked' cluster-specific funds only constituted part

of the funding for the cluster programmes – other public and private financing sources have been used in all programmes.

Table 3 Funding and participation in the Finnish cluster programme

Name	*Number of projects*	*Number of participating companies*	*Number of participating public units*	*Cluster specific funding*	*Other public funding (million euros)*	*Private funding (million euros)*	*Grand total (million euros)*
Wood wisdom	113	12	49	2,5	17,2	14,7	34,4
Well-being cluster	17	8	22	4,4	4,9	0,0	9,3
Food cluster	12	17	12	2,0	2,4	0,1	4,5
KETJU	30	60	10	2,3	4,1	7,7	14,1
Tetra	48	29	42	1,9	7,5	1,3	10,6
Netmate	10	n.a.	n.a.	1,6	0,4	0,2	2,3
Workplace development	13	86	n.a.	5,0	8,4	0,0	13,5
Environment cluster	60	70	110	4,5	8,0	1,0	13,5
Total	303	282	245	24,2	53,0	25,0	102,2

Source: EC 2001

In addition to ministries, Tekes and the Academy of Finland were major financiers. Public resources were allocated as grants to a set of projects. Access to programme resources was based on open competitions. Each programme has its own eligibility criteria that focused on co-operation and networking, as well as scientific and industrial issues. More than 300 projects have been funded, bringing together about 300 enterprises and as many organisations from the public sphere. 110 projects are industry-driven. The total finance of all six cluster programmes is 102 Million Euro, of which 1/4 is earmarked cluster funding from the responsible sectoral ministries and 1/4 is industry money.

(d) The Centre of Expertise Programme

The Centre of Expertise Programme was created in accordance with the Regional Development Act,[7] and started in 1994. The overall objective of the Centre of Expertise Programme is to identity regional strengths, and create economic growth by increasing the number of competitive products, services, enterprises and jobs based on the highest standard of expertise. Centre of Expertise Programmes are realised through cooperation between industry, local government, technology centres, universities, polytechnics, research institutes and other branches of public administration. Responsibility for leading the operations lies with the local technology centre company. A main purpose of the CoE programmes is to bring leading experts in research, education and private enterprises in a region or network into close interaction. Benefits gained from synergy will in these knowledge-intensive clusters substantially improve the environment for the emergence of new products, enterprises and jobs. The Centre of Expertise network provides enterprises with knowledge and know-how derived from national and, where necessary, also international contacts and resources. The Centres of Expertise lean on the following services provided by technology centres: project management; business development and marketing; technology transfer; enterprise incubation; patenting, licensing and financing; co-ordination of extensive research, development and training projects; and development of operating environments and models.

Initial implementation of the programme over the period 1994 to 1998 was based on eleven centres of expertise. Based on the outstanding results of this work, the Council of State extended the programme by nominating new fields of expertise and new Centres of Expertise to implement the second national programme over the years 1999-2006. Fourteen regional CeOs and two nationally networked Centres of Expertise was appointed for this purpose. In this second phase, fields of expertise has been broadened from the traditional high-tech sectors to include new media, cultural business, recreational experience industry, design, quality and environmental expertise. Programme work in the regions is co-ordinated by a National Committee for the Centre of Expertise Programme with members representing the ministries involved, the business community, research, education, culture and experts in municipal and regional administration. One of the main principles applied in implementing the Centre of Expertise Programme is *competitive tendering*. The main criteria for selecting CeOs have been of concentration of expertise of an internationally high standard, innovativeness and impact for the proposed programme measures, and efficient organisation. The

[7] More specically, Regional Development Act No. 1135, 1993.

Centres of Expertise also compete annually for government basic funding, which serves as catalytic, seed-stage finance, and is matched by a contribution from the region. In the words of its main public funder, the Ministry of the Interior, "the programme has provided Finland with a strong and functional network of Centres of Expertise to meet the challenges of 21st century knowledge-based society" (Ministry of the Interior 1993).

(e) The Centre of Excellence programme

This program is funded by the Academy of Finland.[8] The aim of the Academy's Centre of Excellence Programme is to enable the emergence of research and training environments that can generate top international research with social relevance. The goal is to promote interaction between different types of research and foster a multi-disciplinary approach to research. A Centre of Excellence is a research and researcher training unit, comprised of one or more high-level research teams with shared, clearly defined goals and good prospects for reaching the international forefront in its field of specialisation. Centres of Excellence are selected for a term of six years on a competitive basis, with evaluations provided by international experts. The first 12 centres were nominated for 1995-1999 and a further five units for 1997-1999. For the period 2000-2005, a total of 26 units from different fields were granted centre of excellence status. During the first three years, the Academy will be spending 21 million Euro in direct support of the units, and 3.5 million Euro in core facilities funding. The centres also receive support from their host organisations (48 million Euro of universities basic funding and 12.5 million Euro of other funding). Tekes has been closely involved in the planning and implementation of the Centres of Excellence and supports the first three years of 11 units of the 2000-2005 programme at a cost of 5.2 million Euro. Funding from the EU is also important for many of the centres. Funding from the private sector is present in about a quarter of the centres but the amount is rather small.

(f) Other public promotion programmes

There are other promotion programmes than the ones described above. The following list provides an overview of the major public promotion programmes in Finland.

[8] The following is extracted from EC 2001.

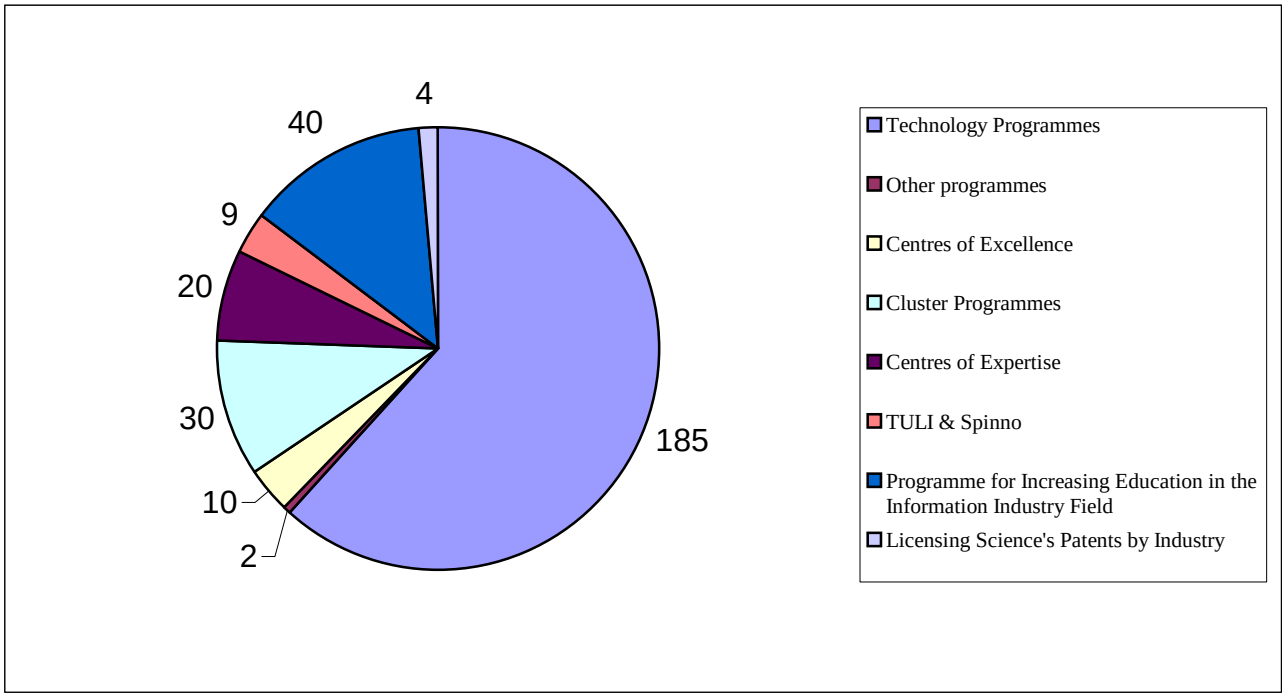
Table 4 Main Public Promotion Programmes

Name of Programme	*Responsible Authorities*	*Main Approach*	*Type(s) of Interaction Mainly Addressed*
Technology Programmes	Tekes	Funding for joint large research projects in 60 technology fields	collaborative research
Technology Clinics	Tekes	Funding for technology consulting to SMEs, developing a market for external technology assistance	technology transfer, consulting, training
Centres of Excellence	Mainly Academy of Finland, partly Tekes	Leading public research to top international level in selected fields of research in order to strengthen the knowledge base	long-term oriented co-operation in high-tech areas, mobility
Cluster Programmes	Several sectoral ministries, Tekes and Academy of Finland	Funding co-operative projects and networks of innovation actors in sectoral fields (research-producer-supplier-user chains)	networking, contract and collaborative research, mobility
Researcher Mobility Programmes	Tekes	Subsidies or tax relief to researchers moving abroad or coming from abroad	international researcher mobility
Centres of Expertise	Ministry of the Interior	Building up regional networks in certain fields of technology involving enterprises, universities, municipalities and intermediaries	networking, start-ups, informal contacts, collaborative research, training & education
TULI & Spinno	Tekes	Promotion of start-ups from science by providing a supportive infrastructure which actively looks for spin-off ideas	start-ups
Programme for Increasing Education in the Information Industry Field	Ministry of Education	Strengthening education relating to information industries	training & education
Licensing Science's Patents by Industry	Finnish Foundation for Inventions, Ministry of Trade & Industry	providing supportive infrastructure (consulting, negotiation, information) to inventors in public science for licensing IPR	IPR

Source: EC 2001

Figure 6 illustrates the relative levels of funding that are channelled through these public promotion programmes.

Figure 6 Main public promotion programmes: funding levels 1999 (million euros)



Source: EC 2001

3.4 Concluding remarks

The approach taken in Finland during the 1990s to promote industry-science interaction has very much been one of using funding as change agent. The impressive results that have been achieved using this 'funding as a change agent'-strategy, shall be further described in the below discussion of *best practices* in Finland. The less 'gloomy' side of Finnish efforts to promote industry-science interaction shall be addressed also, however. The lack of substantial reforms of the legal framework for universities, and the sparse integration of higher education policy with science and technology policy, shall be key topics in the concluding section on *future challenges*.

4 University of Helsinki case study

University of Helsinki was founded in 1640, and is the oldest of current universities in Finland. The University at present has 37.300 full time students, and 61.000 students in various adult education programmes. The University of Helsinki employs 5.850 researchers and 3.540 other staff. Its overall budget is 450 million euros, with one third of this being non-core funding (Mäkipää 2003).

4.1 Entrepreneurial policies and support structures

In 1997 Helsinki University established a network cooperation with the task of promoting interaction between the university and business, called *Helsinki University Entrepreneurial Services*.[9] The aim of this network cooperation and its services was to speed up the transfer of research results and scientific know-how to enterprises, and especially to seek out research-based business ideas and to help researchers to protect them and exploit them commercially. The parties involved in the *Entrepreneurial Services* network were the following: (a) The Research Services Unit in the Department for Strategic Planning and Development of the Administration Office of the University; (b) Spinno Business Development Centre; (c) the Foundation for Finnish Inventions; (d) Culminatum Ltd.; (e) Helsinki Licensing Ltd.; and (f) Helsinki Science Park Ltd.

The rationale of bringing together these units and organisations in a *Entrepreneurial Services* network was to provide services and expertise which one the one hand would help researchers recognise, protect and commercialise their innovations, and on the other hand would help industry exploit research by transferring know-how and technology from the university. To realise this dual aim *Entrepreneurial Services* undertake a wide range of activities. First, it seeks out research results that may be exploited commercially, and evaluate entrepreneurial and business ideas. Secondly, it brings together enterprises and researchers, whether in relation to starting up new joint research projects, or for the commercialisation of existing research results. Thirdly, it helps providing contacts with international networks, assists in making arrangements for funding and offer training and consultation to promote entrepreneurship. In the following each of the partner units and organizations of *Entrepreneurial Services* will be described more or less briefly.

(a) Research Services Unit

The Research Services Unit was established in 1994, within the Department of Strategic Planning and Development of the Administration Office. The unit provides a full-service package to

[9] The following is extracted from Mäkipää et al 1999, and Mäkipää 2002.

researchers, including cost-free information services and personal guidance from drawing up research proposals and seeking out channels of funding, exploiting results and possibly starting up an enterprise.

(b) The Spinno Business Development Centre

Spinno Business Development Centre (SPDC) was established 1991. It's mission is to promote commercialisation of high-tech and knowledge-intensive business ideas. SBDC seeks to achieve this in and through a network of experts such as business consultants, marketing professionals, lawyers, financial advisers etc. SPDC offer a range of business development activities in the start-up, development and internationalisation phase: (i) Training activities focusing on business development, growth and internationalisation; (ii) Programmes assisting in creating well planned internationalisation strategies (iii) club activities encouraging networking between companies (iv) incubator support activities.

(c) The Foundation for Finnish Inventions

The Foundation for Finnish Inventions supports and promotes Finnish invention work and the development and exploitation of inventions. The Foundation's basic tasks consist of consultancy, evaluation and protection of inventions, funding product development and marketing as well as other promotional activities for commercialising inventions. The key criteria for funding are the market potential, inventiveness and patentability of the invention, and its level of technology. The objective of funding is to develop the inventions of private individuals, researchers and small entrepreneurs into products for the market either in the inventor-entrepreneur's own production or under a licence or other exploitation agreement. The Foundation was established in 1971 and is located at the Innopoli Technology Centre in Otaniemi, Espoo, just outside Helsinki. In addition to its staff of 22 there are 28 innovation managers in the main universities and in the regional Employment and Economic Development Centres all over Finland.

(d) Culminatum Ltd

Culminatum Ltd. Oy is a regional development company established in 1995, the principal purpose of which is to serve as a joint instrument of regional development for its owners. The company is owned by the Uusimaa Regional Council, the city authorities of Helsinki, Espoo and Vantaa, and the universities, polytechnics, research institutes and the business community of the region.

Culminatum seeks to improve the international competitiveness of the Uusimaa region and to encourage the business utilisation of the region's educational, scientific and research resources. Through its services and activities it provides a link between experts, public administration and enterprises, and enables partners and experts for various development projects to be located more easily. Culminatum achieves these objectives mainly through managing the Helsinki Region Centre of Expertise Programme, which is now in its second programme period, 1999-2006. The Helsinki Region Centre of Expertise Programme establishes channels of innovation for selected fields of know-how, whereby enterprises can take advantage of the leading expertise, research findings and technology of the region’s universities, institutes of higher education and research facilities to give rise to new, internationally competitive commercial operations. The following five regionally important expertise sectors were selected for the second period in Helsinki region:

- Active materials and microsystems
- Gene technology and molecular biology
- Digitial media, content production and e-Learning
- Medical and welfare technologies
- Software product business.

Culminatum makes proposals and plans development projects promoting the competitiveness of Helsinki region and the utilisation in business of the expertise of its universities and research institutes. Culminatum performs investigations with a view to developing various sectors and their associated business operations in Helsinki region. In performing these investigations and implementing development projects, Culminatum seeks to link the principal stakeholders for each project effectively to investigative work and other development operations in the region. Proposals for development projects arise from the needs of regional partner networks and directly from private subscribers. Culminatum prepares a project plan, which forms the basis for seeking project finance. This finance may come from general, open funding programmes or from the subscriber's own financial sources.

Co-operation and exchange of experience with other national centres of expertise is also an important aspect of realising the aims of the Programme. Co-operation with international, and especially with European organisations involved in regional development work is vital to the development of activities. Culminatum is a member of the European Business and Innovation

Centre Network (EBN) and is through this membership involved in the Innovation Relay Centre Network (IRC).

Implementation of the Programme in Helsinki region is supervised and directed by the Centre of Expertise Steering Group comprising members of the Board of Directors of Culminatum. The members of the Steering Group are the vice-chancellor of Helsinki University of Technology; the Deputy Managing Director of the Helsinki Chamber of Commerce, the Director of Finance of the City of Helsinki; the Director of Planning of University of Helsinki; the Executive Director of Uusimaa Regional Council; and the Managing Director of Innopoli Oy.

(e) Helsinki University Holding Ltd.

Helsinki University Holding Ltd is owned by the university and SITRA, and has established three companies under the Holding to organise its business activities. These are Helsinki Consulting Group Oy Ltd; Helsinki University Development Services Ltd; and Helsinki University Licensing Ltd. *Helsinki Consulting Group Oy* is one of the largest Finnish consulting companies, measured by the number of international assignments it has undertaken. It's annual invoicing amounts to FIM 60 million, and clients include European Commission, the World Bank and Finnish as well as foreign ministries. The company's mission is to contribute to sustainable economic, social and environmental development through international cooperation projects. The company emphasises private-public partnership, assisting in public sector reform and development of human capital. The company has ongoing projects in more than 20 countries around the world. *Helsinki University Development Services* markets training and research services with an annual turnover of approximately FIM 6.500.000. Finally, *Helsinki University Licensing* is a very important company from the point of view of private entrepreneurship. Its field of specialisation is to help university researchers exploiting their research findings commercially and to assist in procuring both Finnish and international funding for this purpose. The company's services includes patenting, marketing and licensing of protected findings.

(f) Helsinki Science Part Ltd

Helsinki Science Park is located in the Viikki district of northern Helsinki, next to the university campus, home of the University of Helsinki Biocenter, the Faculty of Science and the Faculty of Agriculture and Forestry. The overall purpose of Helsinki Science Park is to promote entrepreneurial activities based on innovations in bioscience and related fields. Key areas include

biotechnology, molecular biology, different applications of food technology and environmental technology, pharmacy, biomedicine and diagnostics. At present as much as 12 national centres of Excellence are located in University of Helsinki, covering a wide range of research fields, but with a particular strength in biotechnological and biomedical sciences. Among others, University of Helsinki have Centres of Excellence in Disease Genetics, Cancer Biology, Molecular Neurobiology, Plant Molecular Biology and Forest Biotechnology.

Helsinki Science Park and its collaborating partners provide assistance in patenting and licensing, business management, international marketing and financing. For young entrepreneurs there is a comprehensive training program Spinno in the skills needed for business - tailor-made to meet individual needs. The first business incubator facilities were established in 1999. A new and enlarged business centre and incubator will be in operation in the beginning of 2003. At present, a large number of companies are presently located in the Science Park, cf. the below table.

Table 5 Companies in Helsinki Science Park

Consulting services	Biocid Ltd; Biofellows Oy; Bioviestintä Sirpa Pietilä; Innomedicina Ltd.; Tarjaco Oy
Environment	Ekolab Environmental Oy; Junvegroup Oy; Nordic Envicon Oy; Wood wisdom
Food & Animal Feed & Plant biotechnology	Antarios Oy; Biofellows Oy; Camelina Oy; Novatreat Oy; Omecol Finland Oy; UniCrop Ltd.
Pharmaceutical & Diagnostics	Biotop Oy; Carbion Oy; Fibrogen Europe Oy; Glomega Inc.; Karyon Oy; Ipsat Therapies Oy, Orion Oy, Spectrum Medical Sciences Ltd.
Reagents & Research and analysis services	Biotep Oy; Biovitro Oy; Conexor Oy; Genexpress Oy; Glysim Oy; Mikrofokus Oy; Stockhausen Nordic Oy; Suomen sisäilmaston mittauspalvelu Oy; Viikin Tutkimusplavelut Oy
Other	Lasse Matintalo Oy

More than 1000 research scientists and technicians working in research groups and individual companies in the Science Park. In the below box, a brief description of one of these companies is given.

University spin-out company: UniCrop

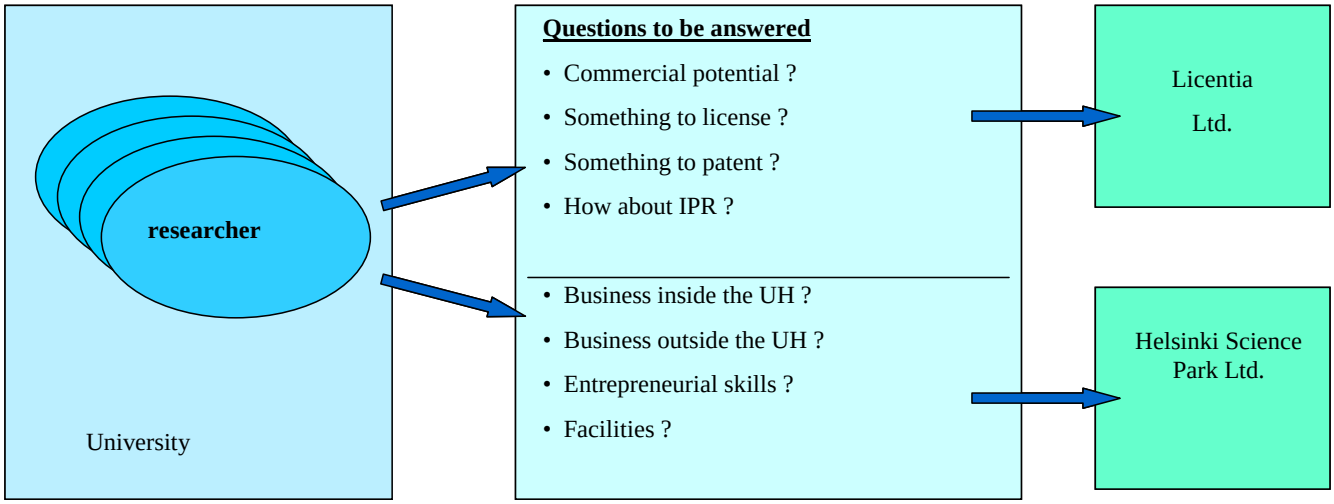
UniCrop is a private biotechnology company focused on developing a novel sprouting technology for the production of therapeutic proteins. The company was established in 1998 by Professor Eija Pehu and three molecular biologists, Anne Kanerva, Kimmo Koivu and Viktor Kuvshinov. UniCrop is located in Helsinki Business and Science Park in Viikki, Helsinki, and employs 27 people. UniCrop finalized its second investment round in the beginning of 2002. The major shareholder is Sitra (National Fund for Research and Development); other institutional investors are Biofund Ventures III Ky, Optiomi Oy and Solaris Capital Fund I Ky. In addition to institutional owners, UniCrop has four private shareholders. UniCrop Ltd is a development and manufacturing partner for the production of therapeutic proteins. The Business Strategy is to seek partnerships with companies and alliances that want to produce pharmaceutical proteins, by offering access to protein production technology that is economical and suitable for medium-volume needs. In terms of technology, UniCrop develops high-yield and low-cost technologies for the production of recombinant proteins for the pharmaceutical industry, thus meeting a growing demand for increasing the production capacity of therapeutic proteins and monoclonal antibodies. More specifically, UniCrop aims to improve the availability of a new generation of protein drugs by using its proprietary technology to express therapeutic proteins in a fully contained plant-based system.

Helsinki Science Park Ltd. is a joint venture of the Finnish government, the University of Helsinki, the City of Helsinki, Sitra, and a number of industrial federations. Helsinki University owns 1/7 of the Helsinki Science Park, the City of Helsinki 2/7, a number of private companies 1/7, SITRA 1/7, and the state of Finland 2/7.

University companies in the innovation chain

Two of the above described companies play a particularly central role in the university innovation chain; Helsiki Licentia and Helsinki Science Park. The distribution of labour among them with regard to the innovation chain may be schematically summarised as follows:

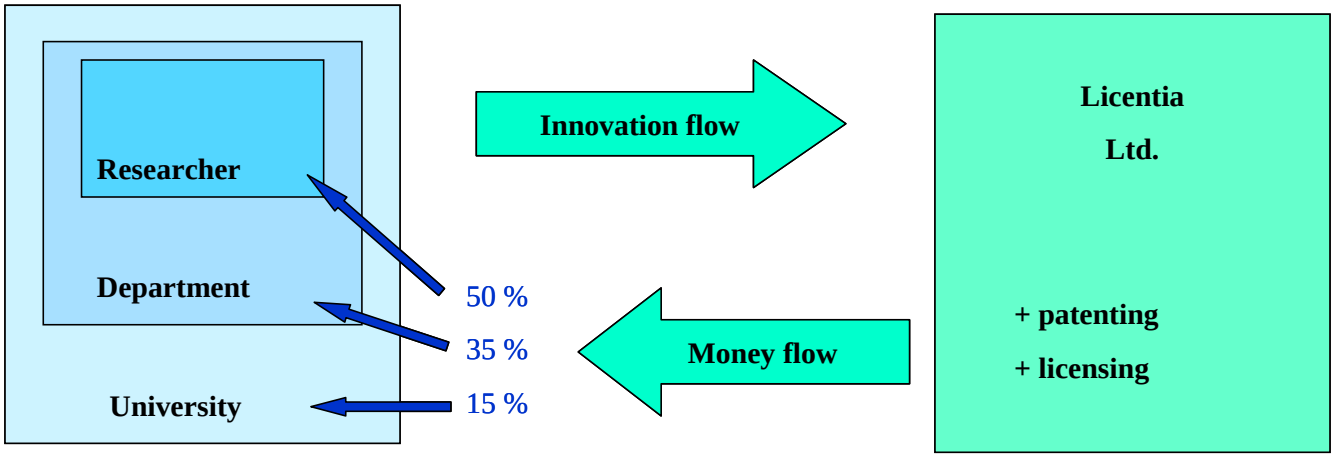
Figure 7 Distribution of labour in the University of Helsinki innovation chain



Source: Mäkipää 2003

The Department of Development and Planning has developed a standard model of distributing revenue generated by patenting and licensing of university research results, ensuring that incentives are in place at all three levels in the University.

Figure 8 Distribution of revenue from patenting and licensing



Source: Mäkipää 2003

Before making a few concluding remarks, the following section identifies a key policy issue with regard to commercialisation of university research.

3.2 The formation of a spin-off company at the University of Helsinki

In the process of spinning out the biotech company, Plant Tech, at the University of Helsinki, all key elements for a successful commercialisation of research results seemed to be present.[10] National science and technology policies were favourable. Public funding both for basic research, and later for more applied research, was provided, and soon after the company was founded, public capital for the further development of the business was granted. The central management of the University of Helsinki was keen to promote commercialisation of its research, and had in 1997 formulated a general policy for those purposes. Thus, when Plant Tech was founded in 1998, the University was in the early phases of building institutional support structures for entrepreneurship and commercialization. An internationally renowned academic, Professor Monto, led the spinout company. Over a period of eight years, from 1990 to 1998, Professor Monto and a dedicated group of junior researchers had developed a research program with strong commercial potential. By 1998, Professor Monto and her research group were determined to bring their research to market. Yet, the process of spinning out the company turned out everything but smooth.

Professor Monto – a Finn by birth, but having done her PhD and subsequent research in UK and US – was recruited in 1990 by the Department of Agriculture at the University of Helsinki. In addition to vast research experience, Professor Monto had experience from working in the Food and Agriculture Organization of the United Nations in developing countries. Recruiting Prof. Monto was part of an attempt to modernize the Department's research. Professor Monto was the first in Finland to apply modern biotechnology to field-crop plants, and it was believed that she could contribute significantly to the envisaged process of bringing the Department's research profile in plant biotechnology to high international standard. The research program of Professor Monto and her group at first focused on combating the biological hazards created by viruses in potato production by developing a virus-resistant potato cultivar. Later the research program was expanded to include research on the insect resistance of a number of plants and the development of a production system for foreign proteins in plants (Tuunainen 2003: 8). In the initial phases of its research, the group received its research funding from the Academy of Finland, which gives grants for basic research on a competitive basis. After a couple of years the group's research started yielding commercially promising results. Consequently, from 1997 the group received its funding

[10] The following summarises key aspects of the work of Juha Tuunainen (2002, 2003) documenting the process of spinning-out a biotech company at the University of Helsinki. For purposes of anonymisation the names of the involved persons and the company were invented by Tuunainen.

from Tekes, the national funding agency for industrial and applied research. It was as the commercial potential of the research grew, that Professor Monto and her group decided to found a spinout company. Professor Monto explained her motivation in the following manner:

> [Plant Tech] is my first priority, and I want to proceed to lead it provided that we can get the capital investment from [a major national research and development fund]. And, then, [I'd like to] maintain, partly, if these people are interested, or if some other unit at the university is interested, an academic group including students from developing countries in order to work with deeper academic questions (Tuunainen 2003: 8).

Though public capital investment for establishing the company was indeed achieved in 1999, Professor Monto never succeeded in realizing this vision. The establishment of the spinout company instead became an issue of heated conflict at the University. The first conflict concerned the boundary between Professor Monto's official duties as a university researcher, and her work in the spinout company. The Dean of Faculty soon found that Professor Monto's "use of office hours for the benefit of one's own firm [was] … slightly liberal" (Tuunainen 2003: 11). The Department Chair shared this concern, stressing particularly that Professor Monto to his view was not taking her share of the teaching load of the Department. In autumn 1998, the Department Chair began insisting on accounts from Professor Monto regarding the spinout company and the relative allocation of the Professor's working hours. Professor Monto fiercely resisted giving any information about the company. Professor Monto was confident that she fulfilled her academic duties outstandingly, and felt that the Department Chair's request for information on the company and on her relative allocation of working hours was an expression of "mistrust, overenthusiastic administration, 'bullying' and 'micromanagement', exercised at the expense of the Department's academic performance and applied mission" (Tuunainen 2003: 15).

In November 1998, Professor Monto informed the Department Chair of her intention to take a partial leave of absence, in order to work part time in the spinout company, while continuing her academic research. She further expressed the hope that the Department would agree to rent laboratory space to the company until the university's business incubator was completed. The Department Chair expressed approval of the leave as well as willingness to arrange a rental agreement. To discuss this part-time, rental arrangement, the Professor invited the university rector to visit her laboratory. Professor Monto did not inform the Department Chair about her meeting with the rector, and when the Department Chair learned that such a meeting had taken place without his knowing it, he sent an email to the rector. In this email the Department Chair assured that the Department saw the spinout company as a positive event, but regretted not having been informed

about the meeting, and asked for the rector's support of the legitimacy of his interest in these affairs, as the Department Chair. When Professor Monto learned about this intervention she responded promptly:

> Hi, my meeting [with the rector] was entirely private, and I do not want you to intervene in it in any manner… If any of my meetings with the university management, or other, are connected to the department I shall inform you properly. I do not want you to mention [the firm Plant Tech] in any occasion either, least associated with this department or your own 'support'. You sure know why. We are arranging our affairs fully legitimately, and we shall contact the department properly (Tuunainen 2003: 15).

Professor Monto insisted that since no legal rules were violated the Department Chair should not get involved in issues relating to the company. The Department Chair was deeply frustrated by Professor Monto's refusal of accountability and partnership with the Department. The Department Chair decided to tighten his attitude (Tuunainen 2003: 17). This included making Professor Monto's partial leave of absence conditional on a number of requirements. From this point onwards, the conflict grew still more aggressive on both sides, and communication by formal letters replaced previous email correspondence, and culminated when the Department Chair contacted the police regarding a controversy over university research equipment. When Professor Monto left the Department, the conflict had evolved around a range of contested issues: (i) general information about the spinout company, (ii) allocation of work time between academic duties and company-related activity, (iii) reporting requirements, (iv) partial leave of absence, (iv) undergraduate teaching, (v) relations to the university rector and the wider university administration, (vi) research equipment, and (vii) external communication regarding links between the department and the spinout company.

The university rector called for a meeting to settle the matter once and for all. At this meeting it became clear that University Administration had decided to adopt a restrictive attitude. The existence of a public-research-group-and-private-firm hybrid from that point onwards was considered illegitimate. Asked how she felt the university had acted in relation the commercialization agenda, Professor Monto answered:

> Ambivalently. That is, the decisions in principle, and these big physical buildings that have been constructed for firms, express the positive attitude. But then every turn of events has clearly [indicated] that in practice there is a lot of backlash, so that people who do not accept this, they are given possibilities to muck around. The passing through of the [new] mode of action is ambivalent. The word has not yet turned into flesh, so to say. People don't yet act in the way rhetoric says (Tuunainen 2003: 11)

In brief, Professor Monto felt that the university "favoured commercialization in the abstract but prevented people from doing it in the concrete" (Tuunainen 2003: 11).

When Plant Tech relocated in the science park facility of the University of Helsinki, the situation ended up in a conflict similar to the one that developed when located in the Department of Agriculture. The three key objectives of Helsinki Science Park were (i) high-quality research, (ii) postgraduate education and (iii) commercialisation of research. As such the science park objectives matched well the objectives of Professor Monto and her group, thus relocating there seemed an obvious way out of the conflicts in the Department of Agriculture. But though the leaders of the host institute in the science park were favourable to entrepreneurship and commercialisation, this was so only on the condition that entrepreneurial activities were "accomplished elsewhere than in the confines of the institute and that it did not affect working hours, or employees' ability to carry out their academic duties" (Tuunainen 2003: 20). For the purposes of ensuring that a boundary was created between the academic projects of Professor Monto's group and the activities of the spinout company, a collaboration agreement was made. In and through this agreement two boundaries were instituted: a social boundary and a spatial boundary. The regulation that sought to institute a social boundary was the insistence that the previous, mixed 'researcher-entrepreneur' roles were abandoned, strictly separating who was working on academic projects and who were working on Plant Tech technology development projects. In addition, the agreement instituted a spatial boundary, demanding that the group's premises were clearly divided between those used for academic projects and those used for the commercial projects of Plant Tech. From the perspective of Professor Monto's group, these boundaries were highly problematic given that its research strategy was to *combine* basic and applied research, resulting in the actual absence of a clear distinction of what was purely academic and what was purely applied and commercial. The group circumvented the spatial boundary by pulling down the partitions, organising their lab space to fit practical needs rather than follow directions given in the collaboration agreement. When it came to the group's finances, however, the Head of Administration insisted on sustained monitoring to ensure that public grants would not flow from the university to the private company. The conflict continued, in other words. Ultimately, the group decided to cease its academic projects and become a fully independent private entity, and Professor Monto herself decided to leave Helsinki altogether, taking up a position in the US. In two successive runs, combining academic research and commercialisation had proved impossible within the confines of the University of Helsinki. The rationality that underlies this resistance towards academic entrepreneurship is well captured by a remark made by the institute's Head of Administration:

> The roles need to stay non-blurred. And, of course, these kind of mixed communities further their confusion… Where does the boundary between university and entrepreneurial activities lie [?]… One can do nothing in such a way that one sits on two chairs… Within the university, entrepreneurial activities can be engaged in by hiring equipment, by paying for premises, instruments, service… But in that case, one can't have a dual role of being simultaneously engaged in the firm and at the university. Instead, it is definite: you are on either side (Tuunainen 2003: 21)

4.3 Concluding remarks

In this case study all the elements for a successful commercialisation of research results were present. National policies were favourable, public funding for R&D, as well as for capital investment was provided. The central management of University of Helsinki was keen to promote commercialisation of its research and had started already in 1997 formulating its policies and creating entrepreneurial support structures. Finally, an internationally renowned academic had developed a research program with strong commercial potential, and a had a dedicated group with her, determined to bring their research to market. Yet, the process of spinning out the company was everything but smooth. The difficulties and conflicts described in the case study should not be seen as exceptional; as merely an incidental conflict between two individuals with dislike for each other. On the contrary, the two persons embody each their rationality, and their conflict is the conflict of those two rationalities, played out in the everyday life of a university department. It is the rationality of academic entrepreneurship against the rationality of academic purity. At present, they each have their own policy patron: science and technology policy on one side, and higher education policy on the other side. Policy-makers need to resolve this opposition. Fundamentally, policy-makers need to rethink the rationality of academic purity. Why is it that an entrepreneurial researcher should not use university resources and thus indirectly taxpayers money to establish a spin-out company? What's the moral difference between using taxpayer's money to fund industrial R&D (through Tekes), and using them to fund the commercialisation of research in universities? Why is the latter inappropriate and the former not? We talk so much about the knowledge economy, about research-based innovation etc., but how are these ideals and visions to materialise, when the only actors whom we seemingly cannot permit to benefit from it – the universities and their researchers – are the ones we expect to run with the ball?

5 Best practices in promoting university interaction with industry

The discussion of best practices in Finland will emphasise the following four characteristics of Finnish science and technology policies: (i) commitment; (ii) clarity and coordination; and (iii) continuous, clever assessment. The discussion of these characteristics of Finnish S&T policy will be illustrated by referring to (i) the additional research appropriation programme; (ii) the common conceptual matrix of public promotion programmes; and (iii) the use of research and evaluation in the formulation of science and technology policies.

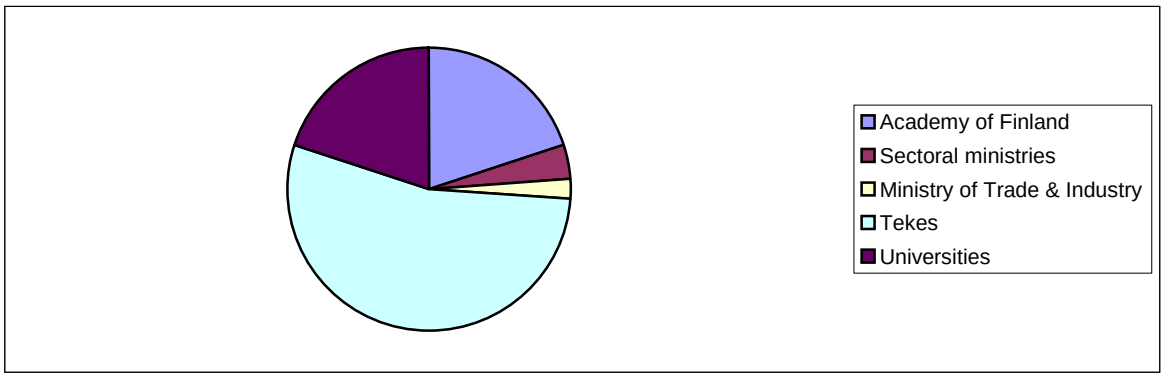
5.1 Commitment: the additional research appropriation programme

In the section above on the history of science and technology policy in Finland, the commitment by Finnish policy-makers to the strategic importance of science and technology policy in the difficult economic situation of the early 1990s was emphasised. Though the Finnish economy recovered from the economic crisis by the mid-1990s this commitment was not abandoned. On the contrary, in 1996, the government of Finland decided to allocate 3,35 billion FIM in proceeds from state property sales, to further increase the level of public funding for research and development.[11] The purpose of this additional appropriation, disbursed between 1997 and 1999, was to intensify the operation of the national innovation system for the benefit of the economy, the business environment and employment alike.

The STP council drew up a plan for the appropriation whereby the bulk of the funds were to be allocated to research and development through the appropriate channels in the science and technology administration, notably by increasing the resources allocated to Tekes and the Academy of Finland by means of competitive tenders.

[11] The following is based on Sitra 2000 and EC 2001.

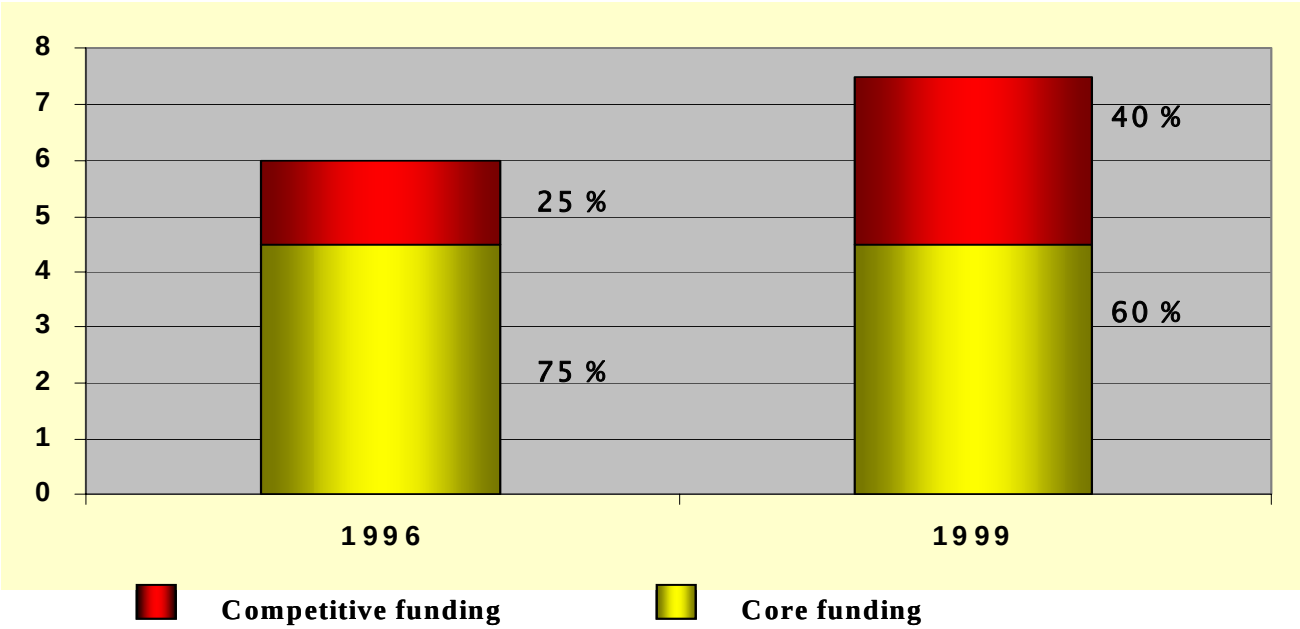
Figure 9 The additional appropriation for research



Source: Prihti et al 2000.

The vast majority of the funds were allocated on the basis of competitive bidding, for which cooperation in and among industry and science actors was explicit key criteria. As is shown in the chart below, the additional appropriation has significantly changed the overall level and composition of public R&D funding.

Figure 10 Public R&D funding in Finland 1996-1999 (billion FIM) [12]



[12] This chart is provided by Esko-Olavi Seppälä, Science and Technology Policy Council, Finland.

The original target in the additional appropriation programme was to raise the national investment in R&D to 2,9 percent of GDP by 1999. This goal was reached and surpassed in 1998. In 1999, an appropriation increment of FIM 1,5 billion was introduced on a permanent basis.

The policy throughout the 1990s of promoting university interaction with industry through continuously increasing the amount of funding available for different modes of collaborative research and development through competitive bidding, has been a core element in Finnish science and technology policy, and it certainly justifies the term *best practice*. The commitment to this strategy was recently affirmed in the triennial policy review by the Science and Technology Policy Council:

> With a view to strengthening innovation and favourable conditions for it, measures will be taken to enlarge the resources of the Academy of Finland and Tekes to enable them to take care of their growing responsibility for the development of new growth fields, research-based innovation and innovation environments (STPC 2003: 37).

5.2 Coordination: common conceptual matrix of public promotion programmes

The Finnish strategy in promoting industry-science interaction has been characterised by a high degree of coordination and clarity. Finnish economic performance in the 1990s has taken great advantage of an unusually clear understanding among different actors of the overall objectives and strategies of the programmes launched to promote industry-science cooperation in research and development. There seems to have been a clear sense of mission among the different actors, which involved also a clear understanding of the different roles that the respective actors were expected to take up in relation to this common mission. Such a common understanding did not develop by chance. The collapse of the socialist markets and the economic recession in the early 1990s created a sense that the country would have to *fight* to recover and to prosper in a new, increasingly integrated Europe. Without an extremely well-coordinated, strategic science and technology policy, this sense of urgency would never, however, have led to a sense of *mission*. The paramount importance of the Science and Technology Policy Council with regard to this coordination is emphasised by all observers (cf., for instance, Ormala 2001).

Finnish efforts to promote industry-science relations have been characterised by a very strong focus on concrete targets – whether a specific *cluster*, a specific *technology*, or a specific *expertise*. Moreover, Finnish efforts have been characterised by making *networking* an integral element of all programmes and projects. The way in which the different stakeholders are involved from the very

first exploratory phases, preceding the launching of a technology programme, is an excellent example hereof.

Though the term itself was not always used explicitly – in industrial policy the preferred term was 'cluster policy' – the thinking, planning and implementation of Finnish policies and programmes throughout the 1990s were all more or less explicitly patterned on the concept of a *national innovation system* (NIS).

> 'NIS thinking' had been gradually entering into policy discussions over the course of the late 1980s. It was taken up a few years before the cluster approach was introduced in industrial and economic policy. Since both the NIS and cluster approaches are characteristically systemic, one is relatively easy to adopt once the other has been adopted. Therefore, the early adaptation of NIS thinking supported the adaptation of a cluster approach. In fact, not only did it support the approach, it also strongly influenced the way in which the cluster approach was introduced into policy making (Romanainen 1999).

This existence of a common conceptual matrix for policy-making no doubt contributed crucially to the clarity of objectives and roles in relation to the promotion of industry-science cooperation. This has been all the more important for the involvement of universities in this cooperation since when *not* convened in and through these public promotion programmes, great confusion prevailed in universities and other higher education institutions with regard to the rules of the game of seeking to become a more entrepreneurial university (cf. the case study).

5.3 Use of research and evaluation in formulating S&T policies

Many observers point to *evaluation* as a key element in Finnish science and technology policies. In its 1990 policy review, the Finnish STP council declared "increased evaluation in all parts of the research system and in different sectors of science and technology policy" to be a key objective (STPC 1990: 62). The Finnish policy on evaluation as a core element of its science and technology policy was outlined in a separate statement by the STP council in 1991. Here, the STP council stressed the need to "extend evaluation to the whole national system of innovation". Three years later, the STP council noted that few of its objectives had "come true as fully as the recommendation for increased evaluation" (STPC 1993: 28). The role intended for evaluation was to continuously inform "objective-setting and selection within the innovation system" and further develop "the knowledge-base which supports decision-making on the improvement of the system" (STPC 1993: 28). Thus, in the Finnish approach, evaluation is an integral element in the ongoing effort to identify and further strengthen the comparative advantages of Finnish economy through R&D, rather than merely an instrument of public control of the correct use of public funds. This applied for the recently completed evaluation of biotechnological research; *Biotechnology in*

Finland – Impact of Public Research Funding and Strategies for the Future (December 2002). This evaluation, funded by the Academy of Finland, evaluated "the current status of the Finnish biotechnology innovation system", and proposed "improvements as appropriate", all in order to "serve as a basis for drafting the next national biotechnology development programme" (Academy of Finland 2002). The evaluation combined an external assessment by an international expert group with an internal self-assessment exercise, and on the basis hereof formulated recommendations directed to the academic sector, the funding organisations and to industry.

> The purpose of the evaluation is two-fold: first, to evaluate the impact of public research funding and second, to advise funding organisations, universities, research institutes and industry how to develop and focus biotechnology and life sciences research in Finland. The mission of this exercise is to improve the competitive ability of the Finnish innovation system in biotechnology (Academy of Finland 2002: 91)

The fact that evaluations are used in this strategic and policy-developing manner is but one expression of the practice in Finland of formulating science and technology policy on the basis of a comprehensive system of continuous policy research and assessment. Another notable example hereof is the launching by Tekes of a technology programme aimed specifically at informing the development of advanced technology policy; namely *ProACT – the research programme for advanced technology policy*. To give an indication of the scope and magnitude of this programme, the individual projects that make up this programme are listed below in table 2.5.

The director of Tekes has motivated the practice of basing the formulation of science and technology policies on research and evaluation in the following manner:

> Policy design and implementation must be innovative and able to experiment with different approaches and tools in order to meet the challenges of the changing innovation environment. This is possible only if the theoretical framework and methodologies continue to evolve and are able to provide a better understanding of the complex interactions and linkages within the innovation environment. Understanding how the system works is the key to successful policy design and implementation. (Romanainen 1999).

Examples testifying to the fact that research and evaluation in the field of science and technology policy are in fact taken seriously, and do in fact strongly influence policy-making are numerous. One classic example is the study on industrial clusters by the Research Institute for the Finnish Economy which preceded and heavily influenced the National Industrial Strategy 1993, and later generations of cluster programmes. A more recent example is the evaluation of Biotechnology in Finland. The biotech evaluation report stressed the need to "modernise University organisational structures… so as to achieve more flexibility" (Academy of Finland 2002: 76), and this was a key focus area of the very recent policy statement by the Science and Technology Policy Council (STPC 2003; see further discussion in section 2.5.3).

An important element of the Finnish approach to the formulation and implementation of science and technology policy is the division of labour between the STP council, the Ministries and the funding and implementing agencies, such as Tekes and the Academy of Finland. That policy-making in this field is extremely well-coordinated, does not imply that everybody are involved in everything. On

Table 6 Overview of the research programme for advanced technology policy

Challenges facing Finland's innovation system	Innovation processes and innovation networks of firms in rural areas and small centres The role of social capital in the innovative process Innovation system in action: an analysis of techno-economic development in the Oulu region The international dimension of the Finnish science and technology system Multinational enterprises and the Finnish innovation system
New perspectives on innovative activity	Challenges and opportunities for the utilization of research results Informal ways to protect intellectual property in SMEs Value creation and renewal of the knowledge base of the corporation Dynamic patterns of innovative activities among Finnish firms R&D patterns in input-output structures
Technology policy and civil society	Technology policy, citizenship, and every-day life A rhetoric of innovation in the case of welfare clusters Toward a multi-purpose technology policy Communicative order in the age of information technology DIGITAL HUBRIS – on the mental and moral dimensions of the computerized network-society Information technology in Finland after World War II: The actors and their experiences
Co-operation and interaction in innovative activity	Producer-user collaboration and new forms of innovation activity Technologies, strategies and women's business activities within the new economy Public-private partnership in market construction Increasing eco-efficiency: an analysis of factors generating innovations Processes and boundary conditions for embedded foresight in innovation networks
Biotechnology and society	Managing transepistemic innovation processes Biotechnology as part of the national innovation system Acceptability and interaction as a challenge for technology projects Rights and responsibilities in biotechnology

Source: Tekes 2003

the contrary, a substantial degree of autonomy with regard to policy implementation have been delegated to the funding agencies.

> Individual research or technology programmes are not decided by the Council, nor by the ministries, but at the level of the implementing agencies. This makes it possible for the system to react relatively quickly to new industrial and societal challenges as they are identified (Romanainen 1999).

Tekes employs staff with research experience and significant understanding of those technological fields that they are involved in evaluating and further developing. This enables Tekes to provide scientifically high-quality mediation between public science researchers, industry partners, and other players in the innovation system. This system of basing science and technology policy on research and evaluation, and of basing policy implementation on scientifically high-quality mediation certainly qualifies for the term *best practice* in promoting university interaction with industry.

6 Future challenges in Finland

In the following three main challenges facing Finnish policy-makers with regard to the promotion of university interaction with industry will be discussed. These are: (a) Commercialisation & Internationalisation (b) Integration of higher education policy and science and technology policy (c) Shaping up the university for third mission

6.1 Commercialisation and Business excellence

Observers stress that much of the Finnish economic growth over the past decade has been based on business-to-business product development and sales. The core competences of the Finnish growth success have been technological. There is widespread recognition that Finland is underperforming when it comes to business management competences of an international standing. This was noted, most recently, in the international evaluation of the Finnish biotechnology sector:

> Competent and experienced managers are in short supply; a national effort to train managers and business development specialists for biotech would be very beneficial (The Academy of Finland 2003: 77).

The Helsinki School of Economic recently launched a new degree programme in Biotech Management. Without going into detail on the profile of this programme, one can appreciate that this well illustrates the mutual responsiveness in and among the different actors of its national innovation system that Finland in recent years has become so famous for. Key agents in the Finnish national innovation system are discussing, at present, the possibility of creating a national centre of

excellence in business management (Seppälä 2002, Romanainen 2002). Generally, an increased focus on internationalisation in the Finnish national innovation can be noted, reflected also in the title of the recent policy review from the Science and Technology Policy Council, *Knowledge, innovation and internationalisation*.

> The national line of development, which has proved successful, will be continued and further strengthened. In keeping with that, input will be made into the production of technological and social innovations and into *the expansion of internationally successful business* built on it. The set of measures thus determined will form the core of the future national strategy (STPC 2003: 35, italics added).

In the Finnish approach to strengthening its national innovation system, the focus has previously been on stimulating co-operative research in technological fields closely related to its key industrial clusters. *Commercialisation* of university research results *as such* did not enter the policy agenda in Finland until the latter half of the 1990s, and is only recently being considered a policy agenda in its own right. One may expect the Finnish innovation model to broaden in the coming years, in terms of seeking to mobilise universities to contribute to economic development in other ways than through co-operative research. This is very likely, however, to accentuate the tension between the rationales of Finnish higher education policy on one hand, and the rationales of its science and innovation policies on the other hand.

6.2 Integration of higher education policy and science and technology policy

In the section on best practices above, it was stressed that a key component of the Finnish approach has been a high degree of integration of policy-making across a number of key policy areas, including science, innovation, industrial, and economic policies. There is, however, in this coordinated policy-making, a missing link: namely higher education policy. This was noted in a report evaluating the role of universities in the Finnish national innovation system:

> It has to be noted… that [overall] developments in the realm of higher education policy did not have any (visible) links to science and technology policy. For historical reasons, links between these two policy realms have been weak, even though the target institution of the policies has been the same (Nieminen & Kaukonen 2001: 33).

The tension between these two policy agendas was illustrated in the case study on the process of spinning out of a plant-biotechnological company from the University of Helsinki in the late 1990s. A working group under the Finnish Ministry of Education has recently developed a set of guidelines for how universities should promote research-based entrepreneurship. There are ten such guidelines a few of which (italicized) strongly exemplify the fundamental ambiguity with regard to the entrepreneurialisation agenda:

1. Universities should promote research-based entrepreneurship, that is (i) compatible with university's mission and objectives, (ii) compatible with strategy and main activities, (iii) not in conflict with main purposes.

2. University's funds should not be used for the development of new business activities.

3. University's liabilities and guarantees should be clearly defined in contractual agreements.

4. Attention should be paid to possible interest of conflicts between researcher and entrepreneur.

5. Attention should be paid to possible disqualification due to conflict of interest of a researcher/entrepreneur in specific research topics/projects.

6. Entrepreneurship activities should not compete with the teaching and research as the prime activities of universities.

7. The procedures of permission for secondary occupation/ perquisite position should be followed.

8. Confidentiality aspects in contract research needs more attention.

9. University employees or students as participants in entrepreneurship activities should not receive any monopoly rights.

10. University name and logo should not be used in entrepreneurship activities by private researchers/entrepreneurs.

Source: Mäkipää 2003

The message of these guidelines is ambiguous. University entrepreneurship is on one hand encouraged, and on the other hand illegalised: university funds should not be used for new business activities and entrepreneurship activities should not compete with teaching and research as the prime activities of universities. Universities are encouraged to promote research-based entrepreneurship, but are also made clear that any substantial allocation of funds and/or resources in terms of working hours is illegal. This construal of a fundamental opposition and conflict of interest between the traditional missions of universities – research and education – and the new third mission – promoting the utilisation of new knowledge and contributing to the economy – is highly problematic. Framed in this manner, university entrepreneurship seems to be alienated from the outset, rather than being taken up as truly a new *mission* for universities.

In recent months, the Committee on University Inventions have been working on a proposal for defining the "third mission" of the universities in the University Act (Kauppinen 2002). The public does not yet know the contents of this proposal. It is expected, however, that the proposal will be put forward after the upcoming general elections.

6.3 Shaping up the university for third mission

The Science and Technology Policy Council (STPC) in Finland recognises that introducing to universities the third mission of promoting the utilisation of new knowledge demands a commitment from policy-making, both in terms of increased funding and in terms of a revision of the legal framework within which universities operate. The recent policy review from the STPC

explicitly states, “the implementation of the national strategy entails that university core funding is increased” (STPC 2003: 20). Moreover, it is recognised first, that changes taking place with regard to the universities’ mission is shaking up the university as its core, and secondly, that this requires, on the part of policy-makers, that universities are correspondingly *shaped up* to its new mission, by addressing the involved legislative issues.

> Ever since education and research – knowledge and know-how – took centre stage in the development of societies, systematic input has been made into their development. The quality, quantity and right targeting of education and research pose a challenge to all industrial countries … Various research, studies and pilots are being conducted to find out the measures needed to obtain the best results from the inputs made into education and research and the best impact from outputs in terms of both efficiency and quality-based productivity. One major question is how the *university as an institution* will be able to manage the pressures and growing expectations directed at it with regard to social, cultural and economic development – whether the university has the internal capacity for renewal needed to lighten its work load in the face of constant new challenges. The traditional mission of the university is to promote free research and scientific education and to provide higher education based on research. The burning question in today's debate how to include the duty to *promote the utilisation of new knowledge* in the Universities Act the as the university's third mission. This question arises from both the growing expectations directed at universities by the users and from the legislative issues involved in efforts to reconcile the university's administrative culture, business and research ethics. The need to address these questions is tangible, because the change taking place in universities' mission and funding structure is systemic, shaking up the institution to its core (STPC review 2003: 19).

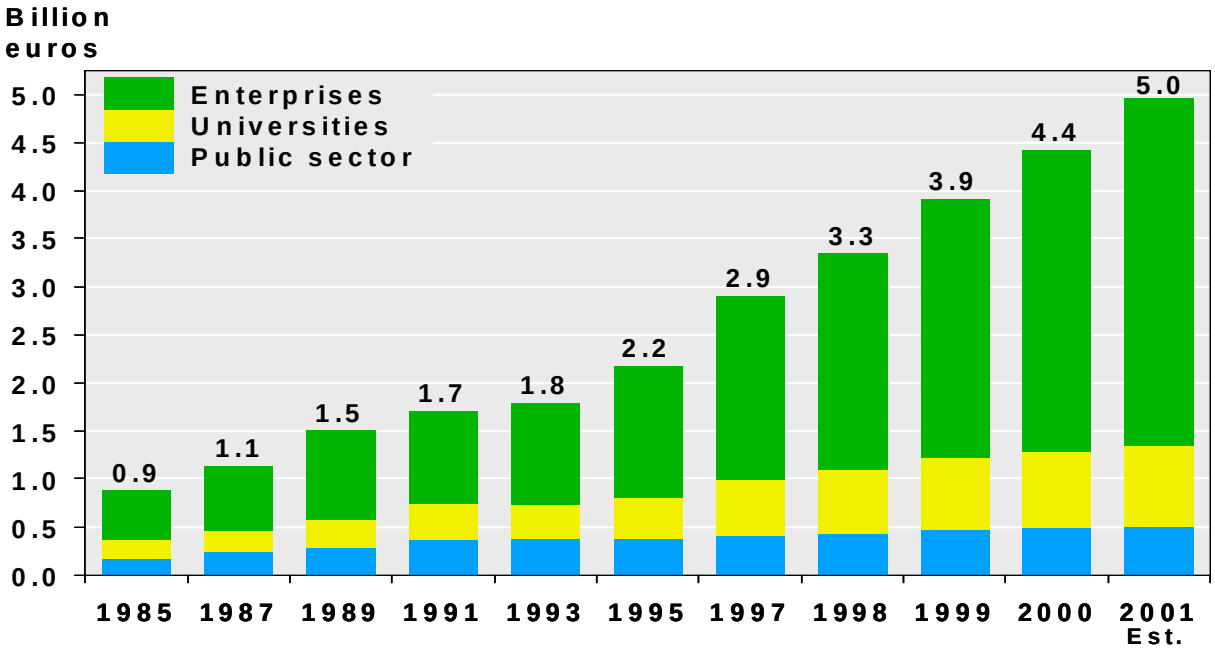
It shall be exciting to see how Finland, in coming years, will deal with this task of adapting the legal framework for universities to its new mission. As noted by Erkki Ormala, the director of technology policy at Nokia, at present university regulation is not aligned neither with the development of the Finnish national innovation system as such, nor with the changing role of universities in the wider global economy (Ormala 2003). Ormala argues a strong case for increasing the basic budgets of universities, but he also argues that such increases in funding streams to universities should not me made without prior structural changes of university regulation and administration. In its concluding sections with policy recommendations, the Science and Technology Policy Council clearly indicates its approach to these issues:

> Universities meet the full force of expectations for social, cultural and economic development. The growing expectations involve open legislative issues concerning ways and means of reconciling administrative cultures, research ethics and business activities in universities. The ongoing transformation of the university mission and funding structure is systemic; it challenges the whole institution to its very core. A new challenge for universities and the whole research system is to be able to combine in-depth specialised knowledge with versatile expertise for the benefit of users and in contract research and in joint projects with them. A question partly relating to this is the future of higher education on the whole: how its different parts will take shape jointly and separately. Universities must have the possibility and capability for organising their economy and administration in a way which will enable their actual operations to develop flexibly (STPC 2003: 38).

7 Concluding remarks: funding as a change agent

All observers agree that the additional research appropriation programme and the massive emphasis in Tekes' funding on promoting research and technology networks, has been a crucial factor in the developmental success of Finland. Observers agree that it is primarily in and through Tekes technology programme activities – in and through the networks, and the concerted effort and action thus generated – that a veritable R&D boom has taken place in Finland. The below figure conveys the magnitude of this boom.

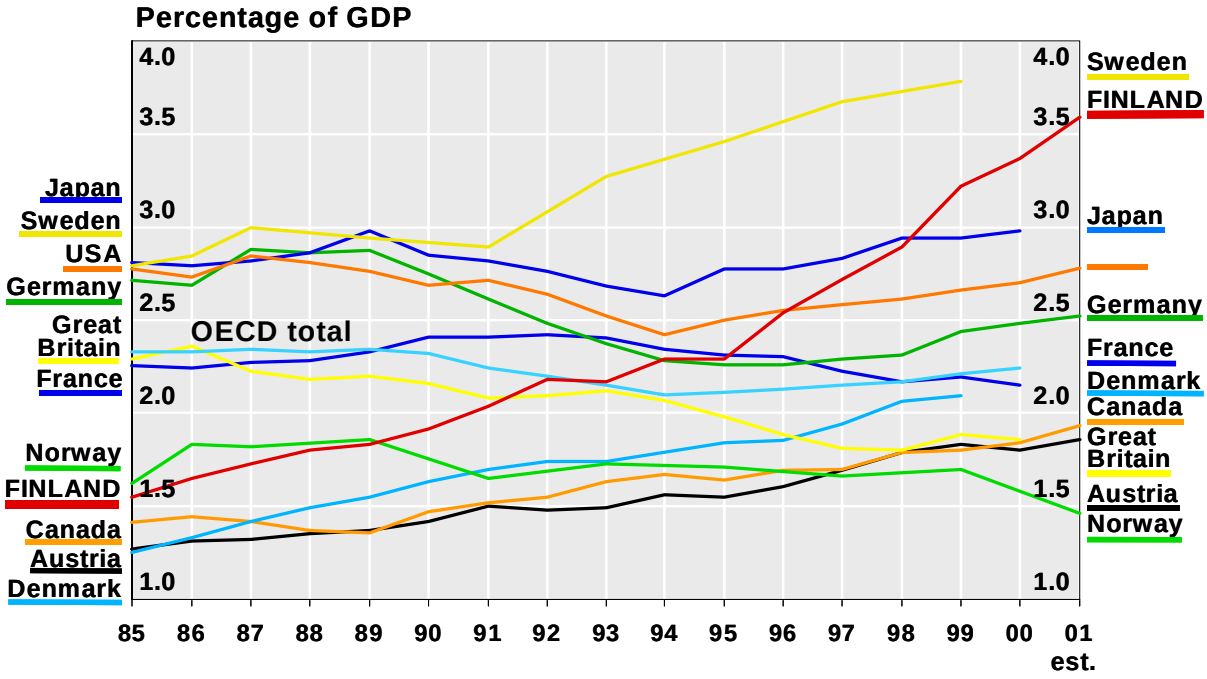
Figure 11 R&D in Finland, 1985-2001



Source: Romanainen 2002

This R&D boom has taken Finland from a position in the lower of end of OECD-countries when it comes to R&D spending, to the absolute top, cf. figure 4 below.

Figure 12 R&D in OECD countries



Source: Romanainen 2002

In 2001, Finland was given top ranking in terms of economic and technological competitiveness in five independent international comparisons, and academic scholars has begun speaking of a 'Finnish model' (Castells & Himanen 2002). Finland is widely renowned for its impressive transformation from being an economy in crisis after the collapse of the socialist markets in the late 1980s and a severe banking crisis in the early 1990s, to being a front-runner economy in terms of innovation and competitiveness. The central element in 'the Finnish model' is the very well-developed networks in and among companies and universities, and their strong orientation toward R&D cooperation. Just to mention one aspect of this, Finland has achieved a level of cooperation among innovative firms, universities and public research institutes that is truly extraordinary: 70 % of Finnish innovative firms cooperate with other firms, universities or public research institutes. In comparison, the EU average is 25 pct. Observers agree that public funding in general and Tekes in particular has been a crucial change agent in promoting this transformation of the Finnish economy.[13]

[13] Some might argue that the role of Nokia should have been stressed. I disagree. Nokia was of course important, but the growth of Nokia should not be seen as external or exogenous to the developmental strategy of Finland, quite the contrary. Though the success of Nokia certainly benefitted from the ICT boom, and though the rest of the Finnish economy benefitted from Nokia's growth, one should not reduce Finnish achievements to a coincident ICT boom, but rather be impressed that Nokia better than any of its competitors survived the ICT crash, a fact that perhaps more than

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