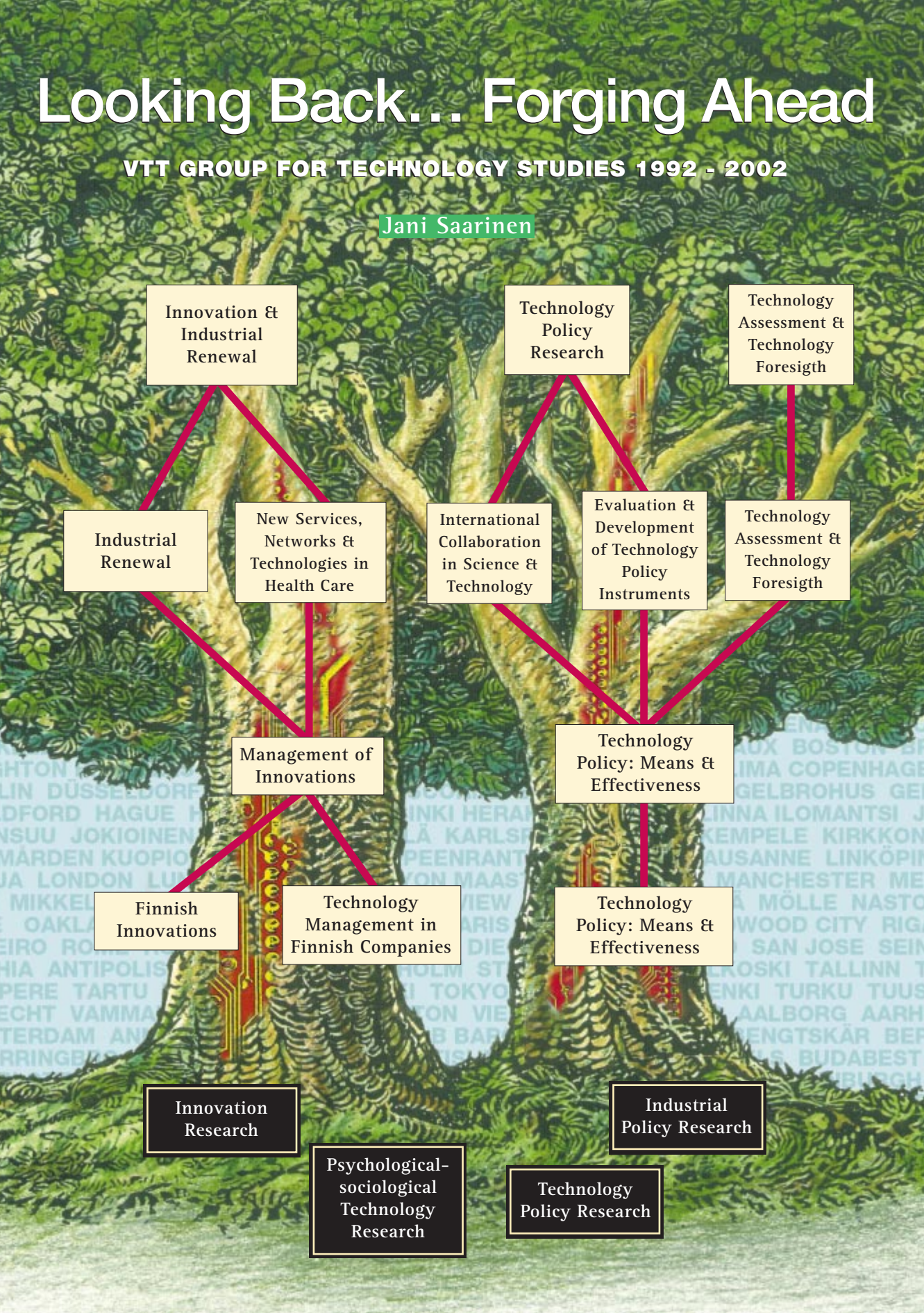
Looking Back... Forging Ahead

VTT GROUP FOR TECHNOLOGY STUDIES 1992 - 2002

Jani Saarinen

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Foreword

Towards an in-depth understanding of successful innovation activity

New knowledge and innovation are among the primary driving forces of industrial renewal and socio-economic changes both nationally and globally. Successful innovation requires a combination of several factors, such as high-level education, qualified R&D and knowledge management, the ability to foresee and assess socio-economic impacts of innovation, and promotion by policy instruments in favourable innovation environments. According to recent records Finland has been successful in developing a technology- and knowledge-based society as well as its related global competitiveness.

In this operating environment the prospects for VTT Group for Technology Studies in its 10th anniversary year are promising but also challenging. The research of VTT Group for Technology Studies is aimed at supporting strategic choices and decision-making of public and private customers in order to foster and develop technology- and knowledge-based welfare in Finland. Besides supporting policymaking in the Ministry of Trade and Industry, the National Technology Agency (Tekes), other ministries, and the EU, the research of VTT Group for Technology Studies serves the business community.

The understanding of innovation dynamics and patterns is a fundamental challenge for the research of VTT Group for Technology Studies. Deepening our knowledge of the emergence and diffusion of innovations as well as their social shaping and effects requires an in-

depth exploration. The foresight studies of new technologies and the assessment of their socio-economic, ethical, ecological and other boundary conditions provide necessary guidance for R&D and resource allocation in the private and public sectors. The evaluation of the effectiveness of innovation policy measures at regional, national and EU level is a basis for policy initiatives. In all these areas VTT Group for Technology Studies accomplishes qualified research aimed at strengthening public and private decision-making.

This year is the 60th anniversary of VTT and the 10th anniversary of VTT Group for Technology Studies. The primary objective of VTT Group for Technology Studies is to provide high-level research services in collaboration with our national and international partners and networks for the benefit of our public and private customers.

Erkki KM Leppävuori
Director General

Torsti Loikkanen
Research Manager

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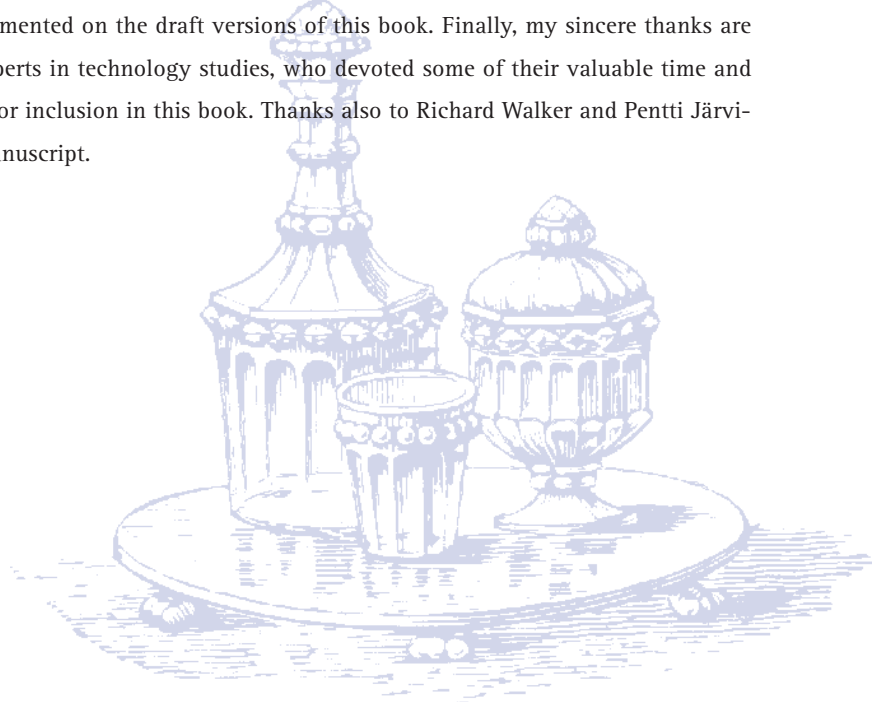
Preface

In 2002, at the same time as VTT honours its 60th anniversary, the Group for Technology Studies (TTR), celebrates its 10th year of activity. The idea of writing a book on the Group's history was first muted last year. After a short incubation period, the task was assigned to me. Fortunately, the history of the Group has been well documented. In addition, the interviewees had crystal clear memories on the early stages of the Group. Hence, for me as a student of economic history, the biggest problem was the amount of important information available, not the lack of it.

Despite the relative short period of time spent writing this book, I was assisted by a great many people. First of all, it would not have been possible to write this book at all without the efforts of Mr. Tarmo Lemola, who fought for the establishment as well as the existence of the Group. I also wish to express my deepest gratitude to the past and present members of the Group, who have actively commented on the draft versions of this book. Finally, my sincere thanks are due to a number of experts in technology studies, who devoted some of their valuable time and prepared short papers for inclusion in this book. Thanks also to Richard Walker and Pentti Järvinen for revising the manuscript.

Espoo, May 2002
Jani Saarinen



Introduction

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The VTT Group for Technology Studies was established as a fixed-term project in February 1992 and was granted permanent status in 1995. Organisationally, the group formed a part of the Management Staff of VTT (Technical Research Centre of Finland). The purpose of the Group is to strengthen the knowledge base for both public and private as well as national and international decision-making on the development and adoption of technology. The Group's main fields of research are related to understanding innovations and industrial renewal, evaluation of technology policy initiatives, technology foresight and technology assessment. In particular, the Group provides input for technology policy formulation and for the management of technology in the public and private sectors.

Like similar organisations abroad, e.g. SPRU (Science Policy Research Unit), MERIT (Maastricht Economic Research Institute on Innovation and Technology), FPI (Forskningspolitiska Institutet i Lund), and ISI (Fraunhofer Institut für Systemtechnik und Innovationsforschung), the Group is multidisciplinary, with researchers representing engineering, the social sciences, economics and business administration. This is due to the nature of technology research, where an understanding of the interactions between technology and society requires interdisciplinary collaboration. An important resource for the Group is the broad and diversified technological expertise of VTT, which is the largest technical research centre in the Nordic countries. Co-operation and joint projects with VTT's research institutes are an essential aim of the Group's activities.

The Group participates in a national co-operation network for technology studies, which comprises researchers from universities and research institutes in the fields of economics, the social sciences and industrial engineering and management. The National Technology Agency (Tekes) and the Ministry of Trade and Industry play a prominent role in the network by both initiating and funding research and by exploiting the achieved findings. Internationalisation of the co-operation network is a growing area of the Group's activities as well. This work includes joint projects with similar institutions in other EU countries, participation in European research programmes, and providing information and tools for the EU Commission.

In 2002 the Group celebrates its 10th anniversary and this book is being published to mark the event. Hence, the main objective of this book is to introduce and describe the major research projects of the Group during the first decade of its existence. This book will briefly illustrate the specific contexts and national needs that led to the start of these projects. By doing so, we can follow the early development of the specific atmosphere of the research field known as technology studies – how it has evolved and what the situation is today, and also consider the future prospects.

The outline of this book is as follows. In chapter 2 an overview of the national needs for technology studies is introduced, followed by a brief introduction to the institutional set-up in the early 1990s. Thereafter, a short presentation of the establishment and evolution of the Group is given. In the third chapter, experts of technology studies share their views of the present developments in this particular field in Finland. In chapter 4, which is the main chapter of this study, the major projects of the Group during its first decade of activity are revisited. A division into two different research areas, innovation and technology policy research, has been made. Organisationally, these two areas have been the core of the research work done by the Group. Chapter 5 concludes the study with a description of the situation today as well as some expectations for the future. The last chapter contains a bibliography covering the first decade of research by the Group.

Historical overview

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The purpose of this chapter is to introduce both to the "climate" of technology studies in Finland and the situation in this field over the ten-year histyory of the Group. This section will also try to answer to the question of whether there is a need for technology studies in Finland. The first section (2.1) is mainly based on the Tekes publication on "Development of Technology Research in Finland" from 1990.[1] In that specific study, the institutional settings of this kind of research both in Finland and abroad were presented. In the last two sections (2.2 & 2.3), the focus is directed more to the establishment and development of the Group for Technology Studies. In these chapters, the main source of inspiration has been the annual reports of the Group, as well as interviews with the researchers of the Group.

2.1 National needs and institutional set-up

> *"The lack of technology research in Finland should not be the reason for starting this kind of research"*
> *(Tekes project "Developing technology studies in Finland" (a comment made at a meeting of supervisory board in 1990)*

According to conclusions of numerous economic, social and management studies, innovation and technological change are among the primary driving forces of industrial renewal. An effective utilisation of technological change as well as a capability to direct resources of technological development meaningfully require knowledge about the factors affecting the origin and development of technology. This research area, which can be approached from various scientific directions, has been called technology research.

The Finnish economy faced many socio-economic and technological changes during the first half of the 1980s. Considering the structure of production, the number of firms producing high-technology products and utilising the most recent technology available increased rapidly. In the

[1] Lemola, T.; Loikkanen, T.; Lovio, R.; Miettinen, R. & Vuorinen, R. 1990. *Teknologiatutkimuksen kehittäminen Suomessa (Development of Technology Research in Finland)*. Tekes Publication 24/90. Helsinki.

beginning of the 1980s, the industrial sector made an initiative in order to improve the level of research and development in Finland. The reasons for this initiative were to diversify the technological base, increase value added, and boost competitiveness on the international market. Since then, private investment in research and development (R&D) have risen steadily. Since the mid-1980s, the role of the public sector has also increased, especially due to the foundation of Tekes in 1983, its technology programmes, etc.

During the 1980s, technology research in Finland was still in its early stages. However, after a difficult period in the mid-1980s, a clear need to increase the amount of research and enhance the academic level of technological R&D was recognised. The Technology Council stated already in the "Council Commitment" (1980:5, p. 8)[2] "that the developments of the last decade have witnessed that the entire society has become strongly dependent on technology and technical development". In addition to incessant demands from the Science and Technology Policy Council for research on this area, other sectors of society facing the challenges of technological change and technological foresight also recognised the need for such knowledge in order to support their decision-making.

The 1980s saw increasing interest and initiatives in the field of technology research in Europe (SPRU, MERIT, ISI etc.). This kind of systematic research was lacking in Finland. However, during the 1980s, some technology-related studies were done in the field of economics. In Finland, the economic sciences were divided into three different scientific sub-disciplines) – the economics, business economics, and engineering economics – which were loosely, if at all, connected to each other. This was mainly due to the fact that these sub-disciplines were located in different research institutes: economics in universities, business studies in business schools, and engineering economics in universities of technology. In each of these institutes, some efforts were made in the field of technology studies. The research itself, in terms of its scientific value and objectives, was partly similar in these three fields. However, the research methodologies and approaches differed greatly.

2.2 The establishment of the Group for Technology Studies

The Group for Technology Studies was created from a clear need to increase knowledge and understanding of the prerequisites, nature and effects of innovation and technological change in Finland. Among the most important users of this information were the public organisations and private companies that determined the scope and scale of research and development investments. Besides these groups, however, the number of users of the knowledge was rising as the effects of technological change reached more and more areas of society.

[2] Technology Council. 1980. *Teknologiakomitean mietintö (Technology Council commitment).* 1980:5. Valtioneuvoston kanslia, Helsinki.

The establishment of the Group alone illustrated the need to increase and diversify the scope of technology studies, but the history of technology studies in Finland did not begin there. Phenomena related to technical change had already been studied at VTT and other research organisations and universities. In fact, the first article published in Finland, "Technical research and innovation – review of the innovation literature" by Tarmo Lemola in a magazine called "Research and Technology", dates back to the year 1979. The information gathered in studies, mainly the research done by Raimo Lovio during the 1980s, provided a good foundation for expanding knowledge and improving competence in the field.

When the VTT Group for Technology Studies was established in February 1992, it was decided that the Group would be a fixed-term project scheduled until the end of 1995. Its future would be decided on the basis of the results and experiences gained by that time. At the same time as the Group began its operations, a decision was made that an interim evaluation of the Group's activities would be carried out in 1994.

During the review process, the evaluators emphasised two reasons for the existence of the Group. First, there was a general need to improve the knowledge base in science and research policy in Finland. Second, there was a practical need to improve the level of planning both nationally and in individual organisations such as VTT. According to the evaluators, Dr. Ormala and Dr. Räsänen, the activities of the Group as a whole were proceeding according to the plan and the necessity for the Group was substantiated.

In the evaluation report, the Group for Technology Studies was studied as part of the Finnish research co-operation network for technology studies. Taking this into consideration, the evaluators emphasised the fact that the Group was the only one of all the units within the network that had maintained the focus on technology studies. This bestowed upon the Group a highly regarded position and responsibility in the field.

Another noteworthy feature of the Group that the evaluators highlighted in their report was its presence within VTT. This connection to a strong and diverse technical research centre opens up opportunities to exploit both VTT's expertise and its broad client and co-operation network. The main challenge for Finnish technology studies as well as for the Group, according to the evaluators, was to strengthen of the position within the international co-operation network. In order to do this, both high-level internationally esteemed publications and active participation in international co-operation projects were considered necessary.

As to the focus of the Group's activities so far, the evaluators emphasised that the three designated research areas – Finnish innovations, technology management in Finnish companies, and the means and effectiveness of technology policy – embodied a well-planned foundation for technology studies. In addition, it was mentioned that the Group's research had been conducted using practical approaches to satisfy practical needs while integrating this into the latest theoretical research.

Also worth noting is the evaluators' concern about the small size of the Group as compared to its foreign counterparts. In addition, there was a reason to question whether the three research areas exhibit adequate diversification, even though they did cover a wide spectrum of relevant fields. The evaluators offered the obvious solution by suggesting that the activities of the Group be expanded and diversified and that the knowledge base be deepened. The latter requirement meant that the research level of the Group would have to be raised to the highest international standard.

In connection with VTT's operational plan for 1995, it was decided to make the Group's position permanent from the beginning of 1995.

2.3 Evolution of the Group for Technology Studies

The following citation has been borrowed from Tarmo Lemola, the founder of the Group, in order to illustrate the evolution and societal challenges of the Group:

"Starting up a new research group – even a small one – is always an exciting development process. The new group must find a niche of its own among existing and already firmly established research interests. It must devise sustainable guidelines for its own work and create the conditions necessary for the accumulation of knowledge and skills. It should be persistent enough to pursue its basic policy, but also flexible enough to adapt readily to the changing needs of constituencies.

The articulation of research needs is one of the most demanding challenges facing new research groups. Unfortunately, there are no simple responses to tough challenges. Real needs are not necessarily identical to the acute problems faced by decision-makers. We have also learned that research needs cannot be derived directly from theoretical discussions or from problems that interest or excite researchers.

As students of innovation, we know that the problem can be solved. In short, we must increase co-operation between the producers and users of knowledge. We must concentrate on the identification of research needs and the formation of projects. We must develop the forms of reporting research findings and of applying them. But we must also leave room for the creation of expertise that consciously maintains a certain distance from practical decision-making. These considerations have not necessarily obtained the attention they deserve in our work, although signs of improvement are already apparent." (Tarmo Lemola, 1995.)

Consequently, the Group for Technology Studies evolved in close co-operation with other Finnish researchers and research organisations. In December 1993 VTT Group for Technology Studies and ETLA (The Research Institute of the Finnish Economy) began the development of a co-operation program for technology studies. The goals of the co-operation program were to improve the prerequisites for technology studies in Finland, to ascertain which topics and areas showed an urgent or clear need for more research, and to increase and strengthen national co-operation in

the field. The program was supported and financed by the Ministry of Trade and Industry and completed in September 1994. In addition to VTT, ETLA, and the Ministry of Trade and Industry (MTI), researchers and representatives from Helsinki University of Technology, the Helsinki School of Economics and Business Administration, Statistics Finland and Tekes participated in preparing the program.

Even though the development of national co-operation has received a strong emphasis within the program, it was clear that the questions concerning international co-operation played a central role in the implementation of the program. The aim was to integrate the projects with international and especially European co-operation networks. The opportunities offered by the EU's fourth framework program was employed for this purpose. Another important aim of the program was to secure an advantageous position for Finnish technology studies in the EU's science and technology policy planning.

Since the earliest days of the Group's existence, internationalisation has been considered one of its most important tasks. As mentioned above, the goal for the Group has been to achieve an internationally moderate level of research in terms of quality. The first project on the internationalisation issue started already during the first year of activity. It was a Eureka project, in which the goal was to analyse the results and benefits of Eureka for Finnish companies. This was followed by projects related to ESA (European Space Agency), ISE (Innovation Systems & European Integration), EIMS (European Innovation Monitoring System), the European Union's Framework Programmes II - V, COST (European Co-operation in the field of Scientific and Technical Research), ETIC (Economics of Technological and Institutional Change), ASTPP (Advanced Science and Technology Policy Planning), and ESTO (European Science and Technology Observatory). The last mentioned network project is still active today. All this international co-operation has created a significant core competence that can be utilised when facing future challenges. In addition, these projects have helped especially young scientists to forge new and valuable international contacts.

In 1997 the Group organised and participated in events that symbolise the nature of its tasks. In May the Group invited its partners to join in a seminar discussion on "*Technological Development - Personal Visions of Doom and a Better Life*". In June the Group hosted a larger conference of the Six Countries Programme network on "*The Past and Future of EU Research Funding*". In the autumn the Ministry of Trade and Industry launched the first Finnish "*Programme of Technology Studies*", marking the shared commitment to invest in wide-ranging research in technology development and application. Together these events indicated the maturity of Finnish technology studies in raising fundamental themes and facilitating dialogues on them.

As new forms of activity, the Group started to offer services in Technology Foresight (TF) and Technology Assessment (TA). Both were well received. There seemed to be an acute demand in Finnish industry for systematic TF projects. This work was also closely linked with the European Science and Technology Observatory network, which was serving the needs of the EU Commis-

sion. In Finland, attempts to start systematic TA activities were made as long ago as in the 1970s. In 1993 the Finnish Parliament's Committee for the Future was established and TA became one of its areas of responsibility. In 1997 the Parliament gave the first TA assignments. The Group has been actively involved in parliamentary TA projects since then.

During the late 1990s the number of researchers in the Group increased in line with economic development in Finland. New large projects were started, new collaborative contacts and studies, both domestic and international, were created and carried out, and some serious discussions on new ways of organising and institutionalising the Group were on the agenda. However, difficulties encountered since the turn of the millennium have led to these plans being buried for the present.

Dr. Keijo Räsänen
Research Manager 1997

Mr. Tarmo Lemola
Research Manager 1992–1996 and 1998–1999

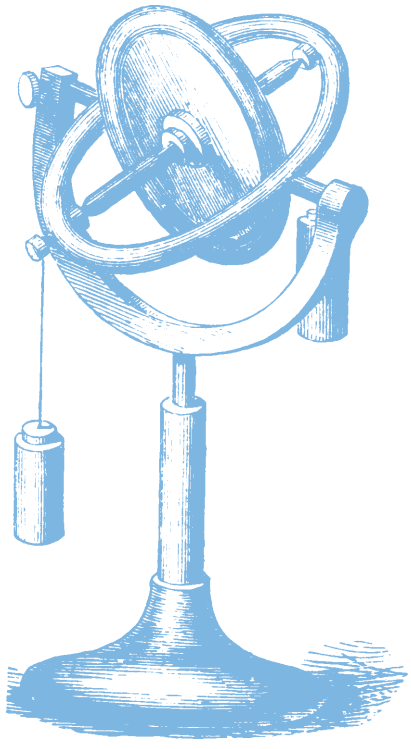
Dr. Terttu Luukkonen
Research Manager 2000

Mr. Torsti Loikkanen
Research Manager 2001–

Technology studies in Finland

3

In this chapter, some experts of technology studies shared their views of the present developments in this field in Finland. This group of experts consists of both scientists and policy-makers who have been active in this field for a long time. As the only instruction for their contributions, we asked them to describe what has happened in the field of technology studies in Finland over the last ten years. The size limit of the papers was one page. The following six papers introduce different perspectives on the developments of this field during this specific period of time.



Martti af Heurlin

Tekes – The National Technology Agency

VTT Group for Technology Studies has played an important role in the Finnish master play of innovations

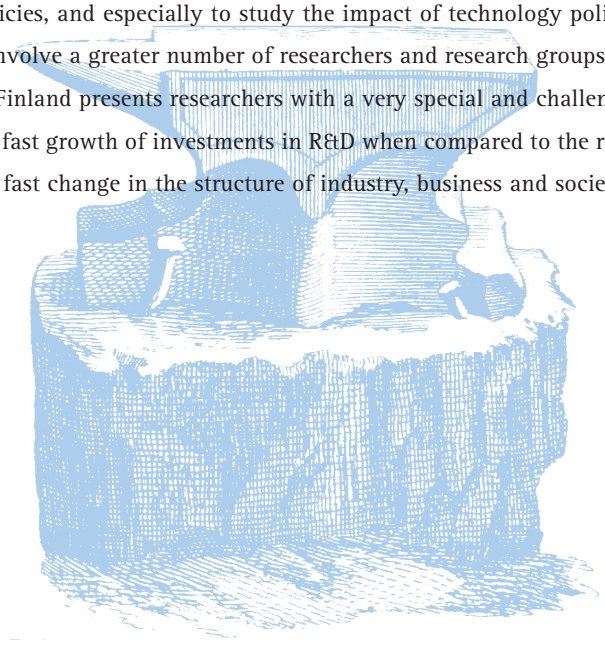
The national technology policy went through a strong and dynamic period in Finland during the 1980s and 1990s. The Finnish approach was relatively pragmatic: we decided to invest and, in practice, did invest a lot in R&D over these twenty years. Mainly private but also public investments in R&D increased during the period. The early 1990s were a good time to concentrate on how to plan, measure and follow up technology policy at a general level and the specific measures taken in this field. Highly important phenomena in this process included the growing interest and investments in technology and innovation studies, which helped us to understand the innovation processes, R&D investments, and the impact of technology policy in general. The Group has been a very important unit in this learning process by accumulating knowledge of impacts in the innovation investments.

The approach of the Finnish technology policy has been relatively pragmatic. Rather than spending too much effort on planning and measuring, we have taken decisions to invest in R&D and we have implemented those decisions by increasing funding and services. However, for decision-making and implementation of a technology policy, we now need more information and feed back about the experiences.

The expertise and knowledge needed to understand the dynamic life of innovations and the innovation environment is becoming more and more important. We have to develop this understanding in a multi-dimensional way. In this process, we need to involve political bodies, policy implementers, research units, the media and many other partners that have different viewpoints. We must also ensure that they all work together.

From the point of view of technology policy implementers, the increasing competence of the Group has been most important. The studies conducted by the latter have helped develop services and instruments for future needs, to better understand innovation processes and to sharpen the specific tools used in promoting innovations. They have also helped Tekes, as the key operator in the whole innovation service environment in Finland, develop funding and service schemes.

In the future, we will have to invest more and in a multi-approach way in research and studies for technology and innovation policies, and especially to study the impact of technology policy investments. For this, we have to involve a greater number of researchers and research groups to build up our knowledge platform. Finland presents researchers with a very special and challenging environment: an exceptionally fast growth of investments in R&D when compared to the rest of the world, and an exceptionally fast change in the structure of industry, business and society.



Jorma Hattula

Professor emeritus

When I became Director of the Science Policy Division at the Ministry of Education in August 1993, I was asked about my plans to promote science policy studies. I was also told that a group for technology studies had started at the Technical Research Centre of Finland (VTT) under the auspices of the Ministry of Trade and Industry. Since I have always been against setting up new institutes and institutions, I began to think of other alternatives. It is easy to establish new institutions but extremely difficult to shut them down, even if they become redundant.

After discussing the matter at the Ministry of Education, I decided to turn to the Academy of Finland. Many planning officers from the former planning office still worked at the Academy. Also, several experts now engaged in technology administration and many researchers working at VTT originally came from the Academy. Professor Antti Tanskanen, the then chairman of the Academy's Central Board of Research Councils, was of the opinion that a research programme would be a natural solution for the Academy in this matter. Consequently, the matter was further developed based on this concept.

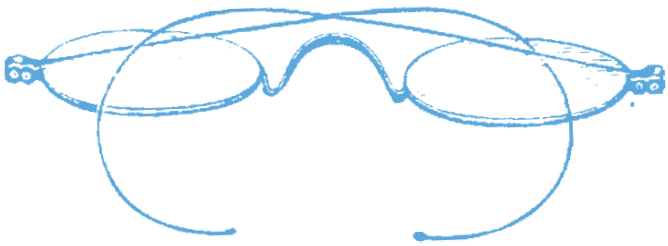
Preparations for a research programme on science and science policy studies were made in 1995. As often with a bottom-up model, researchers wanted to make sure that their own research areas were included in the programme. For this reason, the programme was not focused clearly enough at the beginning, and it became even more difficult to focus it when selecting projects for inclusion. The Academy expects its research programmes to generate synergy added value. How-

ever, the research programme quite often ceased to be a programme after the funds had been granted. It now appears that even though the Research Programme on Science and Science Policy Studies contributed to a better understanding of those making decisions, it generated little new knowledge that was applicable directly to science policy solutions.

When the Academy closed its science policy unit, it commissioned studies from outside groups and researchers. VTT Group for Technology Studies was naturally among them, in addition to university groups. A problem with VTT was, however, the high overheads involved. This factor reduced interest both at the Academy and VTT. Special arrangements were made to improve the situation, and the Academy used especially those studies by VTT Group for Technology Studies that related to EU research programmes.

There are only a few researchers in Finland, particularly with degrees in natural sciences or engineering, who are specialised in science and technology studies. VTT Group for Technology Studies as well as university groups have done some good work in training new researchers. There have also been several attempts at establishing a graduate school in the field, and this has finally succeeded. The start is quite modest but it provides a good basis for future work.

The greatest challenge to science and technology studies is to raise the standard of research to the forefront of the field internationally. This is best achieved by working at leading research institutes abroad. VTT Group for Technology Studies has actively responded to this challenge.



Kimmo Halme
Science and Technology Policy Council of Finland

Shooting at a moving target

Although Finland may stand out as a good example when it comes to adapting and implementing new policies and tools, our indigenous research related to technology policy has been, and still largely remains, unknown in international fora. With this in mind, for the past ten years or so there has been a deliberate effort to strengthen and widen the national competence-base in this field, and to vitalise academic debate around it.

In the early 1990s, there was a strong drive among the few technology policy experts to establish a 'serious', multidisciplinary research unit that concentrated purely on technology policy questions. It was also to serve as a national contact-point towards similar units in other countries. The Technical Research Centre of Finland provided a natural and appropriate environment for this unit, and so VTT Group for Technology Studies was established in 1992. At that time, most avenues for technology studies were unexplored, which was reflected in the work of the group: basic information on innovation in Finland, defining a solid approach to innovation studies, collecting and analysing studies that had been carried out by reputable research units abroad, etc.

The ground for systematic research on technology policy issues was laid in 1994, when the Ministry of Trade and Industry and Tekes launched a co-operation programme for technology studies. Because its structure had been largely designed by the Research Institute of the Finnish Economy ETLA and the Group for Technology Studies, it was natural that the main focus remained largely in the competence of these two research institutes. In 1997 this co-operation programme was succeeded by a national programme for technology studies, also financed by MTI and Tekes. The new programme was the first true attempt to collect the scattered bits and pieces of research related to technology policy in Finland. Many of the units involved had only recently entered this field and the overall policy implications of the programme remained rather vague. A few years later, Sitra launched a complementary programme for national innovation systems involving a dozen research projects, with strong hands-on management to ensure relevant results.

Over the years, the mainstream of research has focused around innovation processes and other fundamental issues and less so on innovation policy itself. Rapid increases in R&D expenditure during the second half of the 1990s drew greater attention to the effectiveness and efficiency of funding, and resulted in many impact analyses and evaluative studies. Perhaps surprisingly, the social and ethical impacts of technology policy decisions have received attention mainly from the Finnish Parliament's Committee for the Future. Technology foresight has been one of the most apparent fields of activities, where the Finnish contribution has been minimal compared to that of other countries. Recently, efforts have been made to enforce and systematise the studies in this field, too.

Although the history of Finnish technology studies is relatively short, there are today roughly fifty research units that are more or less active in this field. When MTI and Tekes launched their latest national programme for technology studies ProACT, interest among researchers was overwhelming: more than 200 applications were received. It is evident that there are issues yet to be addressed, such as the strengthening of researcher education in this field. However, good progress has already been made in many areas, and the overall challenge remains clear: the operation of a leading-edge innovation system requires a continuous flow of high standard indigenous research to facilitate the understanding of various aspects of innovation and their implications for policies.

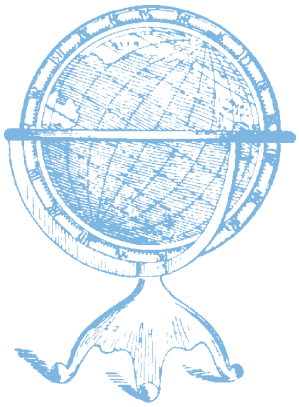
Esko-Olavi Seppälä
Science and Technology Policy Council of Finland

The S&T policy council: Keeping technology studies on the agenda

The first Working Paper of VTT Group for Technology Studies was composed of presentations held in a seminar in April 1991. The theme of the seminar was technology policy and technology studies in Finland. My task in the seminar was to give an overview of the formation and topical challenges of the Finnish technology policy. I referred to three initiatives, which taken together - if implemented - would have marked leapfrogging in the area of science and technology and their impact studies. The initiatives concerned 1) the founding of a centre for futures studies attached to the Academy of Finland, 2) the founding of a science and science policy research unit at the Academy, and 3) the development of technology studies in Finland on the basis of two expert reports commissioned by the National Technology Agency (Tekes). What happened to these initiatives?

In early 1991 it could be anticipated that the proposals presented in 1989 by a governmental committee on futures studies, which was chaired by the President of the Academy of Finland, Professor Erik Allardt, were not to be implemented. Quoting the seminar presentation, 'if nothing unexpected is going to happen, the outcome of the Allardt committee will be the founding of one small unit, attached to the universities in Turku and operating mainly through project funding'. The preparations of the Academy, led by professor Allardt, in order to found a science and science policy research unit, were at that time still proceeding. The goal was not reached however. The project failed in the end, because of other plans aiming at restructuring the Academy and an institutional evaluation of the Academy attached to these plans.

The third initiative was more successful: the VTT Group for Technology Studies was founded. It soon became an important institution in the dispersed area of technology and innovation research. It also seemed to be able to offer the necessary continuity, and thus a genuine career



option for competent researchers. However, the institutionalisation of the research area ended and various international and domestic needs, such as co-operation, research, training etc., soon started to burden, partly even overburden, the Group. This all resulted in the recent rearrangements, considered necessary by VTT. As to the overall situation and future development of this research area in Finland, the impact of the decision remains to be seen.

In addition to the founding of the VTT Group, technology studies have been developed in many other ways as well. There is a special reason to emphasise the activity of the National Technology Agency in the planning, funding and running of two major technology research programs. Researchers from various organisations have had the possibility to obtain new resources for studying technology and its impact. The programs have helped also in strengthening related activities in academic environments.

Since its founding in 1987, the Science and Technology Policy Council of Finland has emphasised the importance of technology foresight, assessment and impact studies, as well as innovation and technology research. In the beginning, one important background document was the Government Report on Technology Policy submitted to Parliament in September 1985. The Report contained similar findings and recommendations. The interlinking of technology and economy in Finland has been quite unproblematic, and related policy plans have also been implemented quite well. Compared with this strong development line of technology policy, a corresponding development has not been seen between the processes of technological and social innovation, regardless of the clear wishes expressed in policy documents. Technology studies will thus remain on the agenda of the Science and Technology Policy Council in the coming years.

Raimo Lovio
Helsinki School of Economics (VTT - Group for Technology Studies)

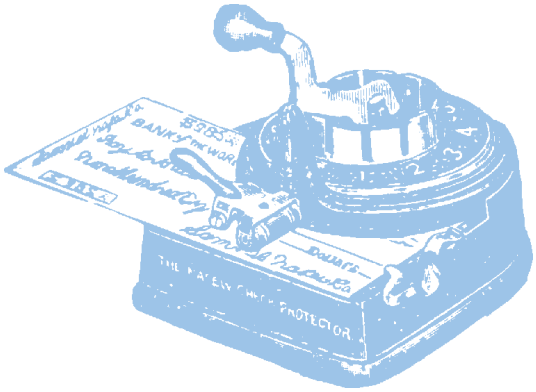
From national competitiveness to global contribution

Modern, economics and business management-based technology studies emerged in different Western countries roughly between 1965 and 1985. For such technology studies, the major starting point was the claim that in mainstream economics and economic policy, the issues of technological change and innovations had been underestimated. And therefore the focus should be shifted: in economics, to explore the unknown content of the black box called technological change, and in economic policy, from price competition and exchange rate manipulations to technological and quality competition and innovation generation.

Since then, many comparative studies on the nature, effectiveness and competitiveness of different national innovation systems have been carried out. In the 1970s and 1980s - before the setting up of the VTT Group for Technology Studies - comparisons revealed that Finland was a latecomer among the OECD countries with regards to R&D input and output. Recently, researchers at the VTT Group have indicated that Finland is technologically among the most advanced nations. Therefore in the national perspective, things have gone very well, at least better than I could ever have imagined as a young researcher at the VTT planning and marketing office in the early 1980s.

The world, however, has changed a lot at the same time. The rate of internationalisation of economies, companies and R&D activities has grown significantly. For example, research work done by Finnish companies abroad has clearly increased. One third of industry's research currently falls into this category. Moreover, European integration has progressed in many ways: the EU now includes 15 nations and more may join in the near future, the euro has replaced national currencies, Brussels's capacity to produce new directives has proved to be amazing, and EU-level research programmes involve more and more researchers from different countries working together.

The largest Finnish multinational companies have even been able to go beyond European borders. Direct investments in the USA and China have increased alongside more traditional in-



vestments in Sweden, Germany and the UK. And when Finnish money has gone out, foreign money has come in: today, 25 of the 100 biggest companies in Finland are foreign-owned subsidiaries, and foreign investors own about one third of shares in the companies listed on Helsinki Exchanges.

In short, the major actors in technology are more often than ever before multinational companies, research programmes and institutions. In addition, the systems and problems associated with technology have internationalised. In the 1970s, Finland participated in building the Nordic Mobile Telecommunication System. Currently, efforts are being put into building the Universal Mobile Telecommunication System. In the 1970s, the major environmental problem of industry in Finland was related to local water management systems. Today, global climate change challenges our energy production system and consumption style.

Globalisation means that the actors, systems and problems of technology are multinational and because of this multinational network of interdependencies, all local and national actions have long-distance effects. The problem is that in this global village, wealth and technological capabilities are dangerously unevenly distributed. For example, as this book is published there are around 1,000 million mobile phone users worldwide, which means that about 15 per cent of the world's population has access to this technology. This elite is served with sophisticated and fashionable devices and entertainment services, while the overwhelming majority of the world's population has never had a chance to make a call. Multinational technologies and freedom of trade call for global responsibility.

National or regional questions are not outdated, but we should learn to answer them in a European and global perspective, which means that the question of national competitiveness changes to the question of our contribution to global development: how could our technological contribution be more useful, relevant and important from the perspective of global welfare.

Pekka Ylä-Anttila

ETLA – The Research Institute of the Finnish Economy

Technology studies in Finland – do we need more?

During the last ten years, Finland has become one of the world's most technology-intensive economies. R&D expenditure in relation to GDP has risen to over 3.5 per cent (in 2001), a ratio second only to Sweden's among the EU countries. As a consequence, the Finnish economy and industry have undergone a major structural change. A production structure that was previously characterised by raw material, energy and scale intensity is today mainly characterised by a single factor: knowledge. The share of high-tech products in total exports (more than 25 per cent) and the high-technology trade surplus are among the highest in the world.

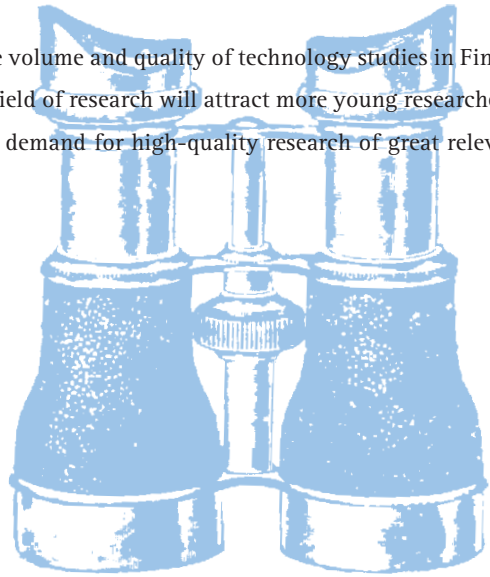
Research into the economic and social prerequisites and impacts of this fast technological progress has not been developing at the same rate in spite of many efforts to increase it. There is a growing need to understand the role of technological development in the economy and society. The establishment of VTT Group for Technology Studies was one of the most important actions responding to the needs expressed by policy-makers, the business community and politicians.

Also, many of the institutes that were already established in the field of technology studies, such as ETLA and a number of universities, have intensified their research efforts. As a consequence, both the volume and quality of research have increased significantly. EU membership and European research programs have added a new element to technology studies. Much of industry's R&D is carried out at the European level and as international collaborative ventures. Hence, technology studies have become international and their focus has shifted to look at European research networks and organisations.

However, the national perspective is still valid and the national innovation system still important. The bulk of R&D funding comes from national sources and technology is a key determinant in both national and regional competitiveness. What would be especially needed is research on the impacts and efficiency of R&D investment and the role of public R&D funding. Some useful studies have already been conducted. The potential of the unique databases of Statistics Finland has, however, been used only partially. Studies utilising micro-level data on technology inputs, organisations and performance of plants and firms would both serve decision-making and contribute to international research.

Another field where more research is needed concerns the risks involved in the increasing ICT dependency of the Finnish technology sector and industry. Dependence has increased the cyclical instability of the economy, particularly given the turbulence of export markets in the telecom sector.

All in all, despite the rise in both the volume and quality of technology studies in Finland, the research agenda is busy. Hopefully this field of research will attract more young researchers in the future. At least in economics, there is a demand for high-quality research of great relevance for policy analysis.



Evolution of the research areas

4

As has been stated earlier, the main objective of this book is to describe the evolution of the research fields of the Group and to introduce its activities to a broader public. This evolution has been illustrated on the cover, where different research themes are depicted in the form of a tree. The two separate trunks illustrate the main fields of Group's activities, namely innovation research and technology policy research. Since the establishment of the Group, its core competence has revolved around these main fields, which have augmented each other over the years.

In addition to the research themes, the picture on the cover also illustrates the roots of the Group's research activities. There are four boxes, each representing a different research field that has affected the approaches and objectives of the research over the past ten years. These four fields are innovation research, which was mainly embodied in the work done by Raimo Lovio during the 1980s; technology policy research, where the pioneering work of Tarmo Lemola was the main source of information available; so-called psychological-sociological technology research, which was Reijo Miettinen's field of speciality; and industrial policy research, which was carried out to a lesser extent in the Group. Larger projects in this field were started in ETLA, due to efforts by Pekka Ylä-Anttila.

All these four roots have together played an important role in the evolution of the research fields of the Group. In the following pages (pp. 33–96), the evolution of these two fields – innovation research and technology policy research – are introduced on a project-level basis. The project has been anchored to the theme according to the starting time of the project. Each project has been introduced only once. The description relies closely on the picture of the cover, where different research themes can be found in the boxes. The research themes have been introduced in chronological order, from bottom to the top, where boxes on the top illustrate the most recent research done by the Group.

FINNISH INNOVATIONS

"Technological Innovation in Finland"

Sirkku Kivisaari (1992 - 93) Tekes

"Development of Technological Innovations in SMEs"

Eija Ahola & Kimmo Halme (1992 - 95) Tekes

"Creation of New, Technology-based Firms: Case Biotechnology"

Kimmo Halme (1994 - 95) Tekes

"Innovative Activity of the Finnish Biotechnology Sector in the 1980's"

Reijo Miettinen & Mervi Hasu (1994 - 95) Tekes

"New Technologies for Telecommunications - A Strategic Platform for New Innovative Companies in Finland"

Jorma Lievonen & Sakari Luukkainen (1995 - 96) Tekes

"User-producer Relations in Health Care Technology Innovations"

Mervi Hasu (1995 - 2000)

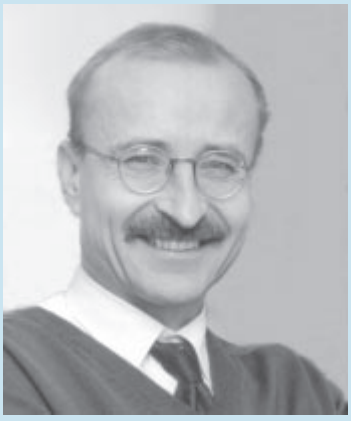
"From Research to Innovation – The Case of Biotechnical Pulp Bleaching"

Reijo Miettinen (1994 - 95) Tekes

Dr. Sirkku Kivisaari

Ms. Eija Ahola

Mr. Kimmo Halme



Dr. Reijo Miettinen

Finnish Innovations

Reindustrialisation has become a central economic and political issue in Finland. There is an urgent need to strengthen existing industrial and technological competence, as well as a need to create new industrial activities. Because this renewal of industrial structures takes place, to a large extent, through innovations, this process earns a special focus in technology studies in Finland.

"Technological Innovation in Finland"

Sirkku Kivisaari (1992 - 93) Tekes

During the early years of the 1990s, the issue of industrial renewal and the need for a multifaceted technology base were widely discussed in Finland. The ability to face the challenges set by future changes requires an understanding of the factors that have played an important part during the previous years. It is also necessary to know what the strengths of Finnish companies are, and what kind of knowledge has to be improved. This project is a basic analysis of innovation actors, sources and development in Finland's metal, manufacturing and electronics industries. It focuses on innovation management, competence development and application. According to the results, success in innovation activity presumes, besides a technologically advanced product, knowledge related to manufacturing and marketing.

"Development of Technological Innovations in SMEs"

Eija Ahola & Kimmo Halme (1992 - 95) Tekes

This project focuses on understanding the role of Small and Medium Sized Enterprises (SMEs) in the Finnish economy and their innovative activities, as well as outlining the various support measures and strategies for their future development. One of the characteristics of the recent development in Finland has been the increased role played by SMEs (employers and industrialists). In the mid 1990s, about half of all jobs in the industry were concentrated in SMEs. Considering the value added, the role of SMEs was more than 40 per cent, accounting also for one fourth of industrial exports. However, in the other member states of the EU, the importance of SMEs is even greater than in Finland.

"Creation of New, Technology-based Firms: Case Biotechnology"

Kimmo Halme (1994 - 95) Tekes

Due to the recent changes in the global and national economies, Finnish companies seem to be divided more clearly into the more and less successful companies. It has been commonly accepted that in a small country such as Finland, the main emphasis has to be on the production of high value-added and knowledge-intensive products and services, as is the case of the biotechnology sector. In order to help and improve such business models, it is necessary to have a good understanding and knowledge of the context in which these companies are acting and in which Finnish know-how has a special advantage.

"Innovative Activity of the Finnish Biotechnology Sector in the 1980's"

Reijo Miettinen & Mervi Hasu (1994 - 95) Tekes

This study analyses the innovative activity of the Finnish biotechnology industry during the 1980s and early 1990s in order to discern the national characteristics of such innovations. It seeks to explain how a new demanding technology and capital-intensive product development process succeeded in a small country with relatively scarce resources and a strong tradition of domestic-market business activity. In recent years, "new industrialisation" has been defined as a national aim in Finland. Hence, it is interesting to know to what extent a new biotechnology industry really developed during the 1980s.

"New Technologies for Telecommunications - A Strategic Platform for New Innovative Companies in Finland"

Jorma Lievonen & Sakari Luukkainen (1995 - 96) Tekes

An important common denominator in the discussions that took place over recent years in Finland has been the strong belief that high technology is the sector that will put Finnish exports on a growth track. There are good reasons for such optimism. On the whole, Finnish exports have done very well in the last few years, and particularly in the high tech sector. The major product group in the high tech sector is telecommunications equipment. In this project, the latest developments and the growth potential of telecommunication technologies in Finland are examined. By focusing on the structure and dynamics of the sector, the role of new small companies in telecommunications equipment, and that of Finnish inventions and innovations in the sector, will be analysed.

“User-producer Relations in Health Care Technology Innovations”

Mervi Hasu (1995 - 2000)

This doctoral research focuses generally on innovations in health care technology, and more particularly on the formation of relations between the developers and users of innovations and their co-operation in various innovations. Major changes are taking place in the health care sector, and these are also reflected in product development. The market is expected to shift from traditional hospital care products to home health care products. This will require qualitative change from traditional user-producer relations to more co-operative and interactive relations between manufacturers and users from the beginning of the innovation process. The research will produce information on the dynamics of the producer-user relationship for R&D and equipment manufacturers. It will also produce information that will serve as a basis for user-oriented innovation and facilitate further development.

“From Research to Innovation – The Case of Biotechnical Pulp Bleaching”

Reijo Miettinen (1994 - 95) Tekes

This paper deals with the emergence and development of a research-based innovation, i.e. enzyme-aided pulp bleaching. The economics of innovation rightly stresses that commercialisation makes the difference between invention and innovation. The first transaction in the market can be regarded as the criterion for innovation. Research on innovations has therefore understandably concentrated on the commercialisation phase of the innovation process. However, it is also important to understand how new viable ideas and conceptions come into existence. Consequently, in this study the innovation process includes the formation of the immediate preconditions of invention, formulation and early development of the idea, and the product development and commercialisation of the new method. Using these criteria, the time span for the development of the biotechnical pulp bleaching process was found out to be about twenty years, from 1972 to 1992.

TECHNOLOGY MANAGEMENT IN FINNISH COMPANIES

"Development of New Products as a Managerial Challenge"

Sirkku Kivisaari (1994 - 96) Tekes

"Foreign R&D of Finnish International Companies"

Tuomas Hölsä & Harri Luukkanen (1993 - 94) Tekes

"A Study on Technology Management in Finnish Industry"

Tuomas Hölsä & Kirsi LaPointe (1994) Tekes

"Success Factors in Finnish Sustainable Technology Innovation in the Energy Sector"

Sirkku Kivisaari, Mika Kuisma & Raimo Lovio (1995 - 96) Tekes

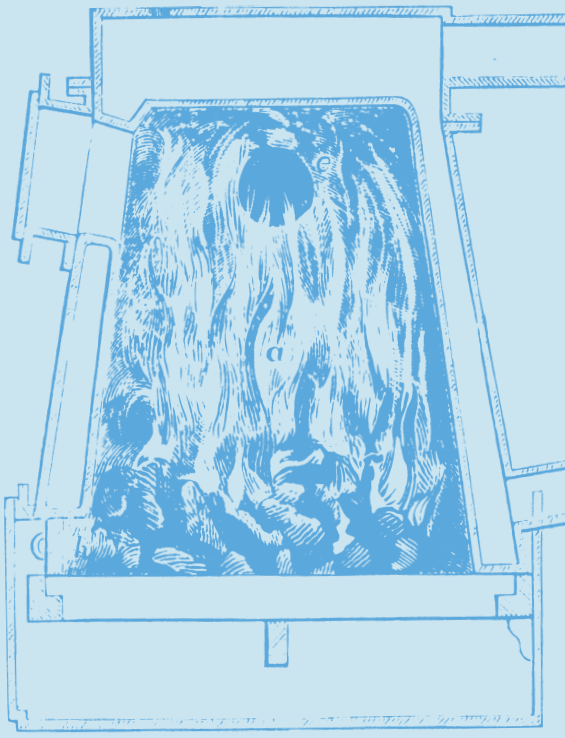
"Technology Assessment in the Finnish Parliament"

Reijo Miettinen (1995) Finnish Parliament

Mr. Tuomas Hölsä

Dr. Raimo Lovio

Mr. Ari Leppälahti



Technology Management in Finnish Companies

Companies play a key role as creators, developers and exploiters of process and product innovations. The effectiveness of a company's innovation activities is primarily dependent on internal factors. However, a company's ability to collaborate and interact with customers, subcontractors, as well as with universities and research institutes, in Finland and abroad, is also essential.

"Development of New Products as a Managerial Challenge"

Sirkku Kivisaari (1994 - 96) Tekes

This project studies the role of management in the generation and utilisation of successful innovations. In the previous study of the Finnish electronics and engineering industries, in which technological development and performance since the mid 1980s was analysed, two really successful business models were identified: one in ICT and the other in the health care industry. In the field of health care, businesses are typically small, research-intensive and highly specialised. R&D work is characterised by the importance of a deep understanding of the medical field, and the ability to integrate the expertise of different branches of science. Continuous re-evaluation of the business concept was found to be a recurring managerial challenge, and the customer concept proved to be a particularly interesting issue in the field.

"Foreign R&D of Finnish International Companies"

Tuomas Hölsä & Harri Luukkanen (1993 - 94) Tekes

Strong internationalisation through foreign acquisitions, which was a characteristic of Finnish companies between 1985 and 1990, is the main reason for the rising share of foreign R&D. Since the 1980s, there has been a substantial change in companies' R&D activities. Due to the globalisation and opening up of markets, competition has increased, production cycles have shortened and developments in ICT have caused information and the way it is used to become more important factors of competitiveness. These changes have meant that the R&D activities of companies – organisational, managerial & developmental – have received particular attention. According to the results of the study, foreign R&D has been useful to Finnish companies in helping to improve the flow of information between foreign markets and domestic R&D.

"A Study on Technology Management in Finnish Industry"

Tuomas Hölsä & Kirsi LaPointe (1994) Tekes

Technology management is an important area of management overall, but one that has traditionally generated far less research interest compared to other areas of management. Technological development proceeds rapidly and with accelerating speed. Competition has tightened up and the success of companies on the market is based more and more on their fast utilisation of the technology available. As markets open up, companies have to be capable of competing with the best companies in the world for their share of the market. In order to develop a sustainable competitive edge in this kind of environment, companies have to be familiar with the changes that are occurring around them as well as with the latest technological developments. Hence, the goal of this study is to make technology management principles known to companies, and help guide their own technology strategy development processes.

"Success Factors in Finnish Sustainable Technology Innovation in the Energy Sector"

Sirkku Kivisaari, Mika Kuisma & Raimo Lovio (1995 - 96) Tekes

Up until the 1980s, the response of company managers, considering the increasing environmental problems, has been rather slow and mainly driven by external factors. Earlier on, investments in environmental protection were seen as sanctions imposed by legislation. Since the second half of the 1980s, companies have improved their attitude as well as activity level with regards to environmental protection related issues. In the light of the early evidence gathered from the beginning of the 1990s, the last decade of the millennium looks like being the decade of environmental management. In this study, the focus has been placed on the potential and competitiveness of Finnish energy technology in reducing carbon dioxide emissions.

"Technology Assessment in the Finnish Parliament"

Reijo Miettinen (1995) Finnish Parliament

Technology assessment means that scientific results and the implementation of technology, as well as their impact and implications for the entire society, are systematically analysed. It follows that technology is understood as an action, which is widely being abused by individuals. Technology assessment is a policy-oriented research. As part of the proposal regarding the initiation of

technology assessment within the Finnish Parliament, the Group for Technology Studies carried out a study on the work of assessment units working in conjunction with parliaments and other political decision-making units in European countries. The purpose was to assess their experiences in order to implement a similar system in Finland. In the proposal made to the Finnish Parliament, the German model was regarded as the best one.

MANAGEMENT OF INNOVATIONS

"Development of Health Care Technologies and Markets - TUMA"

Sirkku Kivisaari, Sami Kortelainen & Niilo Saranummi (1997 - 99)
Tekes & Private companies

"New Firms and Industry Evolution in Finland"

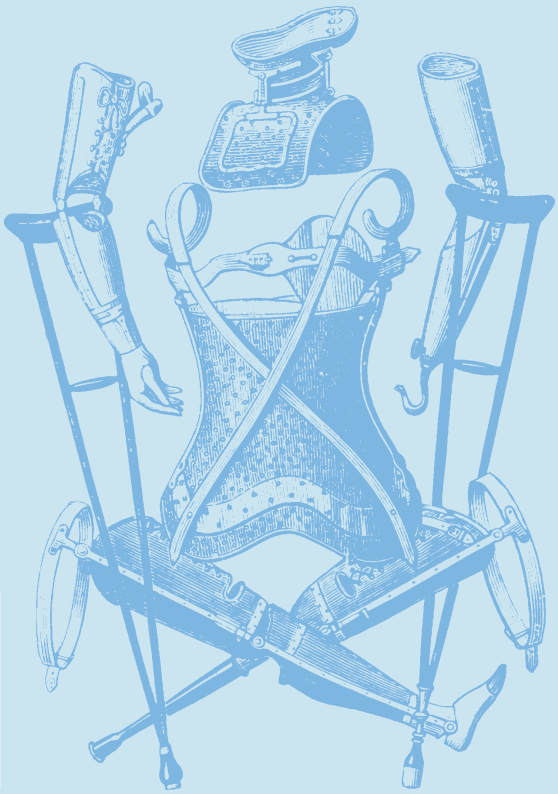
Eija Ahola (1996 - 98) Tekes

"Innovation Systems and European Integration (ISE)"

Tarmo Lemola & Christopher Palmberg (1996 - 98)
European Commission

Mr. Sami Kortelainen

Mr. Christopher Palmberg



Ms. Dalia Janceviciute
Mr. Jorma Manninen
Ms. Mia Puruskainen
Ms. Anne Räfsten

Management of Innovations

In Finland, there is an urgent need to strengthen existing industrial and technological competence as well as a need to create new industrial activities. Companies play a key role as creators, developers and exploiters of process and product innovations. However, it is necessary that the national innovation system as a whole be as viable as possible.

"Development of Health Care Technologies and Markets - TUMA"

Sirkku Kivisaari, Sami Kortelainen & Niilo Saranummi (1997 - 99) Tekes & Private companies

It is a highly necessary requirement for the success of technological innovation that the needs of the users are understood, and that there exists a possibility to produce technically developed solutions for them. However, this is not enough. Strategies aiming at technological change need to be based on a close link between societal needs and new technological possibilities. Innovation is a social process integrating technological, economic and socio-cultural aspects. It can be accomplished via continuous dialogue and negotiation between multiple actors. Hence, this project (TUMA) focuses on the development and commercialisation of radically new health care services and supporting technologies.

"Innovation Systems and European Integration (ISE)"

Tarmo Lemola & Christopher Palmberg (1996 - 98) European Commission

Concerns about the international competitiveness of European industries and national economies have always been a central force in the policy decisions of the European Union. From the outset, the link between these concerns and those related to innovation policy was weak. In the late 1950s, the overriding structural concern (and the initial goal of the European Economic Community) was the achievement of economies of scale through the creation of a unified market. Nowadays, as indicated in the 1995 Green Paper on Innovation, the concern has shifted to making structural changes that will provide a basis for economic growth based on technological innovation. The goal of this ISE project is to elaborate on systems of innovation theory in order to illuminate and compare developments in science and technology in the different European countries.

“New Firms and Industry Evolution in Finland”

Eija Ahola (1996 - 98) Tekes

Structural change, industrial renewal and new industrialisation are some of the most important national objectives in Finland. In particular, new companies and industrial evolution are crucial aims of industry and technology policy. It has been stated that high-tech companies, innovative and renewing traditional companies, as well as knowledge-intensive firms, might solve the problem of unemployment in the long run. With this in mind, the goal of this study is to analyse the background and knowledge base of new start-up firms, analyse the role of new firms in each branch, and consider structural change in the manufacturing industry.

INDUSTRIAL RENEWALL

"Biotechnology Business in Finland"

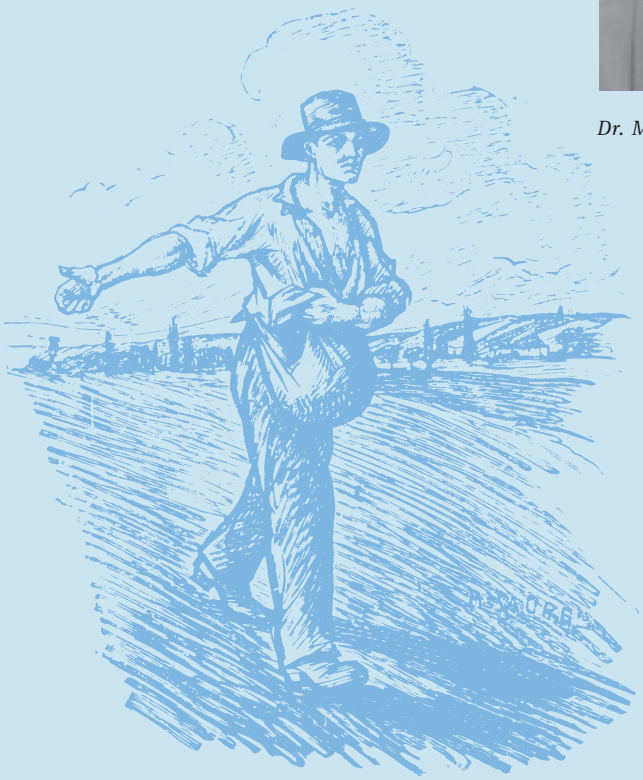
Eija Ahola & Mika Kuisma (1997 - 98) Tekes

"Finnish Innovations – SFINNO"

Tarmo Lemola, Christopher Palmberg & Jorma Lievonen (1996 -) Tekes

Mr. Janne Urpo

Dr. Mervi Hasu



Industrial Renewal

The process of industrial renewal is fundamental for economic development, growth and employment. Innovations, whether commercialised by new or mature and established firms, are at the core of this process. In order to better understand the process of industrial renewal in Finland, the projects within this research area study innovations from various topical perspectives.

"Biotechnology Business in Finland"

Eija Ahola & Mika Kuisma (1997 - 98) Tekes

This study focuses on the evolution and future business prospects of the biotechnology sector. Biotech is a new and emerging field. It is neither clearly demarcated nor properly institutionalised. It includes a range of actors and companies from a variety of scientific disciplines, different kinds of universities and research institutions, different economic sectors (pharmaceutical companies as well as instrument makers) and so on. In a loose sense, we may talk about a biotech community, since across all differences and all the competing classifications being applied and used, relevant players identify themselves in certain situations and contexts as working in biotech.

"Finnish Innovations – SFINNO"

Tarmo Lemola, Christopher Palmberg & Jorma Lievonen (1996 -) Tekes

Sfinno aims to understand the very core of industrial renewal and the Finnish system of innovation through a micro-economic analysis of significant innovations commercialised during the 1980s and 1990s.

For more information, look at the specific chapter on Sfinno.

INNOVATION AND INDUSTRIAL RENEWALL

"Evaluation of the Well-being Cluster"

Mikko Mäkinen, Mika Pajarinen, Sirkku Kivisaari & Sami Kortelainen (1998 - 99) Ministry of Social Affairs and Health

"From Telecluster to Service Industries"

Sakari Luukkainen (1999 - 2001) MTI & VTT

"Challenges of Company Growth in Health Care – WELLDONE"

Sirkku Kivisaari, Sami Kortelainen & Niilo Saranummi (1999 - 2001) MTI

"Industrial Networks and Clusters – Potential for Growth"

Tuomo Pentikäinen (2000 - 01) MTI

"Industrial Clusters in the Finnish Economy"

Sakari Luukkainen (1999 - 2001) MTI

"Opportunities for ICT Co-operation in the Baltics"

Marja Nissinen (2000 –) MTI, SET & PrizzTech

"Knowledge-intensive Business Services and Industrial Competitiveness"

Sakari Luukkainen & Petri Niininen (2000) MTI

"Societal Embedding of Innovations Related to Renewable Energies and Energy Saving"

Erja Väyrynen, Raimo Lovio & Sirkku Kivisaari (2001 - 2002) Tekes & VTT

"Public-Private Partnership in Market Construction – PPP"

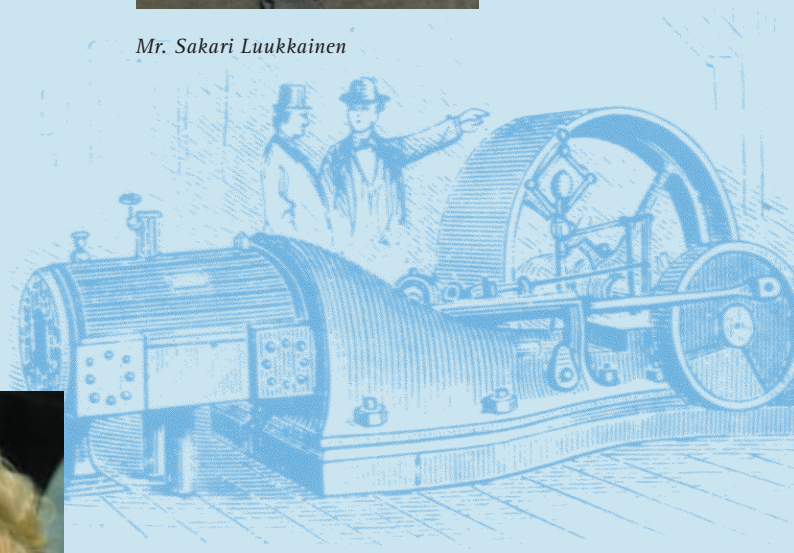
Sirkku Kivisaari, Niilo Saranummi & Raimo Lovio (2001 - 03) Tekes, VTT & Private companies

"Multinational Enterprises and the Finnish Innovation System - MEFIS"

Pekka Ylä-Anttila, Jyrki Ali-Yrkkö & Raimo Lovio (2002 - 03) MTI

Mr. Sakari Luukkainen

Mr. Tuomo Pentikäinen



Dr. Marja Nissinen

Dr. Petri Niininen

Innovation and Industrial Renewal

Enhancing wellbeing and economic growth in society calls for continuous industrial renewal. An understanding of the background conditions and mechanisms of industrial renewal is therefore of key importance. Our research focuses on these issues by studying concrete innovations in their entrepreneurial context at the micro-level, and on spillovers and interrelationships between different industries. The common denominator in our various research projects is an interest in understanding change processes and the interaction of private companies and public organisations in innovation.

"Evaluation of the Well-being Cluster"

Mikko Mäkinen, Mika Pajarinen, Sirkku Kivisaari & Sami Kortelainen (1998 - 99)
Ministry of Social Affairs and Health

This study analyses the competitiveness aspects of the Finnish well-being cluster in the 1990s. During that decade, the industrial activity of the cluster has been modest. Its share of total Finnish industrial exports, for example, has remained at some two per cent. The cluster is also small by international standard: its export share is clearly below that of the OECD countries on average. Furthermore, there is a significant difference in the export structure of the Finnish well-being cluster compared to our main OECD competitors. Although the growth of the cluster in the 1990s has been slower than expected, it still has growth potential. Products in the cluster typically require a long R&D period before they are ready for commercialisation. It is important that the relevant firms find suitable domestic and foreign partners and networks when they begin to commercialise their products.

"From Telecluster to Service Industries"

Sakari Luukkainen (1999 - 2001) MTI & VTT

This project analyses the interface between the industrial and service sectors in Finland by network and cluster methods. In the past decade, there has been a significant structural change in manufacturing industry towards high added value products. In the post-industrial stage, the primary and secondary sectors have been declining as the service sector has been growing. Even though growth in services is higher than decrease in the other sectors, such a development can be problematic for the Finnish economy as a whole. In any event, manufacturing has been the engine

of growth because of its ability to extend markets, increase productivity and generate technological innovations. The knowledge generated in industry could also be applied to the service sector, which already is a significant user and producer of information technology. Its mode of operation is also approaching that of manufacturing. By developing advanced methods using IT, the added value creation of service industries can be increased. Thus technology ought to be targeted at the needs of the service industry as well.

"Challenges of Company Growth in Health Care – WELLDONE"

Sirkku Kivisaari, Sami Kortelainen & Niilo Saranummi (1999 - 2001) MTI

This project describes the industrial activity that took place in different market segments in Finland during the 1990s, and sheds light on the challenges to company growth and internationalisation in different market segments. The health care market is expected to form one of the fastest growing areas of technological competence. The growth expectations are based mainly on highly developed health care delivery and high competence in research. Demand is expected to rise because of trends such as the ageing of the population in industrialised countries, and the population's growing interest in health care. The health care-related industry in Finland is still very small: it only accounts for about two per cent of industrial employment and exports. How can the growth and internationalisation of health care be supported by means of a technology policy?

"Industrial Networks and Clusters – Potential for Growth"

Tuomo Pentikäinen (2000 - 01) MTI

Networks and clusters have been focal issues of contemporary technology policy. It is generally agreed that governments have a role to play in facilitating appropriate network or cluster conditions, and even in implementing focused cluster programmes. In practice, however, cluster and network policies are highly complex and can entail serious risks. A major complication arises from the fact that these policies are almost always focused on a set of heterogeneous agents. Understanding the natural networking behaviour and incentives for networking of different types of agents constitutes a necessary starting point for successful public initiatives. The second issue is that co-operation is not always fruitful. The third complication originates in the dynamic nature of clusters and networks. In this study, tools to analyse these three issues have been developed.

"Industrial Clusters in the Finnish Economy"

Sakari Luukkainen (1999 - 2001) MTI & VTT

Technology is currently the most important determinant of long-term economic growth, as it accounts for at least half of the growth of industrialised nations. Economists have demonstrated that R&D performed by innovating companies generates widespread value in the economy through the diffusion of technology. The objective of private financing is, however, to increase the value of particular innovating companies, and the spillovers to other companies are not so important in this context. The market failure created by R&D spillovers is thus one of the main justifications for government policies. The advancement of spillovers through government's actions can be called cluster policy. In this study, a widening of the knowledge needed to support decision making in the realisation of an efficient cluster-oriented technology policy will be produced.

"Knowledge-intensive Business Services and Industrial Competitiveness"

Sakari Luukkainen & Petri Niininen (2000) MTI

In the post-industrial stage, the primary and secondary sectors are supposed to decline as the service sector grows. Even though growth in services is stronger than decrease in the other sectors, such a development can be problematic to the national economy as a whole. In any event, manufacturing has been the engine of growth because of its ability to extend markets, increase productivity and generate technological innovations. The knowledge generated in industry could also be applied to the service sector, which already is a significant user and producer of information technology. Its mode of operation is also approaching that of manufacturing. By developing advanced production methods using IT, the added value creation of service industries can be increased. Thus technology policy ought to be targeted at the needs of the service industry as well.

"Opportunities for ICT Co-operation in the Baltics"

Marja Nissinen (2000 -) MTI, SET & PrizzTech

The purpose of this study is to serve the needs of both Baltic and Finnish small and medium-size enterprises (SMEs) that are seeking internationalisation. Preliminary contacts both with Finnish and Baltic companies as well as associations that represent them suggest that there is a keen interest in contact facilitation on both sides, but external support is often needed for the initial stages of matchmaking. We base our initiative on the principle of mutual interest: the promotion of the Baltic states' ICT sector may help both sides to find business partners. However, the benefits

of collaboration in this field are not confined to business contacts: it also facilitates technology transfer and the spread of know-how.

"Societal Embedding of Innovations Related to Renewable Energies and Energy Saving"

Erja Väyrynen, Raimo Lovio & Sirkku Kivisaari (2001 - 02) Tekes & VTT

Issues such as strengthening the status of energy saving and considering renewable energy sources are significant means of reducing greenhouse gas emissions. Despite the obvious benefits, the market has not yet adopted these on as large a scale as one might have hoped. It can be stated that there are both visible and invisible obstacles in the market to the implementation and commercialisation of these technologies. As a part of the CLIMTECH (Technology and Climite Change Programme) technology programme investigating technologies that can be applied to control climate change, this project assesses the possibilities of constructing a market for climate-friendly energy technologies by applying the process of 'societal embedding of innovations'. The two case studies have been selected to represent both renewable energy sources and the promotion of energy saving: 'Increasing the use of wood pellets in single-family houses' and 'Shaping of the ESCO-service (Energy Saving Company) in the municipal sector'.

"Multinational Enterprises and the Finnish Innovation System - MEFIS"

Pekka Ylä-Anttila, Jyrki Ali-Yrkkö & Raimo Lovio (2002 - 03) MTI

Nowadays, a significant part of technological development in the world takes place in multinational companies. The largest companies in Finland are also engaging in activities like R&D, production as well as collaboration with customers, outside the national borders. According to the most recent statistics available, the role of foreign R&D constitutes some 25 to 30 per cent of the whole R&D activity of the company sector. However, this amount fluctuates on a sectoral basis: in research-intensive sectors such as metal and electronic industries as well as in the chemical industry, the role of foreign R&D is higher than average. During the 1990s, the amount of R&D conducted abroad increased much faster than domestic R&D. Also, it seems that the R&D strategies of companies have changed. Companies are transferring their research activities to those regions where knowledge, from a global perspective, is the best available. The home country as a place for strategic core activities no longer enjoys special status.

“Public-Private Partnership in Market Construction - PPP”

Sirkku Kivisaari, Niilo Saranummi & Raimo Lovio (2001 - 03) Tekes, VTT & Private companies

This project focuses on public-private partnership in commercialising innovations motivated by the societal concerns for a cleaner environment and wellbeing of a society that is in the process of ageing. Meeting these challenges will call for major changes in the way many societal functions are fulfilled. Changes need to involve the simultaneous development of technological solutions, infrastructures, practices, regulation, industry structures, and so on. This project focuses on managing these change processes on a relatively small scale, and it places special emphasis on the possibilities of a new kind of partnership between private companies, the government and other public actors. The project aims to increase our insight into the kind of partnership and roles that are needed, and provide information on barriers to the adoption of new roles. It also furthers the development of an approach of ‘Societal Embedding of Innovations’ to market construction, and studies the transferability of the approach from the health care sector to the energy sector.

FINNISH INNOVATIONS – SFINNO

"Sectoral Patterns of innovation and Competence Requirements"

Christopher Palmberg (1999 - 2001) Sitra

"Significant Innovations in Finland"

Jukka Hyvönen (2000 - 02) Tekes

"Empirical Analysis of Processes underlying Various Technological Innovations"

Tanja Tanayama (1999 - 2001) Tekes

"Software Innovation in Finland"

Hannes Toivanen (1999 - 2000) Tekes

"Innovation and the Success of Firms"

Petri Niininen & Jani Saarinen (2000) Tekes

"Successful Innovations – Commercialisation and Break-even Times of Innovations"

Christopher Palmberg (2001 - 02) Tekes

"Innovations, Human Capital and Industrial Growth in Finland"

Jani Saarinen (2001 - 05) Lund University

Mr. Jukka Hyvönen

Ms. Tanja Tanayama

Mr. Jani Saarinen

Mr. Hannes Toivanen

Mr. Jyrki Kiviniemi
Mr. Pentti Rytkölä
Mr. Adam Tulos
Ms. Kati Varis
Mr. Miikka Virtaharju
Mr. Ville Walden
Mr. Heikki Wilenius

Finnish Innovations – SFINNO

In Finland, industrial renewal has been particularly rapid in the 1980s and 1990s thanks to the increase of both public and private R&D investments, and the emergence and rapid growth of high-tech industries, with Nokia and the ICT industry at the forefront. Nonetheless, our knowledge of the underlying mechanisms of this renewal and of the innovation outputs of these developments remains meagre. The aim of this project is to provide a more thorough and systematic micro-level understanding of recent industrial renewal processes in Finland from the perspective of innovations.

"Sectoral Patterns of Innovation and Competence Requirements"

Christopher Palmberg (1999 - 2001) Sitra

The recent emphasis placed on the knowledge-based economy and the role of high-tech industries takes unnecessary attention away from the strengths and the competence base of the traditional low-tech industries, which still constitute the backbone of our economy...and will continue to do so for quite some time. This project thus aims to provide a more nuanced picture of the nature of innovation and competencies across different sectors of the Finnish industry. It contributes to the policy discussion by providing a more concrete interpretation of science and technology indicators and their use. It also provides an in-depth insight into the nature of innovation in low-tech industries. The project complements the database of Finnish innovations with case studies.

"Significant Innovations in Finland"

Jukka Hyvönen (2000 - 02) Tekes

In previous studies on significant innovations, the emphasis has been placed on the commercial value of the innovations considered. In the SAPPHO-project undertaken by SPRU in the early 1970s, the focus was on successful innovations and the paired comparison between successful and unsuccessful innovations. The criteria for a successful innovation was related to net sales, to the market share of innovation and to innovations alignment with company strategy, which in fact refers to anything but monetary gain and market share. However, for our purposes, the definition of a significant innovation is that it has to be economically or technologically significant. The idea here is that an innovation may have had an important impact on the dynamics of a sector, such as creating a new market or product concept, even if it was not met with economic success.

"Empirical Analysis of Processes underlying Various Technological Innovations"

Tanja Tanayama (1999 - 2001) Tekes

The majority of the empirical econometric innovation studies have attempted to identify various determinants of innovative activity. The focus has been on both sector and firm level variables that seem to determine the intensity of innovative activities within a sector or a firm. The intensity of innovative activities has often been measured using proxies like R&D expenditure, patents or innovation counts. The basic underlying issue has been to identify which characteristics make some firms or sectors more innovative than others in terms of a specific quantitative proxy for innovativeness. Common topics in this area have been the relationship between innovative activity and variables such as firm size, market concentration, cash flow, diversification, market size and technological opportunity and appropriability. This study differs from the usual approach in that the unique data at hand makes it possible to do the analyses at the innovation level.

"Software Innovation in Finland"

Hannes Toivanen (1999 - 2000) Tekes

Advanced computing has become one of the corner stones of modern economy and industrial power. In recent decades, computing technologies have been one of the major powers that have facilitated the industrial restructuring experiences that have occurred in all modern economies. The software industry has also come to embody the classical Schumpeterian Mark I hypothesis, as it has proved to be very turbulent. Since the 1970s, the industry has witnessed a number of great innovator-entrepreneur histories. Indeed, there exists no other industry where the rankings of the largest companies has changed at the same pace. This study examines the pattern of software innovation with respect to firm, innovation process and market aspects, and compares the main findings with other innovations.

"Innovation and the Success of Firms"

Petri Niininen & Jani Saarinen (2000) Tekes

This project attempts to shed light on the innovative process and its effect on the profitability of firms. In the new growth theory, innovative activity is the engine of economic growth. Innovative activity is captured by the Solow residual, ie technological change. Technological change is the most important factor of economic growth in developed economies: new technologies account for

at least half, if not three quarters, of economic growth. Technological change is driven by innovations. At firm level, a constant flow of innovations is required to maintain competitiveness and organic growth.

"Successful Innovations – Commercialisation and Break-even Times of Innovations"

Christopher Palmberg (2001 - 02) Tekes

Successful innovation is a topical issue for firms and policy makers alike. Successful innovation is the cornerstone of competitive advantage, not only for high-tech industries, but also for the more traditional and maturing industries. Successful innovation is also a prerequisite for technological change and growth. The determinants of successful innovation are thus of particular relevance since they should be taken into account in the design of specific policy measures, as well as for the selection of innovation development projects that produce a higher success rate. The purpose of this project is to trace the determinants of commercialisation and break-even times of individual innovations, focusing especially on the effects of different types of innovation opportunities on the durations.

"Innovations, Human Capital and Industrial Growth in Finland"

Jani Saarinen (2001 - 05) Lund University

The second half of the twentieth century has been characterised by a period of rapid economic growth all over Europe. Finland has been no exception in this domain. In actual fact, Finland was among the fastest growing economies in the whole of Europe over those years. Its transformation from a forest-based economy to one led by electronics, especially in the area of the telecommunications industry, can now be seen as a success story. Researchers have been arguing widely over the reasons for this phenomenon, stating for example the opening of new markets (globalisation), a large and stable trade with the Soviet Union (up until the end of the eighties), as well as those systematic efforts that have been made in order to increase the level of education and the amount of research and development expenditure. This doctoral study will analyse the importance of the level of human capital in the labour force, as well as the importance of innovations, to technological change and growth within Finnish manufacturing.

TECHNOLOGY POLICY: MEANS AND EFFECTIVENESS

"Finnish Companies in EUREKA Projects"

Tarmo Lemola & Kirsi LaPointe (1992 - 93) Tekes & VTT

"Evaluation of the Effectiveness of Tekes' Industrial R&D Projects"

Sirkka Numminen & Olli Hämäläinen (1994 - 95) MTI

"Evaluation of the Tekes Programs Promoting Technology Adoption in SMEs"

Sirkka Numminen & Kirsi LaPointe (1994) Tekes

"Evaluation of the Antarctic Activities of Finland: Technical and Economic Aspects"

Sirkka Numminen (1994) MTI

"Evaluation of the OPTIMI Peat Research Programme"

Reijo Miettinen, Sirkka Numminen-Guevara & Mervi Hasu (1994) VTT Energy

"International and National Eureka Evaluation"

Tarmo Lemola & Kirsi LaPointe (1994 - 95) Tekes

"An Evaluation of Tekes Funding for Industrial R&D"

Sirkka Numminen (1994 - 95) MTI

"Evaluation of Tekes' Corporate Cluster Programmes Promoting Technology Implementation"

Kirsi LaPointe & Sirkka Numminen (1995) Tekes

"National Innovation Systems: The Pilot Case Study of Finland"

Sirkka Numminen (1995) MTI

"Development of Research-Based New Business – the Evaluation of TULI-Projects"

Eija Ahola & Kirsi LaPointe (1996) Tekes

"Impacts of Finnish Participation in the European Union's Research and Technology Programmes"

Terttu Luukkonen & Pirjo Niskanen (1995 - 97) Tekes & Ministry of Education

"Centres of Expertise in Finland – Evaluation of the Specified Regional Programme"

Eija Ahola & Sami Kortelainen (1997) Ministry of Interior

"Research on the Success of Product Development Projects"

Sirkka Numminen & Olli Hämäläinen (1996) Tekes

"Analysis of Foreign Technology Foresight Exercises"

Jorma Lievonen (1996) MTI

"Overall Situation for Technology Transfer and Commercialisation in Finland"

Mika Kuisma (1996 - 97) Sitra

"Thematic Network on Advanced Science & Technology Policy Planning – Towards the Integration of Technology Foresight, Technology Assessment & S/T Policy Evaluation (ASTPP)"

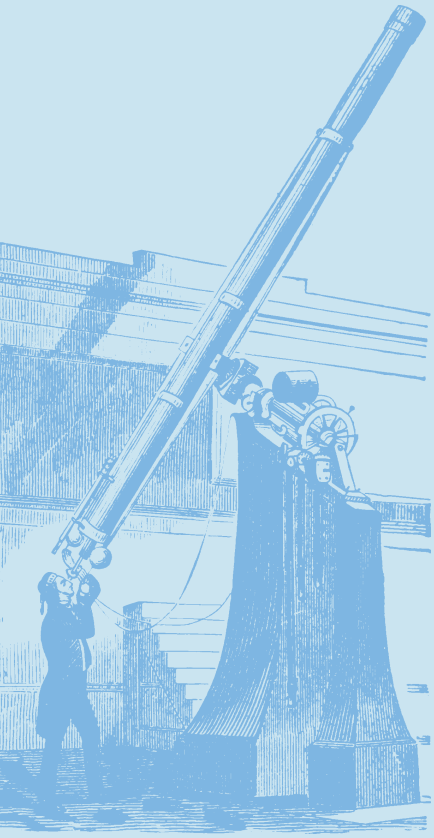
Tarmo Lemola & Terttu Luukkonen (1996 - 2000) European Union

Ms. Kirsi LaPointe

Ms. Sirkka Numminen

Mr. Mika Kuisma

Dr. Annele Eerola



Technology Policy: Means and Effectiveness

Finland's technology policy faces new tasks and choices as a result of rapid European economic and political integration. The volume and allocation of R&D funds are still, and will continue to be, basic issues of technology policy. However, technology policy-makers are in a rather new situation. They must now find a proper balance between national and international needs and interests. In addition, they should have a good view of the global as well as national future needs and opportunities of science and technology.

"Finnish Companies in EUREKA Projects"

Tarmo Lemola & Kirsi LaPointe (1992 - 93) Tekes & VTT

Eureka, founded in 1985, is a common high-technology project of European countries. Its aim is to increase the collaboration of European companies and research institutes in order to develop new compatible products. Thanks to Eureka, the level of European high-tech activity and competitiveness, compared to the US and Japan, has been presumed to increase. After a cautious participation of Finnish companies at the very beginning, the number of companies involved has been growing steadily. Hence, the objective of this study is to analyse the results and benefits of Eureka for Finnish companies.

"Evaluation of the Effectiveness of Tekes' Industrial R&D Projects"

Sirkka Numminen & Olli Hämäläinen (1994 - 95) MTI

From a technology policy point of view, one of the central questions regarding the use of public funds deals with the significance and the positioning of publicly supported R&D projects to the strategic activities of firms. Ideally, public funding for industrial R&D should enable firms to carry out projects that have a marked potential of raising the technological innovation ability and the competitiveness of the industry concerned but that may, at the same time, be too risky to be carried out as part of the firms' normal R&D work. In Finland, Tekes occupies a central role in the Finnish National System of Innovation. One of its main activities is to provide public funding in the form of grants and loans to industrial R&D projects. The aim of this study is to give a thorough description of industrial R&D projects funded by Tekes, and present the direct, indirect and broader effects as well as evaluate the significance of Tekes funding.

"Evaluation of the Tekes Programs Promoting Technology Adoption in SMEs"

Sirkka Numminen & Kirsi LaPointe (1994) Tekes

This project evaluates the degree to which technology transfer and adoption aspects have been assimilated by SME firms participating in the 20 programmes funded by Tekes. Central to the study is determining the extent of technology and capability development reached during the program. Of special interest is to gain an understanding of the best practices and essential factors that enhance the technology adoption and implementation process. In addition, the study examines the direct techno-economic effects within the participating firms.

"Evaluation of the Antarctic Activities of Finland: Technical and Economic Aspects"

Sirkka Numminen (1994) MTI

Since joining the Antarctic Treaty in 1984, Finland has participated actively in international scientific co-operation concerning Antarctica. The original goals of these activities were set out for political, scientific and techno-economic reasons. These activities are seen as important for technology development and testing in arctic conditions. The evaluation of their technical and commercial aspects aims to assess the extent to which the objectives have been achieved. Foremost in the evaluation is the study of the economic, technological and commercial effects and benefits of this research to the participating firms and other organisations. The intended projects for the evaluation include all technical research and commercial projects related to Antarctica. The evaluation is done by survey whereby participating firms and other organisations are interviewed.

"Evaluation of the OPTIMI Peat Research Programme"

Reijo Miettinen, Sirkka Numminen-Guevara & Mervi Hasu (1994) VTT Energy

This project is an evaluation of the OPTIMI Peat Research Programme commissioned by the programme's co-ordinator, VTT's Fuel Energy Laboratory. The aim of the OPTIMI programme has been to develop a more effective method of solar energy-based peat production. The evaluation focuses on analysing project implementation, steering mechanisms and co-operation among participating organisations to draw useful lessons from the experience. Special attention is paid to the role of objectives in project implementation. The results of the programme are analysed at five levels: achievement of the overall programme objective, quality of the most important methods

and equipment developed in the programme, comparison of results to the project plan, research quality based on publications, and changes in objectives during the programme.

"International and National Eureka Evaluation"

Tarmo Lemola & Kirsi LaPointe (1994 - 95) Tekes

Eureka's existence and development can be justified by the fact that it offers an important and necessary alternative to EU programmes. In Finland, Eureka has a good reputation, and consequently its promotion has been successful in terms of its number of projects and participants. The industrial and economic effects of Eureka were evaluated during the French presidency of Eureka in 1992-1993. VTT Group for Technology Studies carried out the Finnish component of the survey. This project was followed by a national study that analysed the experiences and results from the perspective of the Finnish participants. This national evaluation provided a more in-depth picture of the nature, results and benefits of the participation. It also analysed the value added of international co-operation and the significance of Eureka for participants and their R&D activities.

"An Evaluation of Tekes Funding for Industrial R&D"

Sirkka Numminen (1994 - 95) MTI

This study aims at providing a thorough description of industrial R&D projects funded by Tekes and at presenting their direct, indirect and broader effects and evaluating the significance of Tekes funding. It forms an independent part of a larger international evaluation of Tekes set up by the Ministry of Trade and Industry and conducted in 1994-1995. To a large extent, the survey results reinforce earlier assumptions about the role and significance of Tekes funding. According to the findings, Tekes projects appear to be very successful.

"Evaluation of Tekes' Corporate Cluster Programmes Promoting Technology Implementation"

Kirsi LaPointe & Sirkka Numminen (1995) Tekes

Tekes' corporate cluster programmes seek to facilitate the implementation of new technology by SMEs. The success of programmes commissioned by Tekes in promoting technology implementa-

tion in the participating companies is evaluated in this project. The evaluated programmes differed with respect to size, technology and goals. In some programmes, direct company-specific applications were made while in others, development work was still at an initial stage. In some programmes, the technology had not yet been internationally standardised. The main immediate effect of the programmes was an increase in know-how. Most of the respondents also mentioned increased co-operation, especially with other companies. Product quality and productivity increased somewhat.

"National Innovation Systems: The Pilot Case Study of Finland"

Sirkka Numminen (1995) MTI

Under the auspices of the OECD's Working Group on Innovation and Technology Policy in the Directorate for Science, Technology and Industry, a programme of exploratory studies for developing and testing a new conceptual framework for analysing the system for knowledge creation, distribution and use in the national systems of innovation was launched in 1995. With pilot case studies being conducted in several countries, the common purpose is to assess the availability of data to compare and measure the distribution power of national innovation systems. The Finnish pilot project focuses on mapping the available empirical data according to the framework proposed by the OECD. As a result, various aspects of the university – industry and research institute – industry interactions and effectiveness in the use of the knowledge base by the industry are presented.

"Impacts of Finnish Participation in the European Union's Research and Technology Programmes"

Terttu Luukkonen & Pirjo Niskanen (1995 - 97) Tekes & Ministry of Education

Finnish research organisations have been able to participate in the European Community's research and technology programmes since 1987. This project is the first systematic study of research collaboration involving Finnish organisations in the EC/EU's second and third framework programmes. It examines the utility for and impacts on the Finnish innovation system of these programmes. The study covers Finland's participation in the Second and Third Framework Programmes. Projects in the latter are largely ongoing and the study examines the nature of collaboration and research being carried out rather than the impacts, which will take some time to appear.

"Development of Research-Based New Business – the Evaluation of TULI-Projects"

Eija Ahola & Kirsi LaPointe (1996) Tekes

One of the main objectives of the technology and industrial policy is to create new businesses that are based on new technology, research knowledge and results. The development of new research-based businesses was the aim of Tekes' TULI projects, which were accomplished by nine technology transfer organisations in 1994-96. These projects included screening of research results in universities and research organisations, evaluating the commercial potential of research-based business ideas, and conducting feasibility studies. The aim of the evaluation of the TULI projects was to consider how the basic principle, i.e. the development of new business, had succeeded. According to the results, one strength of the TULI projects was the large number of ideas processed.

"Centres of Expertise in Finland – Evaluation of the Specified Regional Programme"

Eija Ahola & Sami Kortelainen (1997) Ministry of Interior

The Centres of Expertise Programme was launched in 1994 by the Finnish Ministry of the Interior. Its objective is to improve the conditions that enable the location and development of internationally competitive knowledge-intensive business enterprises. The programme aims to support specialisation and division of labour between the Centres of Expertise. At regional level, the most central co-operation organisations are universities, research institutions, enterprises and regional authorities. The programme aims to improve network-building between these parties. The aim of this evaluation of the Centres of Expertise is to consider the activities, operations and projects that have been accomplished, as well as the outcome, results and consequences of the programme.

"Research on the Success of Product Development Projects"

Sirkka Numminen & Olli Hämäläinen (1996) Tekes

The factors of successful innovation activity have been widely analysed during the last decades. The most famous study of factors affecting the success of product development projects is the SAPPHO project, conducted in Great Britain in the early 1970s. One of the conclusions of SAPPHO was that successful technological innovations speed up the growth of companies. Based on the international evaluation of Tekes' industrial R&D projects and using the evaluation survey results,

this study focuses on clarifying the factors generally influencing the success or failure of product development projects in Finland. It also examines project success from the perspective of the funding organisation, i.e. to clarify the added value and importance of public support.

"Analysis of Foreign Technology Foresight Exercises"

Jorma Lievonen (1996) MTI

In the spring of 1996, the Finnish Ministry of Trade and Industry initiated a consultative process to develop a technology vision for Finland. This process aimed to clarify the national needs and opportunities opened up by scientific and technological development, and identify topics for research and development. The Group conducted an analysis of the most significant technology foresight exercises carried out abroad in recent years. This analysis reveals that the two most common approaches to foresight on a national level are the generation of lists of critical technologies and Delphi-based forecasting. The analysis concludes that foreign foresight results offer a source of ideas and inspiration, but the specific national characteristics has to be taken into account in developing the Finnish approach.

"Overall Situation for Technology Transfer and Commercialisation in Finland"

Mika Kuisma (1996 - 97) Sitra

With the general economic development that has taken place in recent years, technology transfer and diffusion as well as the utilisation and commercialisation of research results and the creation of new technology-based businesses have come strongly to the fore in Finnish innovation policy. Most of the measures concerned with technology transfer and commercialisation take place in firms in connection with internally funded R&D work and the development and introduction of other technologies. R&D activities carried out in research institutes and universities primarily with Tekes's programme and project finance are also important functions associated with technology transfer and commercialisation. Organisations and programmes set up for technology transfer and commercialisation also have an important role to play in augmenting and supporting these functions. In addition, EU programmes focusing especially on regional development have brought new features and actors to this field. Hence, this study focuses especially on technology transfer companies, science parks, business incubators, centres of expertise, special business idea search projects (Tekes), regional and other similar development programmes, as well as funding targeted at these from various sources.

"Thematic Network on Advanced Science & Technology Policy Planning – Towards the Integration of Technology Foresight, Technology Assessment & S/T Policy Evaluation (ASTPP)"

Tarmo Lemola & Terttu Luukkonen (1996 - 2000) European Union

The Group for Technology Studies was one of the 11 leading research institutes in the field of science and technology policy studies that participated in ASTPP, a thematic network funded from the EU's TSER (Targeted Socio-Economic Research) programme. The core task of the network was to exchange and link competencies and experiences in the three areas of advanced science and technology planning tools through a series of nine scientific workshops. Each workshop was accompanied by a one day user-oriented seminar aimed at disseminating the network results to S/T policy makers and other interested parties. The Group organised a workshop on technology foresight in Lapland in September 1996.

INTERNATIONAL COLLABORATION IN SCIENCE AND TECHNOLOGY

"Internationalisation of Research and Research Policy in the Nordic Countries"

Terttu Luukkonen & Pirjo Niskanen (1997 - 1998) Nordiskt Ministerrådet

"Study of COST (European Co-operation in the Field of Scientific and Technical Research) Collaboration"

Marja Nissinen & Pirjo Niskanen (1998 - 1999) Tekes

"Finnish Participation in the EU's Fourth Framework Programme"

Pirjo Niskanen, Riikka Eela, Terttu Luukkonen & Sasu Hälikkä (1998) Tekes & Ministry of Education

Ms. Erja Väyrynen

Ms. Pirjo Niskanen

Ms. Riikka Eela

Mr. Sasu Hälikkä

International Collaboration in Science and Technology

International research collaboration has generally increased in recent decades. Intergovernmental programmes aimed at promoting international collaboration have been among the factors which have furthered this development. The Group's research aims to improve our understanding of the significance and impacts of various European collaboration programmes compared with each other and with international research collaboration generally. Finland's membership of the European Union since the beginning of 1995 has increased the relative importance of EU framework programmes in terms of visibility and participation frequency.

"Internationalisation of Research and Research Policy in the Nordic Countries"

Terttu Luukkonen & Pirjo Niskanen (1997 - 1998) Nordiskt Ministerrådet

International RTD (research and technological development) co-operation takes place at different levels and at different organisational levels. Typical examples are informal collaboration between researchers, collaboration at institutional level, and within the frame of supra-national programmes, organisations or facilities. Furthermore, co-operation may be restricted to certain geographical areas such as the Nordic countries or Europe, or comprise participants world-wide. Some initiatives concern only certain disciplines, while some are part of a more comprehensive programmes (e.g. the EU's Framework Programme). In addition, the purpose, funding mechanism and management of the programmes may differ. Taken together, this leaves us with a highly diverse and complex picture of their relative importance for participants from different sectors of the research system, and also of their impact and relation to national efforts. In this study, the formal RTD co-operation at European level is the main focus. It describes the extent of Nordic participation in different formal RTD co-operation initiatives in Europe.

"Study of COST (European Co-operation in the Field of Scientific and Technical Research) Collaboration"

Marja Nissinen & Pirjo Niskanen (1998 - 1999) Tekes

COST collaboration primarily fulfils the function of a contact forum for researchers. Recent statistics indicate that the number of COST Actions has more than trebled since the early 1990s. This

unexpectedly strong growth has taken many decision-makers by surprise because, as some previous evaluations from abroad conclude, COST is relatively unknown outside a circle of devoted researchers. At the same time, COST hardly burdens the Commission budget since its functioning is based on the concerted action principle. According to the international COST Evaluation of 1997, the entire volume of research funding allied to all COST Actions in 1996 was roughly comparable in size to the BRITE/EURAM budget within the Framework Programme, estimated at 450 million ecus per year. This inevitably raises the question of COST's secret: great success with a modest investment – what lies behind this?

"Finnish Participation in the EU's Fourth Framework Programme"

Pirjo Niskanen, Riikka Eela, Terttu Luukkonen & Sasu Hälikkä (1998) Tekes & Ministry of Education

The EU framework programmes are among the very few European research programmes giving money to concrete cross-country research collaboration, and it is the most substantial programme in this respect. Granting research money is an effective way of bringing research partners together for solving joint research problems. Because of the rapid growth of Finnish participation, EU research collaboration has become an important form of international research collaboration for Finnish organisations. Still, Finns do not yet participate quite as much as they might when taking into account the research intensity of the country. There is still room for further increase. This report examines the extent to which Finnish participants in the programme have succeeded, and the types of results they have achieved.

EVALUATION AND DEVELOPMENT OF TECHNOLOGY POLICY INSTRUMENTS

"The Evaluation of Finnish IEA-energy Projects"

Tarmo Lemola &
Christopher Palmberg
(1997) Tekes

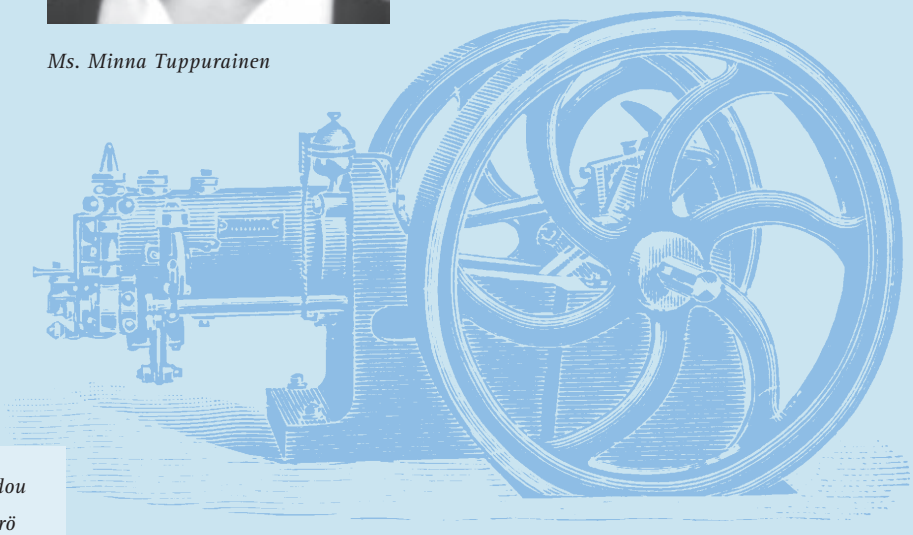
"Evaluation of the Foundation for Finnish Inventions"

Sini Molin & Eija Ahola
(1998) Tekes

Mr. Sampo Niskanen

Ms. Tiina Antila

Ms. Minna Tuppurainen



Ms. Pirjo Aristidou
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Ms. Kaisu Loikkanen
Ms. Sini Molin
Ms. Nina Pesonen

Evaluation and Development of Technology Policy Instruments

Finland's technology and innovation policy faces new challenges to encourage and produce innovations, new jobs and businesses. New measures and actors are emerging and evolving, from both national and international initiatives. As a result, the activities of technology policy are growing and diversifying and the field dispersing. At national level, it is important to find and develop the best and most effective measures to achieve the set goals. This in turn leads to an ever increasing demand for evaluations.

"The Evaluation of Finnish IEA-energy Projects"

Tarmo Lemola & Christopher Palmberg (1997) Tekes

The International Energy Agency (IEA) was founded in 1974 in connection with OECD. The main reasons behind its foundation were the economic and political problems of OECD countries, mainly caused by the oil crisis of 1973-73. The sudden increase of oil prices, together with the excessive dependence on oil and oil import of industrial countries, created some pressure to develop institutional frames for international collaboration regarding energy questions. An international political and economical organisation was needed, which in turn was able to co-ordinate the availability of oil dependency as well as improve the transformation of information and its abuse. The aim of this project is to evaluate Finland's participation in the IEA's research projects and to identify the benefits, possible weaknesses and ideas for future development of the co-operation.

"Evaluation of the Foundation for Finnish Inventions"

Sini Molin & Eija Ahola (1998) Tekes

The Foundation for Finnish Inventions was established in 1971 and is mainly funded by the Finnish Ministry of Trade and Industry. It supports and helps private individuals and entrepreneurs to develop and exploit invention proposals, both within Finland and internationally. The Foundation serves as a link between inventors, innovators, consumers, businesses and industry in Finland or other parts of the world, whether it is a matter of setting up production, licensing or any other means of exploiting an invention. This project evaluates the role and value added of the Foundation for Finnish Inventions in the network of actors promoting inventions. According to the results, the Foundation was found to be the most significant actor in this network, operating at all the levels of promotion identified in the study.

TECHNOLOGY ASSESSMENT AND TECHNOLOGY FORESIGHT

"Technology Foresight for the Finnish Food and Drink Industries' Federation"

Ahti Salo, Jari Kauppila & Jukka Salminiitty (1997 - 98) Finnish Food and Drink Industries' Federation

"Technology Foresight for the Chemical Industry – Technological Opportunities in Biotechnology"

Jorma Lievonen (1998 - 99) Tekes & Chemical Industry Federation of Finland

"Parliamentary Technology Assessment Study on Plant Genetics"

Ahti Salo, Veli Kauppinen & Mikko Rask (1997 - 98) Finnish Parliament

"Technology Assessment, Values and Participation – Experiences of Assessing Gene Technology"

Mikko Rask, Riikka Eela, Topi Heikkerö & Aleksi Neuvonen (1998 - 99) MTI

"Assessment of Technologies Supporting the Autonomous Life of Ageing People"

Annele Eerola, Sirkku Kivisaari, Mikko Rask & Riikka Eela (1999 - 2001) Finnish Parliament & Sitra

"Participation in The European Science and Technology Observatory"

Tarmo Lemola, Ahti Salo & Annele Eerola (1997-2006) European Union / IPTS

"Evaluation of Satakunta Macro Pilot – Co-operation between Private and Public Actors"

Sirkku Kivisaari, Petri Rouvinen & Pekka Ylä-Anttila (1999 - 2001) MTI

"Value Basis of Finnish Technology Policy"

Mikko Rask & Riikka Eela (1998 - 2000) MTI & VTT

"Developing TF&TA Practices on the Basis of European Experience"

Annele Eerola & Erja Väyrynen (2000 - 02) EU/ESTO

"Nordic Technology Foresight – Feasibility Study"

Annele Eerola & Erja Väyrynen (2001 - 02) Nordic Industrial Fund, Risoe National Laboratory & VTT

Dr. Ahti Salo

Mr.Mikko Rask

Mr.Aleksi Neuvonen

Ms. Maria BergenWall

Technology Assessment and Technology Foresight

Technology foresight and technology assessment have received increased attention in various national and international fora. Rapid technological developments and the anticipation of new opportunities and threats have facilitated this discussion: policy and decision-makers need tools to face the challenges of a rapidly changing world, and their attention can be directed to important issues with the help of prospective technology studies. On the other hand, there have been increasing concerns about the inadequacies of the present TF&TA practices from the perspectives of technology policy-making and industrial strategies. Closer investigation and further development of the practices are thus called for.

"Technology Foresight for the Finnish Food and Drink Industries' Federation"

Ahti Salo, Jari Kauppila & Jukka Salminiitty (1997 - 98) Finnish Food and Drink Industries' Federation

The food and drink industry has traditionally been seen as a "low-tech" sector, due to its low investment rate in R&D. However, because of its large size, this industry plays an important role by implementing innovative solutions that have been created in some other sectors (such as electronics, biotechnology and material technology). Hence, the food and drink industry plays the role of a "carrier industry", in which technological knowledge serves the needs of end-consumers. This technology foresight project identifies various changes and developments that can have an impact on the future and competitiveness of the Finnish food industry, as well as opportunities created by technological development.

"Parliamentary Technology Assessment Study on Plant Genetics"

Ahti Salo, Veli Kauppinen & Mikko Rask (1997 - 98) Finnish Parliament

Plant genetic technique is a gene technology directed at plant organisms that makes it possible to make genetic transfers across species in the utilisation of plants. The technology aims to improve the specific qualities of selected plants by means of genetic transformations. The purpose of this study is to provide information for discussion; it does not offer recommendations nor any conclusions on the topic. The project focuses on describing the principles of plant genetics, its current and future applications and its possible effects. This project was the first parliamentary technology assessment study in Finland.

"Technology Foresight for the Chemical Industry – Technological Opportunities in Biotechnology"

Jorma Lievonen (1998 - 99) Tekes & Chemical Industry Federation of Finland

Biotechnology is often referred to as the next wave of technology with wide-ranging economic and societal impacts. However, it is not straightforward to determine its real potential in the various fields of industry. In this study, a systematic attempt is made at examining the opportunities in four specific fields of biotechnology (biocatalysts, biomaterials, medical diagnostics and pharmaceuticals). A medium-term time frame is used in the examination: only the developments that can be anticipated in the light of the existing biotechnical paradigm (systematic screening, combinatorial chemistry, molecular modification, gene transfer and bioinformatics) are considered. A map of technological opportunities is created on the basis of recent international research findings.

"Technology Assessment, Values and Participation – Experiences of Assessing Gene Technology"

Mikko Rask, Riikka Eela, Topi Heikkerö & Aleksi Neuvonen (1998 - 99) MTI

New forms of technology assessment (TA) have been developed in order to ensure that all relevant stakeholders can contribute to a balanced and integrated assessment. The applications of gene technology have been studied with various assessment methods in Europe. Because of the value-addedness of gene technology, the limits of traditional expert assessment have been clearly revealed. This project focuses on how the treatment of values and participation are managed in technology assessment. Besides problems concerning the moral aspects of gene technology, value concerns often arise in questions of expertise and in the framing of TA studies. The study provides some background information and a discussion framework for the development of parliamentary technology assessment in Finland.

"Assessment of Technologies Supporting the Autonomous Life of Ageing People"

Annele Eerola, Sirkku Kivisaari, Mikko Rask & Riikka Eela (1999 - 2001)
Finnish Parliament & Sitra

Future developments in the welfare sector have been considered in several prospective studies of this research theme. These studies contribute to a deeper understanding of the barriers and carriers

of co-operation between producers, users and societal actors in developing radically new health care services in order to meet changing future needs. These studies also provide a good basis for assessing the challenges posed to welfare systems by the ageing of the population in all western societies. The aim of this study is to provide well-grounded information on relevant new technologies and their impacts, and to point out important issues that should be considered by the Finnish Parliament. In particular, the aim is to provide well-grounded information on Internet-based disease management services and their impacts, and to point out important issues that should be considered by the Parliament.

"Participation in The European Science and Technology Observatory"

Tarmo Lemola, Ahti Salo & Annele Eerola (1997 - 2006) European Union / IPTS

The European Science and Technology Observatory was established in 1997 as a network of European organisations with expertise on prospective technology studies. The idea of the ESTO network is to support European Commission and EU decision-making processes with timely information on technological and scientific developments that need the attention of decision-makers. The best available expertise is sought. The aim is to improve communication between those producing and those using the information. By participating in ESTO's longer-term monitoring projects, we have examined European foresight, technology assessment and technology forecasting activities, paying attention to cultural differences in the countries covered. In addition, we have identified VTT experts as partners for ESTO collaboration in the form of prospective technology studies on more specific issues.

"Value Basis of Finnish Technology Policy"

Mikko Rask & Riikka Eela (1998 - 2000) MTI & VTT

The idea of integrating social, institutional and environmental needs in the technological development process is now widely accepted. Methods of decision-making analysis and interactive planning have been developed to provide better tools for policy-making under these new requirements. However, the articulation of the base values of a national technology policy is not quite clear. It is also unclear how new concepts like the "precautionary principle", "ethical values" or "public understanding" will affect technology policy and its goal setting. In this project, the value basis of the Finnish technology policy is examined from two different perspectives: the factors affecting both the value basis and its philosophical foundations, and the argumentation in high-

level policy documents over the past decades. The aim is to deepen the understanding of the frames of reference and historical developments.

"Evaluation of Satakunta Macro Pilot – Co-operation between Private and Public Actors"

Sirkku Kivisaari, Petri Rouvinen & Pekka Ylä-Anttila (1999 - 2001) MTI

Rapid integration and internationalisation development over the recent decades have created new kinds of challenges for the Nordic well-being model. On the one hand, there is an increasing need for the services and the "security network" of the model, mainly caused by the toughening of competition as well as an increased level of uncertainty. On the other hand, possibilities to improve and finance the well-being model have been narrowed due to the tax-competition and harmonisation pressures. Satakunta Macro Pilot is a project focused on developing and testing a seamless, client-centred, independent service chain support model for social and healthcare services. The seamless service chain is a functional model where, from the client's point of view, social and healthcare services form an integrated whole. Satakunta Macro Pilot's cluster implications were evaluated as a co-operative effort of Etlatieto Oy and VTT.

"Developing TF&TA Practices on the Basis of European Experience"

Annele Eerola & Erja Väyrynen (2000 - 02) EU/ESTO

Technology foresight and technology assessment have received increased attention in various national and international fora. Rapid technological developments and the anticipation of new opportunities and threats have facilitated this discussion. On the other hand, there has been increasing concerns about the inadequacy of TF&TA practices from the perspectives of planning and decision-making, especially in the contexts of technology policy-making and industrial strategy processes. A research project with the aim of producing a clear overall picture of the Finnish and European TF&TA practices was started within VTT Group for Technology Studies in April 2000. The purpose of the project is to facilitate the development of Finnish TF&TA practices on the basis of the experience gained.

“Nordic Technology Foresight – Feasibility Study”

Annele Eerola & Erja Väyrynen (2001 - 02) Nordic Industrial Fund, Risoe National Laboratory & VTT

Technology foresight is considered increasingly important by governments, funding agencies, R&D institutions and private companies. Also in the Nordic countries (Denmark, Finland, Iceland, Norway, Sweden) various types of TF exercises have been carried out to support strategy development, R&D prioritisation and learning. However, the common knowledge pool and possible synergies have not yet been fully utilised. This project is a feasibility study describing the state-of-the-art of technology foresight activities in the Nordic countries and investigating the basis for common TF activities as a means of strengthening an integrated Nordic knowledge region. In particular, the aim is to identify Nordic partners with a common interest in TF, to build commitment and to make a concrete proposal for submission to the Nordic Industrial Fund. The feasibility study is being carried out together with the Technology Scenarios Group of Risoe National Laboratory.

TECHNOLOGY POLICY RESEARCH

"Experiences of Finnish Participation in the EU's Fourth Framework Programme"

Terttu Luukkonen & Sasu Hälikkä (1998 - 99) VTT, Tekes & Ministry of Education

"Technology Strategies of Firms and EU R&D Collaboration"

Terttu Luukkonen & Sasu Hälikkä (1999 - 2000) Tekes, VTT & Ministry of Education

"Impact of EU Research Collaboration on Finnish Universities"

Pirjo Niskanen (1999 - 2001) Ministry of Education, Academy of Finland & VTT

"Research Evaluation in Finland – Practices and Experiences, Past and Present"

Juha Oksanen (1999 - 2000) MTI

"Economic Evaluation of Finnish Cluster Programmes"

Tuomo Pentikäinen (1999 - 2000) MTI

"Bibliometric Study of Finnish Science"

Olle Persson, Terttu Luukkonen & Sasu Hälikkä (1999 - 2000) MTI

"Impact of Tekes Grants for Applied Technical Research"

Maria Bergenwall (1997 - 2000) Tekes

"The Impact of VTT R&D Activities"

Tiina Antila & Pirjo Niskanen (1999 - 2001) VTT

"Role of the EU Structural Funds in Innovation Activity and Innovation Policy of the Regions"

Soile Kuitunen & Juha Oksanen (1999 - 2002) Ministry of the Interior, MTI & VTT

"Trend Chart on Innovation in Europe"

Tarmo Lemola, Christopher Palmberg, Mikko Rask, Aleksi Neuvonen, Pirjo Niskanen & Juha Oksanen (2000 - 03) EU

"Utilisation of Research Input – Perspectives on Finnish National Innovation System"

Juha Oksanen & Riikka Eela (2000) MTI

"Evaluation of Finnish R&D Programmes in the Field of Electronics and Tele-communications (ETX, TLX and Telectronics I)"

Erik Arnold, Terttu Luukkonen, Leonhard Joerg, Juha Oksanen, Ben Thuriaux & Shaun Whitehouse (2001 - 02) Tekes

"Implementing IPR (Intellectual Property Rights) Policy at VTT"

Pirjo Niskanen & Niina Elo, Lexwell Oy (2002) VTT

"Challenges and Opportunities for the Utilisation of Research Results – TUHTI"

Pirjo Niskanen (2002 - 04) Tekes

"SMEs and the Changing Role of Academic Research: Exploring the IPR System and the Relevant Institutional Framework in the Nordic Innovation System"

Pirjo Niskanen, Merle Jacob, Erik Iversen & Soeren Barlebo Wennerberg (2002 - 03) Nordisk Industrifond

"VTT's Regional Role"

Juha Oksanen & Pirjo Niskanen (2002) VTT

"Societal Impacts of VTT"

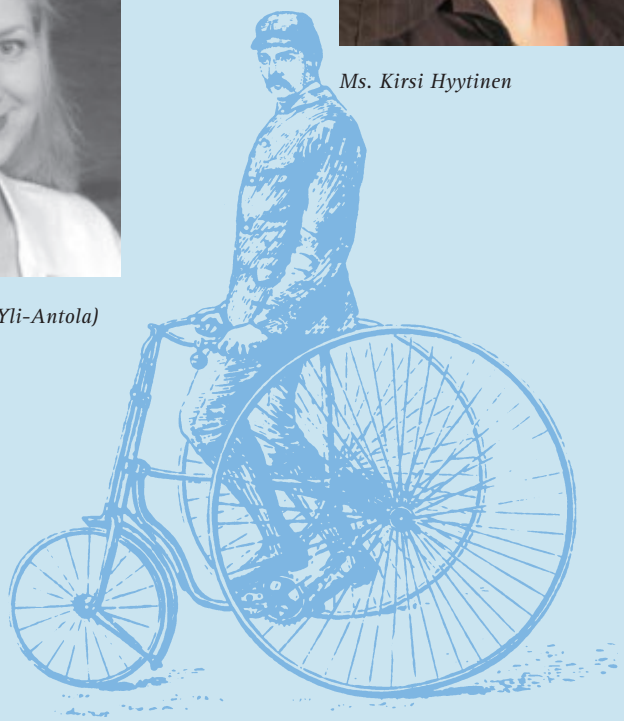
Pirjo Niskanen & Kirsi Hyytinen (2002) VTT

Mr. Juha Oksanen

Dr. Soile Kuitunen

Ms. Kirsi Hyytinen

Ms. Marjo Uotila (born Yli-Antola)



Technology Policy Research

Finland has taken significant steps towards becoming a knowledge-based society. Technology policy plays an important supporting role in this process. Public initiatives help companies to expand their knowledge frontiers by supporting collaboration and flow of knowledge between public research organisations and companies, and also by supporting inter-firm collaboration, particularly in their longer-term R&D activities. Policies thus aim to promote the innovative performance, competitiveness and productivity of companies, and the emergence of knowledge-intensive firms. The tasks for technology policy are growing and becoming more diverse due to heightened competition and increased European and global networking. Technology policy-makers need more in-depth insights into the effectiveness of technology policy initiatives.

"Experiences of Finnish Participation in the EU's Fourth Framework Programme"

Terttu Luukkonen & Sasu Hälikkä (1998 - 99) VTT, Tekes & Ministry of Education

Since Finland's full membership of the European Union in 1995, Finnish research organisations have more than tripled their participation in the EU framework programmes for RTD. EU collaboration has become an important form of international research collaboration for Finnish organisations. This project addresses the objectives, results and impact of collaboration for Finnish organisations in the EU's fourth framework programme for RTD. It studies the learning effects of earlier participation in the EU framework programmes, such as the extent to which participants benefit from the earlier participation and can better utilise collaborative projects for their own research agendas. Other questions considered include the benefits of the status of co-ordinator and the nature of company consortia in different types of programmes.

"Technology Strategies of Firms and EU R&D Collaboration"

Terttu Luukkonen & Sasu Hälikkä (1999 - 2000) Tekes, VTT & Ministry of Education

This study aims to give a picture of the role of EU research collaboration within the overall R&D collaboration activities of companies, particularly in relation to their technology and business strategies. This information is used to assess the importance of EU types of R&D collaboration programmes for technology development in companies, both in large companies and SMEs. One

of the questions studied is the relationship between the additionality of the projects and their strategic importance for the firms concerned. The project results contribute to the understanding of the limits and possibilities of public technology policy initiatives in advancing technology development.

”Impact of EU Research Collaboration on Finnish Universities”

Pirjo Niskanen (1999 - 2001) Ministry of Education, Academy of Finland & VTT

Since the early 1990s, several impact studies of the EU framework programmes have been carried out in EU member countries. These studies have shown, among other conclusions, that EU research programmes have been successful in promoting cross-sector collaboration, strengthening the science base and promoting the education and training of young scientists and engineers. Despite the fact that these studies have provided further insights into the forms of linkages and various impacts of EU collaboration, there is still a lack of information on the scientific quality of EU-funded research. In addition, there has been little probing into the unintended consequences of EU collaboration for different types of organisations. This study examines the views of Finnish academics on the intended and unintended consequences of EU framework programmes for Finnish universities. It also addresses university-company collaboration and participation by academics in the commercialisation of research results.

“Research Evaluation in Finland – Practices and Experiences, Past and Present”

Juha Oksanen (1999 - 2000) MTI

The volume and diversity of research evaluation have grown steadily in Finland during the past two decades. Today, the use of evaluation practices covers a wide range of domains: evaluations of research fields and institutes, universities, R&D funding agencies and R&D programmes. At the same time, knowledge of the evaluation experiences has not been accumulated at the same pace. In order to understand the various uses of evaluations in different sectors of public administration, a summarising study on the issue is needed. The aim of this project is to offer an overview of the evaluation practices and their role in policy-making processes in the Finnish R&D context. The study describes the strategic role of evaluations in support of policy-making processes, and summarises the strengths and weaknesses of the Finnish research system.

"Economic Evaluation of Finnish Cluster Programmes"

Tuomo Pentikäinen (1999 - 2000) MTI

From 1997 onwards there have been eight Finnish cluster programmes that cover a large spectrum of activities. The programmes are public financial initiatives, and their major goal is to create new and permanent co-operation structures, improve the co-operative ability of the whole research system, and increase the relevance and flexibility of activities. The underlying ultimate goals, even though they are hardly measurable, are to generate growth, improve industries' competitiveness and productivity, increase employment, generate new innovations and improve social welfare. This study gives a micro-level view of the Finnish cluster programmes. It gives an insight into which organisations participate, who the financiers are, what kinds of instruments are used, what the volume of funding is, how the governance is organised, and what kind of effectiveness can be expected.

"Bibliometric Study of Finnish Science"

Olle Persson, Terttu Luukkonen & Sasu Hälikkä (1999 - 2000) MTI

Many national R&D programmes aim to promote collaboration and networking among different types of organisations. However, little is known of the extent to which research organisations do collaborate nationally. Earlier studies have drawn attention to growth in international research collaboration and an increase in the number of publications in international scientific journals. This project aims to provide an analysis of research collaboration among different organisations, both nationally across research sectors and internationally. Another focus is to provide an up-to-date picture of the international publication activity of different types of research organisations in Finland, by research field and by sector of the publishing organisation. The study data cover publication data on Finnish organisations between 1986 and 1997. Trends are analysed and the data compared with corresponding data from Sweden.

"Impact of Tekes Grants for Applied Technical Research"

Maria Bergenwall (1997 - 2000) Tekes

Tekes is the main organisation responsible for the financing of applied and industrial R&D in Finland. Tekes funding is divided into three main categories: 1) grants for companies, 2) loans for companies (industrial R&D loans and capital loans to companies for R&D), and 3) grants for

applied technical research carried out at research institutes and universities. The third category, i.e. the grants for applied technical research, is the focus of this study. These particular grants are awarded to research institutes and universities in order to support research aimed at strengthening the technological and scientific knowledge base in Finland.

"The Impact of VTT R&D Activities"

Tiina Antila & Pirjo Niskanen (1999 - 2001) VTT

This study of the impacts of R&D results is the first of its kind carried out at VTT. No similar studies have been carried out at other research institutes in Finland. Furthermore, this is still a relatively new area of research. Studying the impacts of R&D results provides information on the use of public funds and on their significance as a promoter of industrial competitiveness. It also yields information on the objectives and usefulness of the organisation's activities. The study offers insights on the impact of VTT's R&D activities as viewed by VTT's research scientists and the users of the research results. The impacts of the results of 162 significant VTT research and development projects on the partners' businesses, production, co-operation and training are examined. In addition, the study pays attention to broader societal impacts, such as those on the environment, health, safety and employment.

"Role of the EU Structural Funds in Innovation Activity and Innovation Policy of the Regions"

Soile Kuitunen & Juha Oksanen (1999 - 2002) Ministry of the Interior, MTI & VTT

This study focuses on the role of the Structural Funds programmes in the innovation activity and innovation policy of the regions. The objective of the EU Structural Funds programmes is to reduce the differences with regards to standard of living, economy and well-being in member countries. By fostering regional sustainable development and by supporting structural renewal of the regions, the objective is considered to be achieved. Structural renewal is expected, in turn, to strengthen the competitiveness of companies, increase employment possibilities and protect a good environment for the population. In the EU, R&D and innovations have been defined as central factors affecting regional development and growth. Considering Structural Funds programmes, innovations as well as the strengthening of their conditions of origin have been important issues, especially since the end of the 1990s.

"Trend Chart on Innovation in Europe"

Tarmo Lemola, Christopher Palmberg, Mikko Rask, Aleksi Neuvonen, Pirjo Niskanen & Juha Oksanen (2000 - 03) EU

Innovation is a priority of all Member States and of the European Commission. Throughout Europe, hundreds of policy measures and support schemes aimed at innovation have been implemented or are under preparation. The diversity of these measures and schemes reflects the diversity of the framework conditions, cultural preferences and political priorities in the Member States. The "Trend Chart on Innovation in Europe" is a practical tool for innovation policy-makers and scheme managers in Europe. Run by the "Innovation" directorate of DG Enterprises, it pursues the collection, regular updating and analysis of information on innovation policies at national and Community level, with a focus on innovation finance, the setting up and development of innovative businesses, the protection of intellectual property rights and the transfer of technology between research and industry.

"Utilisation of Research input – Perspectives on Finnish National Innovation System"

Juha Oksanen & Riikka Eela (2000) MTI

The main aims of the Government's industrial policy are to ensure economic growth, improve employment and diversify the manufacturing structure in addition to making Finland a competitive working environment for both domestic and foreign investments. The Government regards it as important that industrial policy measures be aimed at improving the functioning of the market, which in turn improves the productivity of economic and business life and gives it the readiness to succeed in competitive world markets. The main focus is on creating measures to improve competitive environment and to enable companies to gain a foothold on the market. Efforts will also be made to maintain the overall investment in R&D at least at the current level by joint measures of the public and private sectors. In this study, we trawl through the papers and publications that have been made on the Finnish national innovation systems.

"Evaluation of Finnish R&D Programmes in the Field of Electronics and Telecommunications (ETX, TLX and Telectronics I)"

Erik Arnold, Terttu Luukkonen, Leonhard Joerg, Juha Oksanen, Ben Thuriaux & Shaun Whitehouse (2001 - 02) Tekes

The ICT cluster has been very important in the recovery of the Finnish economy from the crisis of the early 1990s. However, this growth has also been fragile in that it is based on a comparatively

narrow set of technologies and industries. Strengthening and broadening are both important. The growth has been supported by a research and innovation policy which, in general, is focused on industrial development but also recognises the systemic nature of this. Policy has therefore tackled a range of broad innovation-related constraints, in addition to providing programmatic support to the development of ICT over a period of two decades. A new and potentially important element is closer co-ordination of actions between Tekes, the national innovation agency, and the Academy of Finland, which traditionally funds more fundamental research. The goal of this study is to give the overall picture of the strategy and portfolio of the three R&D programmes, their effect in the Finnish ICT cluster, their management structures and their interaction with each other.

"Implementing IPR (Intellectual Property Rights) Policy at VTT"

Pirjo Niskanen & Niina Elo, Lexwell Oy (2002) VTT

A greater commercial utilisation of research results has been one of the major objectives of Finland's science and technology policy in the early 21st century. Universities and governmental research institutes are viewed as pools of technical expertise and creativity to be tapped into directly through the involvement of academic scientists and engineers in the process of industrial innovation. It is viewed, however, that a large share of knowledge produced by universities and public research organisation remain under-utilised. This is partly due to the lack of various social and technical skills by academic scientists required in the commercialising of research results, and partly due to the inflexible administration of universities and research institutes. This study focuses on the protection of intellectual property and commercialisation of research results at VTT. The aim of the project is to assess the relevance of common IPR policy and services conducted by VTT.

"Challenges and Opportunities for the Utilisation of Research Results – TUHTI"

Pirjo Niskanen (2002 - 04) Tekes

Collaboration between users and producers of knowledge, and commercialisation of research results emerging from public research organisations, have been one of the major objectives of Finland's science and technology policy in the early 21st century. Technology programmes by Tekes as well as the EU's RTD programmes have been the main tools in promoting cross-sector collaboration and utilisation of research results in companies. In addition, research organisations have themselves actively formulated new innovation strategies in order to boost patenting and

inventing among researchers. The aim of this project is to evaluate the factors that have promoted private-public research collaboration and commercialisation of research in Finland. It also examines various challenges and obstacles to the greater utilisation of research results emerging from public research organisations.

"SMEs and the Changing Role of Academic Research: Exploring the IPR System and the Relevant Institutional Framework in the Nordic Innovation System"

Pirjo Niskanen, Merle Jacob, Erik Iversen & Soeren Barlebo Wennerberg (2002 - 03) Nordisk Industrifond

In the knowledge economy, the domains of state and market, culture and mass media and public and private arenas have partially been eroded. By bringing such diverse players into the game, a new 'fuzzy' set-up has arisen with political, cultural and industrial forces influencing research and knowledge production in contemporary society, thus characterising society with both pluralism and diversity and a higher degree of volatility and transgressivity. From a Nordic perspective, we lack an understanding of the specific collaborative relations between universities and SMEs concerning firstly the underlying institutional structures that facilitate their collaboration, secondly the role of the IPR system, and thirdly the influence of the national innovation culture in this set-up. Hence, this study focuses on the SMEs and the changing role of academic research.

"VTT's Regional Role"

Juha Oksanen & Pirjo Niskanen (2002) VTT

Research institutes and universities are expected to play an important role in the development of regions. In particular, organisations that are concentrating on the production and implementation of new knowledge are expected to act as the driving force of regional innovation systems. The issue is widely discussed in the EU since in the statements considering the Structural Funds, the EU has defined R&D activities and innovations as essential actors in the achievement of regional development and growth. At the national level, the topic can be seen in the program of Lipponen II administration, which addresses regional development by way of technology as well as the exploitation of research inputs as a special goals of technology policy. In this study, which is still in progress, the focus is placed on the role of VTT at the regional level.

"Societal Impacts of VTT"

Pirjo Niskanen & Kirsi Hyytinen (2002) VTT

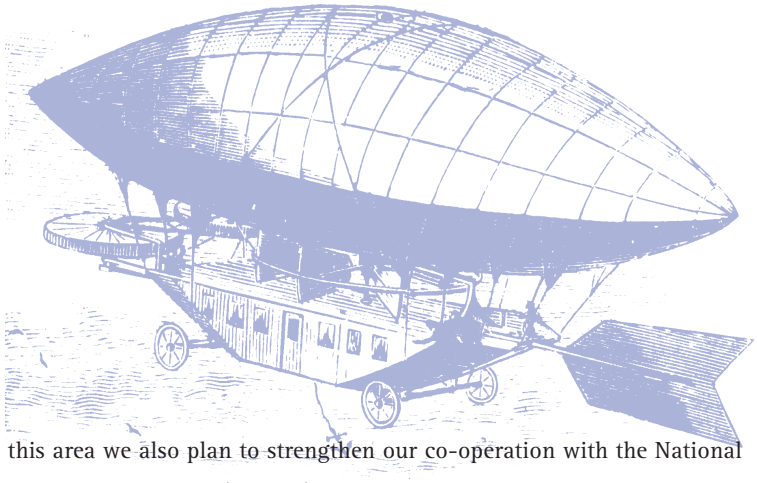
In addition to objectives such as supporting economic activities and promoting technological innovations, VTT also benefit the whole society by supporting decision-making, improving safety, education, health and welfare, and participating in the creation of new technical norms and standards. In this study, the focus is on the role of VTT considering the issues related to the promotion of public interest activities, especially from the point of view of how public interest objectives are taken into account when allocating basic funding. In this study, a general picture of the importance of public interest endeavours in the activity and strategy of the units is created.

Facing the challenges of the future

5

Understanding the dynamics and patterns of innovation and technological change is a basic requirement for innovation research. Consequently, industrial renewal and industrial innovation have been among the key expertise areas of our group. The Sfinno database of Finnish innovations has formed one solid platform for research. The topics of the Sfinno-based studies have included, among others, R&D financing, the commercialisation of innovations, and innovation activities in low-tech industries. The results of such studies are intended to support the assessment and development of national policy measures, and the conclusions on the emergence of innovations can be utilised by firms as well. In the future our aim is to develop our innovation research towards an in-depth understanding of factors contributing to the emergence and diffusion of innovations, the social shaping of technologies, and their economic, social and ecological consequences. This will also enable us to draw conclusions on the effectiveness of policy measures.

The assessment of economic, social and ecological effects of technological change is an integral element of modern innovation studies. The group has carried out a contract research in technology assessment for the Finnish Parliament, covering topics such as technologies supporting ageing people, and future energy alternatives from the perspective of potential health effects. These studies are aimed at raising awareness and supporting decision-making in the Finnish Parliament. The foresight of technological change as well as the economic, social and other factors affecting such change is expected to provide policymakers and firms with guidance for R&D resource allocation. We are participating in several policy-oriented foresight studies, road mapping, and related methodology development. Some of these studies are being carried out as national collaborations with experts from VTT and Finnish industry, and some with European part-



ners (e.g. the ESTO network). In this area we also plan to strengthen our co-operation with the National Institute of Science and Technology Policy of Japan (NISTEP), which has an acknowledged tradition in technology foresight.

Over the years the Group has carried out several evaluation studies on the effectiveness of science and technology policy at the national level for ministries, Tekes and the EU. We explored, for example, the effects of the EU's R&D framework programs on the national research system. The regional perspective of innovation is of growing importance from the policy perspective in Europe. Amongst other issues studied in this area, we explored the effects of the EU's structural funds on regional innovation activities. We also launched an evaluation of VTT's role in the Finnish and European science and technology system. We are and will be conducting a number of studies in this area. Evaluation studies help to assess on an institute, program or policy level whether set objectives have been achieved and whether R&D has been applied effectively. Moreover, evaluation gives ideas and open perspectives for improving existing policies and for formulating novel policy options and measures.

The importance of innovation and technological change on different levels of the economy and society is increasing both nationally and globally. Within this context the future prospects for VTT Group for Technology Studies look promising. The challenge we pose for ourselves in this and coming years is to offer our public and private customers high-quality research services in our areas of expertise.

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6

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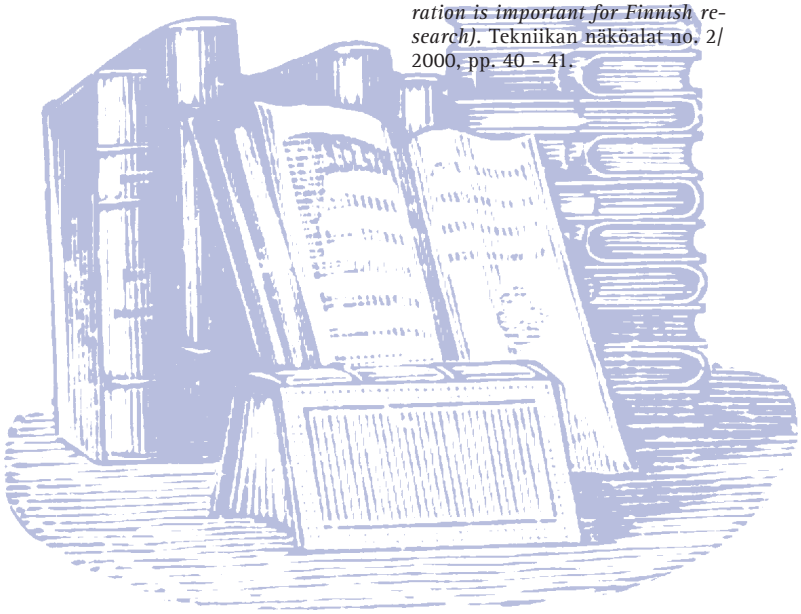

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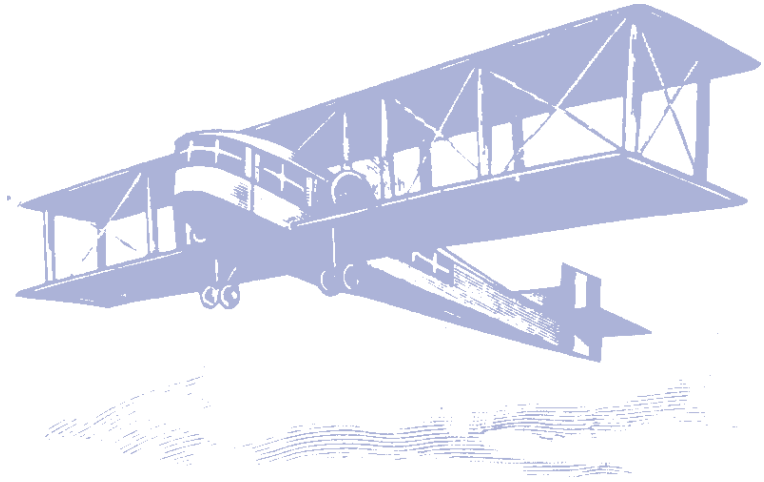

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