*Good*NIP

Good Practices in Nordic Innovation Policies

Part 1

Summary and Policy Recommendations

A report produced by STEP, Verket för näringslivsutveckling (NUTEK), VTT Technology Studies, Danmarks Tekniske Universitet, and Rannsóknarráð Íslands (RANNIS)

Published by STEP, Centre for Innovation Research – a part of SINTEF Industrial Management, Oslo, June 2003

Financed by the

Nordic Industrial Fund
center for innovation and commercial development

SINTEF

STEP REPORT 06/2003

STEP - Centre for Innovation Research

Address/Location:
Hammersborg torg 3,
NO-0179 Oslo, Norway

Phone: +47 22 86 80 10
Fax: +47 22 86 80 49

Enterprise No.: NO 948 007 029 MVA

TITLE

Goodnip - Good Practices in Nordic Innovation Policies
Part 1: Summary and Policy Recommendations

AUTHOR(S)

Per Koch, Lennart Norgren and Juha Oksanen

CLIENT(S)

Nordic Industrial Fund
center for innovation and commercial development

REPORT NO.	CLASSIFICATION	CLIENTS REF.	
STF38A03806			
CLASS. THIS PAGE	ISBN	PROJECT NO.	NO. OF PAGES/APPENDICES
	82-14-03199-0		38
ELECTRONIC FILE CODE		PROJECT MANAGER (NAME, SIGN.)	CHECKED BY (NAME, SIGN.)
Document2		Per Koch	Yngve Stokke
FILE CODE	DATE	APPROVED BY (NAME, POSITION, SIGN.)	
	2003-06-23	Svend Otto Remøe, Research Director	

ABSTRACT

The main objective of Good Practices in Nordic Innovation Policies has been to develop a survey and an analysis of Nordic innovation policy instruments that directly or indirectly are targeting small and medium sized enterprises. The project is to provide Nordic policy makers with information to be used in the development of new or adjusted policy instruments on a national or Nordic level. The project unites researchers from the five Nordic countries: Norway, Iceland, Finland, Denmark, and Sweden. The study is coordinated by Norwegian STEP, a part of SINTEF Industrial Management. The other participants are NUTEK and VINNOVA of Sweden, VTT of Finland, Denmark's Technological University and the Icelandic research council RANNIS.

Report one contains a summary of the GoodNIP exercise, presentations of modern innovation theory and innovation policy developments in the Nordic countries, as well as various policy recommendations.

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	Industrial Management	Teknologiledelse
GROUP 2	Innovation	Innovasjon
SELECTED BY AUTHOR		

A reader's guide to GoodNIP

The Nordic Industrial Fund SME Forum has funded the trans-Nordic research project on good practices in Nordic innovation policies (GoodNIP). The Nordic Industrial Fund – Center for Innovation and Commercial Development is an institution under the Nordic Council of Ministers. Its aim is to strengthen the Nordic business sector through the creation of a Nordic knowledge market, and the organisation does this by initiating and financing projects and activities that create synergy between actors in the Nordic innovation system.

The main objective of *Good Practices in Nordic Innovation Policies* has been to develop a survey and an analysis of Nordic innovation policy instruments that directly or indirectly are targeting small and medium sized enterprises. The project is to provide Nordic policy makers with information to be used in the development of new or adjusted policy instruments on a national or Nordic level. The project unites researchers from the five Nordic countries: Norway, Iceland, Finland, Denmark, and Sweden. The study is coordinated by Norwegian STEP, a part of SINTEF Industrial Management. The other participants are NUTEK and VINNOVA of Sweden, VTT of Finland, Denmark's Technological University and the Icelandic research council RANNIS.

Many of the researchers are also involved in the EU Trend Chart on innovation a European effort providing policy makers and managers of innovation support schemes with summarised information and statistics on innovation policies, performances and trends.[1] The objective for GoodNIP has not been to duplicate Trend Chart efforts, but to use Trend Chart data and reports as a foundation for further in depths studies. The GoodNIP study may hopefully be considered a contribution to the work done by the EU Commission, the OECD and the Nordic Council.

The GoodNIP deliveries consist of three reports:

Report 1: Summary and policy recommendations
Report one contains a summary of the GoodNIP exercise, presentations of modern innovation theory and innovation policy developments in the Nordic countries, as well as various policy recommendations.

Report 2: Innovation policy trends and rationalities
The main chapter of Report 2 gives a thorough presentation a comparison of contemporary innovation policies and policy instruments in the Nordic countries, historically and contemporary. The chapter ends up with several policy recommendations. A separate chapter discusses how policy development actually takes place in ministries and agencies, and introduces the concept of rationalities – i.e. common mental maps or frameworks of understanding that underpins policy development. This chapter also examine policy learning practices in the Nordic countries and gives some concrete advice on how to improve such learning processes.

The report then goes on to a presentation of relevant innovation policy statistics and indicators. This is more than a listing of numbers and tables, however. The chapter uses

[1] http://www.trendchart.org

these figures in order to gain a better understanding of the current status of innovation and R&D in the Nordic countries, and tries to analyse to what extent there is a connection between this status and current innovation policies. The final chapter of Report 2 contains more general theoretical reflections on innovation theory and innovation policy development. It discusses the interaction between innovation research and innovation policy as well as various rationales for innovation policy development.

In an appendix the reader will find national rapports on the historical background for innovation policies in the Nordic countries.

Report 3: Innovation policy measures, documents and government structures
Report 3 is essentially a reference book for innovation policies in the Nordic countries, and includes:

- Presentations of the innovation policy governance structures of the Nordic countries
- Summaries of relevant policy documents
- "Datasheets" presenting selected innovation policy measures
- An extended list of policy measures that goes beyond the ones included in the datasheet section

For more information on GoodNIP, see the GoodNIP Web site at
http://www.step.no/goodnip

Researchers
The following persons have been involved:

STEP, Centre of Innovation Research, a part of SINTEF Industrial Management, Norway
- Per M. Koch (Project Leader)
- Johan Hauknes
- Marianne Broch
- Siri Aanstad
- Rannveig Røste
- Nils Henrik Solum

Verket för näringslivsutveckling (NUTEK), Sweden
- Staffan Larsson (Team Leader)
- Lennart Norgren (VINNOVA)
- Jennie Granat (VINNOVA)

VTT Technology Studies, Finland
- Juha Oksanen (Team Leader)

Danmarks Tekniske Universitet, Denmark, Institut for Produktion og Ledelse (IPL)
- Jørgen Lindgaard Pedersen (Team Leader)
- Søren Jensen
- Kasper Edwards

Rannsóknarráð Íslands (RANNIS), Iceland
- Thorvald Finnbjörnsson (Team Leader)

Contents

Executive Summary

Innovation is considered the engine of technological change and economic growth. Hence innovation policy lays much of the foundation for the future welfare development of the Nordic countries. It is therefore important that they develop sensible, coherent strategies in this area, as well as a set of policy measures that meet the specific needs of each country's industry.

Innovation policies in the Nordic countries are all strongly influenced by the so-called systemic approach to innovation. According to this view technological advance and competence building is characterized by constant interplay and mutual learning between different types of knowledge and actors, including firms, institutes, universities, sources of financing, relevant public agencies and more. This view of technological change and competence development also forms the basis of the GoodNIP reports.

According to this way of thinking public authorities may encourage innovation by strengthening industrial learning and by developing efficient networks for the distribution of knowledge and personnel. The general framework conditions for innovation, including taxation, physical infrastructure, laws and regulations must also be taken into consideration. This is why we now witness a new interest for the so-called third generation, "holistic", innovation policy, i.e. an innovation policy that also includes policy areas that are not directly targeting innovation in companies as such.

Both policy makers and media tend to focus on negative aspects of recent developments. Because of this it should be kept in mind that Denmark, Iceland, Finland, Sweden and Norway are among the wealthiest countries in the world. They do face difficulties in many areas, but all in all thy have been remarkably able to develop profitable enterprises. In general many Nordic companies seem able to adapt new knowledge and new technologies in a productive way. The active use of advance information and communication technologies is but one of many examples.

The Nordic countries have invested heavily in education, investments that have effect on the innovative capabilities of firms, basically because innovation is based on learning, and the companies' ability to learn rests on the "absorptive capacity" of their employees. The high level of education may explain some of the wealth creation in these countries. However, it is worrying that all the Nordic countries show low scores in physical science, mathematics and statistics.

R&D is only one of many activities leading to innovation, but it is an important one. Although many companies may thrive without performing their own research, most of them depend on a surrounding innovation system that does perform R&D, being that in companies, research institutes or universities and colleges. Hence the general interest for R&D investments is understandable.

All the Nordic countries are dominated by small and medium sized companies, often in industries that do not normally invest heavily in R&D. Finland and Sweden, however, has a small number of large technology intensive companies that help bringing the total national R&D investments up to a very high level by OECD standards. However, these R&D investments do not necessarily lead to a high level of innovation in general.

Swedish companies are for instance not much more innovative or entrepreneurial than Norwegian companies, even if the Norwegian investments in R&D are much lower.

This tells us that innovation policy makers must consider other factors that research when developing new policies, including for instance incremental improvements of products, processes and services, organizational change, company learning processes, and the use of design, branding and marketing.

Moreover, research must be understood within the context of the national innovation system. Investments in R&D institutions will not help industry, unless there are ways of integrating this new knowledge in practical industrial endeavours. Furthermore, there are different forms of R&D that serves different purposes. Short term industrial development work cannot replace long term university research and visa-versa.

GoodNIP proposes that national authorities take a close look at their innovation policies, and see if the following functions are covered:

- Measures aimed at improving the absorptive capacities of firms, i.e. their ability to learn.
- Measured aimed at broadening the activity base of the firms, i.e. their ability to invest in risky – but potentially rewarding – projects.
- Measures targeting "unborn" industries or technologies. Hence policy makers should develop policy instruments that guide radical entrepreneurs to sources of finance, advice and relevant competences.
- Measures aimed at improving the interaction between knowledge institutions and industry, being that universities or colleges or institutes.

There is a need for further coordination of innovation policies both within the core area – industrial policy, R&D policy and regional policy – and in the broader "holistic" sense. A lot has been done already, but there remains a lot of difficulties in bridging the gap between various interests, cultures and ways of thinking.

This is why the GoodNIP team would like to underline the need for a better understanding of the innovation practices taking place *within the ministries and agencies themselves*. These institutions talk a lot about learning and innovation in industry, but many of them neglect to a remarkable extent their own learning. GoodNIP therefore proposes that all relevant ministries and agencies develop strategic plans for policy learning, and that they initiate research that can broaden their understanding of such processes.

The GoodNIP study

Background

Innovation policies in the Nordic countries are changing. Globalisation and rapid technological developments constantly rewrite the rules of the game, forcing policy makers to rethink old strategies. At the same time our understanding of how industrial innovation actually takes place is changing, leading to conflicts between different rationalities or mindsets.

There is general agreement on the need for strong innovation policy efforts. Innovation is rightly considered the engine of technological change and economic growth, meaning that innovation policies indirectly lay much of the foundation for future welfare developments. It is therefore important to develop sensible, coherent strategies for policies in this area, as well as a set of policy measures that meet the specific needs of each country's industry.

GoodNIP is meant to serve as a reservoir of policy instruments and practices that might serve as an inspiration for policy makers in the neighbouring countries.

The GoodNIP modules

The work done by GoodNIP has been divided between different modules.

1. A survey of innovation policy instruments

GoodNIP has collected national sets of so-called "datasheets", each one presenting one particular policy measure. Some of these datasheets are expanded versions of datasets collected under the EU Trend Chart project,[2] others are new.

GoodNIP has not made a complete set of such policy instrument presentations; that would be impossible within the framework of this endeavour. The researchers have, however, made a more extensive list of policy measures that will give the reader a more correct view of the breadth and scope of the instrument portfolio of each country.

The datasheet database can be used as a reference when searching for more information on relevant measures. The reader will find the names of contact persons as well as links to relevant Web sites.

The datasheets and the extended list can be found in report no. 3.

2. Surveys of innovation policy governance structures, policy documents and historical development

The GoodNIP team has made a survey of the innovation policy governance structure of each country and the most important innovation policy documents for the last three to five years.

These can be found in report 3, and can be used as a reference when reading report 2.

The GoodNIP team has also made national historical studies of innovation policy, normally covering the last two to three decades. These can be found in an appendix to report 2.

3. Innovation policy analysis

On the basis of the material listed above, other studies, as well as the participant's knowledge of the relevant innovation policy systems, the researchers have made an analysis of contemporary innovation policy trends and policy learning practices (report 2).

[2] http://www.trendchart.org/

The first chapter in report 2, "Innovation policy trends in the Nordic countries", gives a presentation of the development of innovation policies in the Nordic area as well as the present organization of innovation policy measures and institutions. Moreover, the chapter presents several concrete recommendations on how Nordic policy makers may proceed in the near future.

Innovation policies in the Nordic countries are too a surprisingly large degree influenced by statistics and indicators. The GoodNIP team has therefore attempted to go behind more superficial interpretations of common indicators and give a presentation that takes the structures of the national innovation system into consideration. This analysis can be found in report 2's chapter on "Nordic Innovation Indicators".

Policy makers in this area talk a lot about the need for lifelong learning and innovation. However, they do not that often look at their *own* innovation processes. The chapter on policy learning, which is mainly focusing on the social construction of innovation policies, discusses the various "rationalities" that shape innovation policies in these countries. It is partly based on previous research, on analysis of relevant policy documents and on the participants' general knowledge of innovation research and the innovation policy systems of these countries.

There is also a more theoretical chapter on the role of innovation policies.

Innovation policies and the innovation system concept

The innovation policies in the Nordic countries are all influenced by the so-called systemic approach to industrial innovation. Given that this approach also underpins the understanding of the GoodNIP researchers, we have found it useful to include a short presentation of this way of thinking.

Market failure

There are two approaches to the issue of rationales for government intervention in technological advance and innovation activities. One is the neo-classical market failure argument and the other is the system failure argument of evolutionary economics.

The two rationales may have different implication for what policy can and should do in relation to innovation. Both rationales give justification for government intervention, but they partly prescribe different policy instruments. However, market and system failures are not necessarily mutually exclusive; and both require the attention of policy makers.

The traditional core of technology policies have comprised interventions such as managing the science base and designing financial incentives to industrial R&D as solutions to market failures. According to the market failure rationale there is always a tendency for private firms to under-invest in R&D. The main argument is that companies will under-invest in R&D because they are unable to keep all the benefits from these investments to themselves. In other words: their competitors will also be able to make use of at least part of this new invention, technology or knowledge.

However, from society's point of view these external effects ("externalities") or spillovers may be beneficial, as they may contribute to an increased productivity in other

parts of the economy ("additionality"). In order to encourage such research and increase the social returns policy makers develop business R&D support schemes (Arrow 1962).

In some areas of the economy the market failure argument fits the bill. Firms may under-invest in R&D if they fear that their rivals may adapt their innovations right away. This especially applies to branches of industry where innovation equals small incremental changes of products, services and production techniques.

As is often the case, however, the real world tends to be more complicated than economic theories.

> "Because firms gain competitive advantage from their possession of products and processes that are unavailable to rivals, we might expect them to do whatever they can to impede or prevent the spread of this proprietary technology. However, if every firm is denied access to the innovations that are currently employed by others, each will be condemned to activities that are at least partially obsolete, thus putting a break on economic growth. Here I will argue that in fact competition and the pursuit of profits drive many firms to do the opposite: actually to disseminate their proprietary technology, providing it voluntarily, even to their rivals. Of course, they do so only if the reward is sufficient." (Baumol, 2002: 73).

Firms co-operate because it makes sense. By co-operating they learn and get new trading partners. Moreover, firms do not normally have the information needed to judge whether their competitors will gain more from their invention than themselves. They take their chances anyway, exactly because there is no such thing as "perfect information". Moreover, it takes time to find, understand and make use of a new technology, and during this time the innovating company might easily gain a profitable virtual monopoly.

Comparisons of the volume of R&D between countries and sectors are often used as an indicator of under-investment in innovative activities. However, the market failure argument tells us nothing about the optimal rate of R&D. It may vary from company to company, industry to industry, region to region and country to country, all depending on the relevant needs for competences and technology.

In spite of this the market failure argument does make sense in one important respect: Society earns a lot from business innovation:

- Innovative companies are often profitable companies, and profitable companies lay the foundation for taxes and employment, two important factors in any welfare policy
- Innovations made by one company will often lead to productivity growth in companies and institutions that make use of these inventions or services
- Innovative companies broaden the general competence base in their area, leading to learning processes that may be used in other projects and in other areas of society
- Innovative companies may provide society with new socially beneficial products, processes and services, inventions that may contribute to the solution of important social, cultural or environmental problems

- Innovations may lay the foundation for new technologies, new branches of industry and new markets, thus creating an undergrowth of new companies that may replace firms and branches of industry that face extinction

Hence, the social rate of return may be much higher than the company's own profit from a particular R&D program. Thus you may clearly use some kind of market failure argument to legitimize public intervention in this area. Parts of this kind of "expanded" market failure rationale can be found in what is called the systemic failure argument.

Systemic failure

In systemic "evolutionary" economic theories technology change and innovation is considered to be the most important factor behind economic growth. The issue of how technology advances and its driving forces and consequences are at the centre of this kind of evolutionary analysis. Technological change is presented as a two-stage process: one stage for generating variety in technology, i.e. innovations, and one stage for selecting across that variety to produce patterns of change, i.e. diffusion of innovations (Metcalfe and Georghiou 1998).

Technological advance and innovation is characterised by constant interplay and mutual learning between different types of knowledge and actors. Technological change can be seen as a learning process, which is gradual and cumulative in character and leads to a relatively ordered pattern of innovations (technology trajectories).

Firms build upon their existing knowledge base when they search for new innovation opportunities, but they also use external sources of knowledge in this search (Metcalfe and Georghiou 1998, Carlsson and Jacobsson 1997). Overall performance is thus not only dependent on how specific actors perform but also on how they interact with each other as elements of an innovation system.

This division of labour in the generation of innovations means that no firm can be self-sufficient in regard to knowledge and thus gains from linkages with other knowledge generating organisations. Through their innovative activities firms establish relations with other actors such as other firms, universities and R&D-institutes. If these market and non-market organisations interact poorly, technology change may be slowed. Mismatches between elements in an innovation system are one type of "system failures" (OECD 1998).

The recognition of innovation as a process involving many actors and taking place in a complex institutional system is the basis of system failure rationales for policy; a policy that focuses on promoting the generation of innovations. And indeed, the innovation processes are influenced not only by market forces but also by the character of the entire innovation system (Carlsson and Jacobsson 1997).

Systemic innovation policies are about facilitation, i.e. facilitating the emergence of new technology and innovation opportunities by building an innovation infrastructure (Metcalfe and Georghiou 1998). Systemic oriented innovation policy therefore becomes a much more complex issue than in the market failure rationale. Policy makers must design and create an institutional structure that supports the innovation processes in firms. (Lipsey 1998).

If system failures exist then there is a rationale for policy intervention aiming at accelerating the rate of technological advance and innovation (OECD 1998). Hence, the idea is that governments should intervene if such failures exist. It should be noted, however, that there exist no perfect innovation system, no more than there exists perfectly balanced markets. Innovation systems are continuously changing. After all, change is the nature of innovation, and it is this change that propels technology forward.

On the other hand, there can be no doubt that the various channels for technology and competence distribution may be improved, or – to put it another way – the learning processes in the firms can be improved, or that their ability to find, understand and make use of relevant knowledge thorough interaction with others can be enhanced.

Institutions

Institutions and networks constitute elements in innovation systems and their functioning influences the process of technology advance. Hence, they are also possible areas of policy intervention.

Institutions are of two types. Organisations like firms and universities can be considered *hard institutions.* Laws, regulations, culture, attitudes etc are *soft institutions*.

Firms are the prime agents in innovation systems since they develop and introduce innovations into the market. The main focus of any innovation policy will therefore be the firm, or – in a broader context – industries or clusters of companies.

Universities are also important players as they can develop advanced technological competence by pursuing high-risk, long-term, research. Furthermore, the universities and colleges may also influence the innovative capabilities of firms through by delivering highly skilled labour. In several of the Nordic countries research institutes and laboratories also play important roles. These are oriented towards applied research and may help companies absorb advanced knowledge.

Given that the authorities in the Nordic countries carry the main responsibility for university and college research, they have ample opportunity to influence this part of the innovation system. Indirectly they can also make use of the institute sector, by giving them basic funding and by letting them participate in government sponsored R&D programs.

Several of the Nordic countries will also let private companies take part in such projects. However, the extent to which the Nordic countries actually have policy instruments that target companies in particular varies.

The innovation system is a social structure based on learning. Firms, universities, colleges and institutes may influence this learning directly, by producing new knowledge and new technologies that can be used by others, and indirectly by taking part in various forms for collaboration and knowledge diffusion.

However, there are also other institutions that take part in these learning processes, institutions that are under public control and that may easily be used by innovation policy

makers. Among these we find agencies that design, formulate and implement policy initiatives, institutions who support the diffusion of knowledge and innovations (bridging organisations), regulatory agencies, standard setting agencies and patent offices. The behaviour of these organisations can also be conducive to innovations in firms (Edqvist and Johnson 1997).

It should be noted small and medium sized companies find it very hard to set aside the resources needed for efficient learning and networking. Public agencies for industrial research and innovation may help them build such relationships. Hence a research program should be more than a "machine" that produces new technology – it should become a learning arena. The research project itself may fail in reaching its main objectives. By taking part in the process, however, companies and knowledge institutions may gain new competences that can be used elsewhere. That's not a failure.

Soft institutions – i.e. the framework conditions – influence innovation processes in many ways. They may for instance have an effect on the participants' willingness to share resources with other actors and influence the entrepreneurial spirit in general. Laws and regulations may hamper innovation, as can a general negative attitude towards entrepreneurship and industrial innovation.

Policy makers may try to change soft institutions in order to stimulate change. They may also introduce entrepreneurship into the school curricula in order to encourage young people to choose a career as an entrepreneur.

The establishment of new firms and spin-offs and the evolution of these companies depend on a range of factors beyond the control of the individuals starting the firm. These factors can also be influenced by policy makers. This applies for instance to the functioning of the venture capital market and conditions for commercialising academic research results (Carlsson and Jacobsson 1997, Smith 1998).

We now witness a new interest for a so-called third generation – or "holistic" – innovation policy, i.e. an innovation policy that also includes policy areas that are not directly targeting innovation in companies as such. In this context both educational policy, transport policy and social planning becomes part of the innovation policy agenda.

Networks

Networks partly compensate for limitations in a firm's search space and may improve a firm's resource base and degree of freedom. The connectivity of the organisations (or hard institutions) in a system matters, and a well-functioning system with positive and reciprocal external connections between actors may result in a common vision of future technology advance. This means a reduction of perceived risks and co-ordination of investments among independent organisations.

Networks do not necessarily grow spontaneously and there may be obstacles to the growth of a collective identity and shared technological vision. Network failures means that organisations in a system interact poorly, and that these lead to a lack of a collective vision of future technology expectations and co-ordination of investment. To create such a vision one must tie together the relevant actors in the system (Carlsson and Jacobsson

1997). Hence, the building of bridges between organisations for mutual accumulation of knowledge is an important policy area.

Such networking policies should improve the relations between firms and between companies and universities and other research institutions. Establishing and intensifying such connections involve a range of policy instruments such as joint R&D-programmes, technology diffusion programmes and programmes for increasing the mobility of persons. The objective is to increase the number and intensity of linkages among firms, and among firms and R&D-organisations. (Metcalfe and Georghiou 1998, Lipsey 1998, Malerba 1998).

The role of the policy maker

Policy makers are also learners and innovators. Government, as a facilitating actor in an innovation system, need to co-ordinate its innovation policy at the ministerial level. Due to the complexity of innovation systems there is justification for policy experimentation. This in turn means that evaluations of initiatives are necessary for the purpose of policy learning and for avoiding government failure.

There is no optimal innovation policy. Policymaking must rather be based on informed use of theory, information and subjective judgement. There is a need for the adaptive policy maker – as opposed to the optimising policy maker – i.e. a policy maker that has policy learning as one of the most important items on her agenda.

The policy maker will never know the market or the technical aspects of industrial innovation better than the industrialists. However, she may gain a valuable overview of the innovation system that any industrialist bogged down in the minutiae of running a business will fail to get. Moreover, policy makers develop both formal and tacit knowledge of how the policy system works, competences that may be used in changing the system.

For a more detailed discussion on innovation theory and policy development, see the chapter on "What can innovation research tell about innovation policy priorities?" in report No. 2. For a discussion of policy learning and policy culture, see the chapter on "Rationalities and innovation policy learning" in the same report.

A short introduction to innovation policies in the Nordic coutries

Innovation policy trends

Innovation policy, i.e. fostering economic growth and competitiveness of national industry by creating favourable conditions for innovative activities, is a concept of the 1990s. However, policy measures that influence innovative performance have been around for a longer time. The fields of policy that have executed most of such initiatives have been science policy and industrial policy.

The trend within all OECD countries in the 1980s was that the importance of technology policy increased in policies for improved industrial competitiveness. The main instrument

was large R&D-programmes in new technologies like IT, biotechnology and new materials. In terms of public investments the IT-programmes were the largest.

As far as technologies are concerned some national differences are discernible among the Nordic countries. The differences can at least partially be explained by the industrial structure of each country. In Sweden the large public R&D-programmes concerned IT, biotechnology and new materials. In Finland the focus on competitiveness meant large public R&D-programmes in the technologies of automation and micro-electronics. In addition to biotechnology and IT the large R&D programmes also included technologies related to oil/gas and fish-farming in Norway. Denmark focused on food production, Iceland on aquaculture, energy technology and fish processing technology.

One important objective of these technology programmes, and of the technology policy, was a restructuring of industry by developing a science-based industry. The new industries should be promoted by increased public R&D-investments, by promoting commercialisation of research and by supporting collaboration between public R&D-performers and private companies.

The need to increase public R&D-investments was recognised in for instance Norway, Finland and Iceland. A policy consensus developed that meant increasing the R&D/GDP ratio. In Sweden this was not a policy issue, probably because the R&D/GDP ratio was one of the highest in the OECD. However, the promotion of new technology-based companies and technology transfer to SMEs was put on the agenda in all Nordic countries. For instance, public support to so-called technology parks was common. There was also introduced measures that aimed at increasing collaboration between industry and universities, like the competence centres in Sweden.

In the late 1980s an economic crisis hit world economy and the Nordic countries. The magnitude and duration of the crisis differed between countries, as did the policies designed to turn the slow-down into economic growth. However, in all countries the objective of policies was to increase the competitiveness of industry. At the end of the decade some countries developed explicit innovation policies.

In Finland industrial policy became the national policy, i.e. increasing the competitiveness of industry became a prime objective of national policy. A new industrial policy was designed, which primarily aimed at promoting the growth of industrial clusters. Government defined its role as a facilitator providing industry with suitable conditions for increasing innovativeness and competitiveness. Increased public R&D-investments steered towards the needs of industry was one important measure in the new policy.

During the 1990s the Finnish R&D/GDP-ratio increased impressively and is currently one of the highest in OECD. Evaluations got a central role since it was important to assess the success of policies and measures. Regional policy was an important element in the new cluster policy, as was increased support to innovative activities in SMEs.

In Norway the policy answer to the economic crisis was to promote increased productivity and the use of new technology in all industries (not just high-tech and manufacturing industries as in the 1980s). Government aimed at creating suitable conditions for industrial innovation and competitiveness. Identified fields of public

intervention and support were R&D, technology, competence and capital. SMEs, and their use of new technologies, as well as regional issues were given increased attention by policy-makers. The issue of increased R&D-investments continued to be important in the first years of the new century. Different measures to stimulate industrial R&D-investments were introduced.

In Sweden the response to the economic crisis in the early 1990s was deregulation of markets, privatisation of public companies, increased public investments in strategic research and support to commercialisation of research and technology transfer to SMEs. In the closing years of the decade government presented a number of bills where proposed measures and new agencies were explicitly argued for in terms of innovation policies and innovation system theory.

Also, in Iceland the economic crisis was met by privatisation of public companies and deregulation of markets, especially the financial market. Promoting innovation and entrepreneurship became an important policy issue. At the end of the 1990s science and technology policies had moved up on the policy agenda. This was reflected in the establishment of a Science and Technology Council headed by the Prime Minister, with the mission to co-ordinate these policies.

The description of policy trends in each Nordic country (see appendix in Report 2) indicates that changes in policies usually are responses to challenges and problems encountered by government, e.g. the economic crisis of the early 1990s. In fact the prime objective of innovation policies has been to increase the competitiveness of industry.

The concept of innovation system and innovation policies

In all Nordic countries knowledge, new technology and innovations is currently seen as a key to competitiveness, progress and economic growth, the policy implication being that government should design policies that stimulate innovative activities.

In the 1980s the role of government in the Nordic countries was to set national goals for science and technology. The advance of science and technology was seen as increasingly affecting society and government had to ensure that the progress moved in parallel with societal goals.

In the 1990s the view of the role of government in technology advance and innovative activities changed. At the end of the decade the role in most of the Nordic countries was defined as that of a facilitator of innovative activities. In these countries the concept of innovation system are explicitly referred to when arguing for a changed role of government.

Co-ordination of innovation related policy fields are a prerequisite for a successful innovation policy according to the innovation system concept. In the Nordic context such a co-ordination has been in existence for the longest time in Finland (since the early 1990's), where the Science and Technology Policy Council is responsible for the co-ordination. In Denmark the Ministry of Science, Technology and Innovation was given responsibility of co-ordinating innovation policies in 2001/2002 and in Iceland a council was established in 2003 with a co-ordination responsibility.

In Norway the co-ordination takes place in two committees at the ministerial level. In Sweden the co-ordination of innovation policies has been on the policy agenda for a couple of years. However, no organisation or ministry with a co-ordination responsibility of innovation policies has yet been established.

According to the innovation system concept the public authorities should build a strong and flexible public R&D infrastructure (i.e. universities and R&D-institutes), promote commercialisation of research (entrepreneurship and spin-offs) and foster collaboration between the public R&D-infrastructure and industry. Recent policy documents from the Nordic countries show that all these areas are on the policy agenda.[3]

In 2002 the Danish government presented a proposal called "Growth on Purpose" focusing on improving conditions for industry and commerce. In the proposal four key policy areas were identified. It was stated that improvements were necessary for instance in relation to the public R&D-infrastructure and to entrepreneurship and commercialisation of knowledge. In the proposal it was stated that the R&D/GDP ratio should be increased to 3% by tax deductions on R&D-expenditure.

In the "Law on technology and innovation" approved on the 6th of June 2002 measures were proposed aiming at promoting collaboration and diffusion of knowledge between firms and public knowledge generating institutions and at fostering the generation of technology-based firms (e.g. by providing public seed financing).

In Iceland the ministry of Industry and Commerce in 2001 made its objectives and corresponding measures for the coming four years public. A need for improvement was identified in several areas. The commercialisation of research was one area for new initiatives, e.g. the incentive structure, knowledge transfer and spin-offs. Regional economic development should be strengthened by for instance the promotion of innovative activities.

In Norway the level of national R&D-expenditures has been in the policy focus for some years. In a 1999 White paper on research, *Research at the beginning of a new era,* recommended that the national R&D/GDP ratio should reach the OECD average. This issue was also treated in both the Hervik and Mjøs Commissions, which underlined the need for increased public as well as private R&D-investments. Measures to promote private R&D were introduced (the FUNN-measure, which was replaced by tax deductions in 2002).

In 2001 the Bernt Commission presented proposals aiming at increasing the commercialisation of research. The Bondevik II Government in 2002 emphasised the need for strengthening the transfer of knowledge between universities/colleges and industry and the need to foster spin-offs from public research. The need to foster regional development by stimulating innovation in companies was proposed in a White paper on regional affairs in 2001.

[3] The following summary of the use of the innovation system concept in policy-making is based on policy documents presented in report 3 and on the national reports on innovation policy trends found in the appendix to report 2.

In Sweden the first policy document that explicitly referred to innovation system theory was the Bill "Some organisational issues in industrial policy" in the year 2000. It stated the responsibility of government to provide a strong public research base and design appropriate framework conditions for innovative activities. In the context of innovation, promoting collaboration between universities and industry as well as fostering entrepreneurship and commercialisation of research was emphasised.

The Bill proposed the establishment of a new agency, VINNOVA, with the mission to initiate and fund need-oriented (primarily the needs of industry) research and development for promoting Swedish innovation systems and sustainable growth. In the Bill "R&D and collaboration in the innovation system" in 2002 the need to strengthen the Swedish innovation system was emphasised. Once more collaboration and entrepreneurship/spin-offs were stressed as important to promote.

In Finland the innovation system concept (and the cluster concept of Michael Porter) was used in the second half of the 1990s when government introduced a new policy for competitiveness and growth. It included increasing public R&D (as well as supporting private R&D), promoting collaboration and commercialisation of research, e.g. entrepreneurship and spin-offs.

In the "Education and Research 1999-2004 Development plan" from the Ministry of Education the importance of keeping the present level of R&D-expenditures was emphasized. In *Review 2000: the challenge of knowledge and know-how* from the Science and Technology Policy Council the strength and flexibility of public R&D was underlined as well as the importance of collaboration and utilisation of knowledge and know-how, i.e. commercialisation of research. The report also emphasized the need for increased co-ordination of policies between sectors.

In *Innovation policy guidelines: intelligent, learning and competitive Finland* from Science and Technology Policy Council in 2001 it was stated that well functioning and efficient national and regional systems of innovation is becoming more important for the creation of growth and social welfare. Once more the need to improve conditions for innovation, by supporting collaboration and commercialisation of research was pointed out.

The impact of the innovation system concept on policy is, in some cases, also evident at the level of implemented measures.

In the Swedish case the most prominent expression of this impact was the establishment of the agency VINNOVA in 2001. The activities of VINNOVA, i.e. funding of R&D-programmes, are also based on the concept of innovation system and its policy implications. The programme VINNVÄXT, which aims at promoting regional innovation systems, is one example of such a programme. In the Finnish case the cluster programmes of the late 1990s is an example on impact of theory on policy measures. The policy goal of increasing the level of R&D investments in Norway, Finland, and Denmark can be interpreted as an application of innovation theory, as the development of a strong and flexible R&D-infrastructure is important for systemic innovation. However, this need could also be, legitimized for in terms of the market failure argument.

The use of the innovation system concept in policy making is a fairly recent development. However, many of the measures that have been introduced since the middle of the 1990s are in line with the policy implications of the concept. In the list of policy measures in part 3 it can be seen that all countries have introduced measures to promote commercialisation of research (e.g. seed-financing, incubators, entrepreneurship programmes), collaboration between public R&D infrastructure and industry (e.g. joint R&D-programmes, technology transfer programmes, mobility programmes) and measures promoting R&D in companies (e.g. tax deduction schemes).

The present state of affairs

Given the present debate on research and innovation policies in most Nordic countries, one might easily get the impression that everything is rotten in the kingdoms of Denmark, Norway and Sweden as well as in the republics of Finland and Iceland.

The fact remains, though, that these countries are among the richest countries in the world. If one measures wealth as GDP per head, Norway ranks as no. 4 in the world, after Japan and ahead of the US. Denmark is no. 7, Iceland no. 8, Sweden no. 9, and Finland no. 14. They are all above wealthy countries like the Netherlands, Germany, Canada and France. These countries are obviously doing something right.[4]

Education

The Nordic countries have invested heavily in education, and especially higher education. Needless to say, these investments will have effect on the innovative capabilities of firms, basically because innovation is based on learning, and the companies' ability to learn rests on the "absorptive capacity" of their employees. Although "learning by doing" – i.e. practical work experience – is the most targeted form of learning in industry, the educational foundation is nonetheless very important.

At school and in universities and colleges students learn the basic tenets of their trade, fundamental scientific and technological principles as well as relevant "facts". Moreover, they learn the tools of the trade; they learn how to learn, for instance by doing their own research.

It is worrying that all the Nordic countries show low scores in physical science plus mathematics and statistics – which will be a problem for parts of industry. However, competences in the fields of social science, law, the humanities, health and welfare are also useful in the business sector, partly because these people have a general competence base that may be adapted to various purposes, and partly because most SMEs operate outside the high tech sector.

All the Nordic countries are dominated by small and medium sized companies, some of them even more than others. Sweden and Finland have some large high tech companies that influence the national R&D statistics in a significant way, but even these two countries have a significant number of companies within traditional industries like mining, manufacturing, electricity and water. In Iceland and Norway you will find a large number of companies within the fisheries and aquaculture.

[4] *The Ecomist Pocket World in Figures 2003,* p. 26.

Many of these industries are considered low tech and passé by some. The fact remains, however, that many of these companies are highly profitable. Moreover, they make use of very sophisticated technologies. Hence one could say that Nordic wealth is not so much created by a *shift* to new high tech industries, as by the fact that so many companies seems to be able to integrate new technologies into traditional products, processes and services. Sweden has Ericsson, Finland Nokia, but all the Nordic countries are in front as regards the implementation and use of information and communication technologies.

Research and development

Traditionally research and development (R&D) has been considered the most important source of innovation. Some even interpret the word "innovation" to mean "R&D". As noted elsewhere in the GoodNIP reports, R&D is not the only way of innovating. Companies innovate by small incremental improvements of products, processes and services. They innovate by acquiring and implementing new tools and new machinery, and they innovate by gaining new knowledge from suppliers, customers and various partners. In many industries R&D is not the major means of innovation, nor should it be. For many companies it makes perfectly sense to focus their efforts on organisational change, design, branding or marketing.

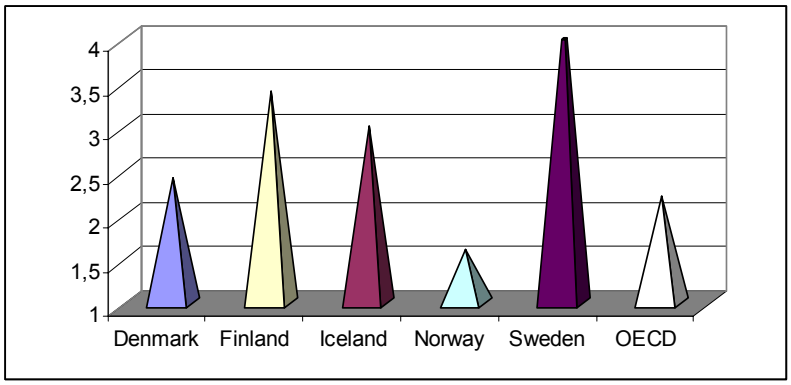
That being said, R&D is important. In many industries companies have to invest in R&D to survive. Moreover, some of them have to perform their own research, not only in order to create new inventions, but also because the R&D process is a learning activity. The employees gain important knowledge through the research process, competences that can be used beyond the concrete research project itself.

R&D is also important in the innovation system as a whole. Even companies that do not do their own research will make use of R&D based machinery, technology or knowledge, and the country needs research environments that are able to find, understand and make use of science and technology developed elsewhere. That is: Nordic industry needs knowledge institutions that can function as bridges to the international scene. These knowledge institutions may be large, R&D intensive companies, universities and colleges or institutes and laboratories. Hence although companies may innovate without investing in R&D, the innovation system as a whole cannot.

The investments in research and development (R&D) have increased considerably in all OECD-countries during the last decade. The Nordic countries show a quite similar R&D tendency, although there are some differences.[5]

[5] See the chapter on Nordic Innovation Indicators in report 2 for references.

Gross Domestic Expenditure on R&D (GERD) as percentage of GDP, 2001[6]

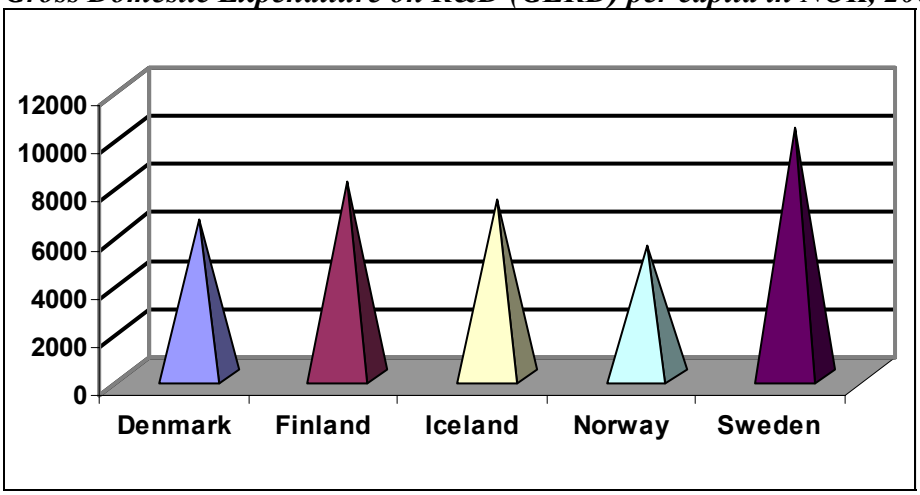


Source: NIFU 2003; OECD 2002/1: Main Science and Technology Indicators

Finland and Sweden show the highest levels of total capital investment in R&D as a percentage of GDP, and Norway the lowest. However, it can be argued that the GERD as a percentage of GDP is a difficult indicator to use in that it does not take into account differences in the sizes of GDP nor the different industrial structure of countries. Norway has a very high GDP due to oil revenues. This affects the GERD as percentage of GDP negatively.

Norway does, however, also rate lower than the other Nordic countries as regards GERD per capita, which clearly indicates that Norway does indeed invest less in R&D than Denmark, Finland and Sweden.

Gross Domestic Expenditure on R&D (GERD) per capita in NOK, 2001[7]



Source: NIFU 2003

When comparing expenditure on R&D as a percentage of GDP from 1991 to 2001 we find that the percentages have gradually increased in all the Nordic countries (table 2.1). The only exception is Norway where the expenditure on R&D as a percentage of GDP has been stable, and has even declined – as it did from 1999 to 2001.

[6] See table A.2.1 in the Statistical Annex, report 2. Finland and Iceland are estimates. Data for OECD is from 1999 and is a secretariat estimate or projection based on national sources.

[7] Data is given in Norwegian crowns, 1 EURO=7,8 NOK (exchange rate at 10.04.2003). See table A.2.1 in the Statistical Annex report 2, where also GERD per capita in PPP$ for 1999 is given.

Table 2.1: GERD as a percentage of GDP 1991-2001[8]

Country	1991	1993	1995	1997	1999	2001
Denmark	1,64	1,74	1,84	1,94	2,09	2,43
Finland	2,04	2,17	2,29	2,72	3,22	3,4
Iceland	1,17	1,35	1,56	1,86	2,37	3,01
Norway	1,64	1,82	1,7	1,64	1,65	1,62
Sweden	2,79	3,27	3,46	3,67	3,78	4,28

Source: NIFU 2003

In Iceland and in Sweden, the increase in R&D investments shows significant "jumps" upwards. This may be explained by considerable increases in some few business enterprises focus on R&D in 2001; the biotech company deCODE genetics in Iceland and Ericsson and ABB in Sweden. Correspondingly, preliminary data for 2002, shows a considerably decline in GERD as a percentage of GDP in Sweden by probably as much as one percentage point. This is mainly due to reduced R&D investments by these particular companies[9]. This is a clear illustration of the liability of these data. In Iceland, Finland and Sweden there are a few high tech companies that alone may change the national level of R&D investments. Countries like Denmark and especially Norway are not to the same extent dependent on one or two R&D intensive companies to ensure high R&D investments levels, but then again this also means that general R&D expenditure is lower. Especially Norway has an industrial structure dominated by small companies in industries that do not invest much in R&D regardless of where they are situated in the world.

Given that all the Nordic countries aim at increasing their total R&D investments, all these governments encourage industry to invest more in R&D. This certainly makes sense, as industrial R&D investments not only affect the companies directly involved, but also other companies by various spill-over mechanisms. A product invented by one company may, for instance, lead to increased productivity among its customers. The competences developed by one company may enrich others by means of technology co-operation, human mobility etc. As a matter of fact, market near R&D of this kind can also benefit university research, which may make use of technology or methods invented in the private sector.

However, one should be careful not to think of R&D as one unified concept. Company R&D cannot normally replace university research. They are of different kinds. Company R&D is often short term and market oriented. University research is on the other hand supposed to have a more long term horizon. An important objective for this research is to interact with the educational responsibilities of these institutions. Students need a broad basic training that go beyond the immediate market-driven needs of a company, partly because of the need to acquire a fundamental understanding of scientific and technological principles, and partly because the technological reality may have changed by the time the students reach "the real world".

This is important, because a more superfluous reading of these statistics may imply that a country that invests relatively much in R&D need not worry about national R&D investments. Actually, there could be a serious systematic instability if these investments

[8] Estimates for Iceland and Finland for 2001.
[9] Unpublished data from Vinnova.

are dominated by one form of R&D, whether this form is defined by a discipline, branch of industry or institutional type.

The Finns have invested heavily in R&D in the field of information- and communication technologies. This may indeed have been a sensible choice, given the country's need for new industries and new markets after the fall of the Soviet Union, and no one can argue with success. However, Finland's "knowledge economy" has also become very vulnerable. If Nokia experiences the same fate as Ericsson the Finish R&D adventure will suffer a momentous backlash. Hence it makes sense for them to diversify.

The Swedes have focused their public R&D activities in their university/college sector. This also makes sense, as it easier to integrate basic and applied research in this way. There is a problem, though. The universities have overreaching objectives that go beyond industrial development. This is reflected in a culture that has to reward scholarly achievements more than on-time innovation and market orientation. This makes it difficult for at least some of these milieus to co-operate with companies, and especially SMEs. This strong focus on university research and technological development also means that Sweden may underestimate the need for other forms of innovation.

The Norwegians have, on the other hand, developed a large sector of market oriented institutes for applied research, institutes that more easily can function as bridges between basic science and industry. These institutions may also more easily understand how to integrate R&D activities into other forms for innovation. The fact that such a sector exists, means that the Norwegian authorities need not to the same extent as other countries encourage university/industry relationships. By making the universities more like the institutes, Norway may actually risk weakening the unique quality of the universities, while at the same time undermining the competitiveness of the institute sector.

One general observation is that the innovation system must be understood as a whole. In many branches of industry companies actually do not have to perform their own R&D or invest in R&D in order to innovate. However, they must have access to companies and institutions that know where to find, understand and make use of new R&D based technologies. In some areas large R&D intensive companies may become such "competence-nodes" in the systems, serving smaller companies through supplier-customer relationships. This observation can be used as an argument for support of not only small and medium sized companies, but also larger companies, if needed.

In other areas public institutions will have to take this role. If an economy lacks R&D intensive industries and companies, it would make sense for the government to compensate for this lack of R&D investments. However, this must primarily be research of direct relevance to the companies in questions.

Norway, and to a certain extent also Iceland and Denmark, lack the large industrial locomotives of the Swedes and the Finns. This can be used as an argument for increasing the public investments in R&D significantly. However, if the main objective of this expenditure is to compensate for small industrial investments, this research must be of direct relevance to the companies in question.

Another way of increasing the total expenditure on R&D in these countries is to develop a policy aiming at changing the overall industrial structure, i.e. replacing low tech with high tech R&D intensive industries. However, by doing this one risks making R&D the overall policy objective and not sustainable development or increased welfare. As long as industries are profitable and provide jobs and taxes, we see no reason for transferring these resources to new types of enterprises, provided, of course, that government take care to support the general development of competences in the country.

Number of innovators
Eurostat has through its Community Innovation Survey (CIS) registered the number of innovative enterprises, but not the number of innovations.[10] Innovative enterprises are here understood as those enterprises that have successfully implemented a new product, process or service new to *the firm*, but not necessarily new to the enterprise's market, the country or the world. [11]

According to the CIS survey[12] Denmark has a much larger share of innovating enterprises in the manufacturing sector than the other Nordic countries (although this may be due to a statistical fluke). Finland and Iceland have the lowest share, while Norway and Sweden is on the CIS average. In all the Nordic countries the numbers of innovators are lower in the service sector than in the manufacturing industry. In Denmark and in Norway the proportion is more than two times higher in the manufacturing sector than in the service sector.

However, as also Eurostat[13] notes, it would be misleading to conclude that the service sector is not innovative. In general, there are problems in measuring innovative activity in firms in the service sector, because innovative activity are most often not singled out in separate R&D divisions. Rather, innovation takes place in many different parts of the organization, developing product, process, organization and market innovations either incrementally or by recombination. Innovative activities are in fact to a large extent conducted in these parts, but the term "R&D" is not normally used for these activities. Innovation in the service sector is therefore underreported.[14]

All the Nordic countries show innovation activity in the category covering coke, nuclear fuel, chemicals and man-made fibres, the category containing machinery and equipment, the class containing electrical and optical equipment, the telecommunication category as well as in computers and related activities.

The table also shows variations between the Nordic countries. In Denmark, and to a lesser degree in Sweden, the share of innovating enterprises is high in all industries. In Finland only coke and chemicals is distinguished noticeably from the other industries. In

[10] Eurostat (2001): *Statistics on Innovation in Europe. Data 1996-1997.*. Data for Iceland are not included in the Eurostat statistic, but are included from Statistic Island in the research report *Science and Technology Indicators for the Nordic countries*.
[11] The CIS-results are based on answers from more than 37 000 enterprises (Icelandic results not included). The response rates vary from 24% to over 90%. The Danish response rate is very low, only 28%, and the Danish estimates are therefore very uncertain. Conclusions concerning the Danish figures should therefore be drawn with caution.
[12] See report 2 for detailed references.
[13] *Statistics on Innovation in Europe, data 1996-1997, Eurostat theme 9 Science and Technology.*
[14] See i.a. Hauknes 1998; Broch 1999

Iceland the machinery and equipment sector and in Norway the firms categorized under "coke, nuclear fuel, chemicals and man-made fibres" are particularly innovative.

The number of innovators (i.e. innovative companies) is a basic indicator of the innovation activity in a sector. This statistic provides a general idea of the propensity to innovate, but fails to measure the complexity of the innovation process. The question "how many have been innovating" is answered unsatisfactory, because the statistic does not say anything about the intensity or the quality of the innovations.

That being said, the table below shows number of product and process innovators as a percentage of enterprises in the manufacturing sector. The numbers for Denmark are unreliable, due to a low response rate.

Number of product or process innovators as a percentage of enterprises in manufacturing sector, 1996[15]

Country	All innovators	Product innovator	Process innovator	Product innovator only	Process innovator only
Denmark	71	58	51	19	13
Finland	36	30	25	11	7
Norway	48	35	40	8	13
Sweden	54	48	38	17	6

Source: Eurostat 2001, Statistics on Innovation in Europe.

The tendency is that pure product innovations outnumber pure process innovators in the Nordic countries, yet not in Norway, where there is a higher proportion on pure process innovators. This is due to the fact that Norwegian industry is dominated by companies that focus on the development of processes used by others. In Denmark the numbers are relatively high for both types, while Sweden has a quite high proportion of pure product innovations.

The industrial structure is also reflected in the size of the innovative companies. In Finland and Sweden, for example, over 70 per cent of the innovation activity is carried out in enterprises with 500 or more employees, while in Iceland only 5 per cent.

Entrepreneurial activity

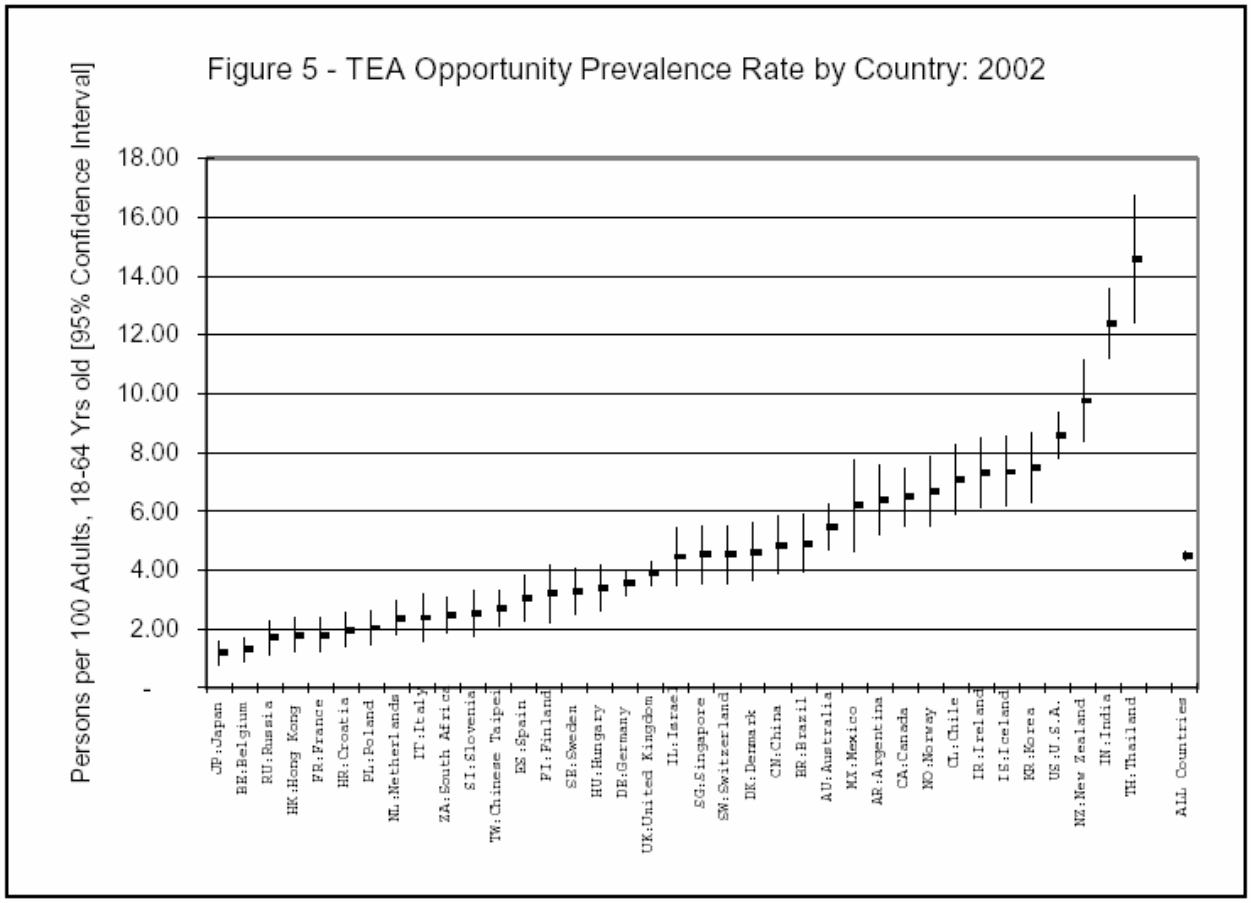
Another indicator measuring the innovation activity in a country is the total entrepreneurial activity (TEA). The TEA index presents the per cent of the labour force that is either actively involved in starting a new venture or is the owner or manager of a business less than 42 months old.

Individuals participate in entrepreneurial activities for two major reasons: (a) they choose to start a business as one of several possible career options ("opportunity based") or (b) they feel compelled to start their own business because all other options for work are either absent or unsatisfactory ("necessity based").

The unemployment rates in the Nordic countries are relatively low, and welfare support is well developed. Few, if any, are therefore forced to establish a new enterprise out of pure need. The opportunity based index gives therefore a more relevant indicator for the

[15] Data are not available for the service sector. Data for Iceland is not included. See methodological comment to table 3.1 and under footnote 29.

entrepreneurial spirit in the Nordic countries. This indicator is also more interesting from an innovation policy point of view, as it is in this category we are more likely to find innovative companies.[16]



This figure is taken from *The Global Entrepreneurship Monitor 2002 Summary Report*, November 2002 (Paul D. Reynolds, William D. Bygrave, Erkko Autio, Michael Hay). It orders the countries according to the propensity to the establishment of new opportunity based companies. The lines delineate the limit for pure statistical noise.

According to this figure you will find Iceland and Norway among the most "entrepreneurial" countries in the world, more or less on the same level as the United States. Denmark is somewhere around the middle, while Finland and Sweden lag behind.

This is interesting, as it shows a reversal of the figures documenting R&D investments. Finland and Sweden have some of the most R&D intensive economies in the world, but these heavy R&D investments do not lead to a high level of opportunity based entrepreneurship. The GoodNIP team has not final the answer to why this is so, but we can raise some possible explanations.

[16] One can argue that establishing a company is in itself an innovation, i.e. a change of behaviour for the ones involved. Indeed it is, and such companies may contribute a lot to the development of the business sector. However, in this connection we focus on companies that are able to contribute with new or improved products, processes or services on the market.

The high R&D investments in Sweden and Finland are mainly caused by a few high tech companies. A high tech company is by definition a company that invest much in R&D, so this does not say much about the "knowledge intensity" of the private sector in these countries. As noted elsewhere, a company may perfectly well be knowledge intensive – in that it makes use of advanced technologies – as well as innovative and profitable, without investing money in R&D.

It could be that Finland and Sweden have invested in high tech industries (ICT) that do not easily lend themselves to widespread entrepreneurial activity. They may be too complex or too knowledge intensive. Admittedly, ICT is an important ingredient in all industries these days, but it is apparently *not* harder for Icelandic, Norwegian and Danish entrepreneurs to make use of this technology than for the Swedes and the Finns.

This reminds us of the figures on the number of innovators as a percentage of enterprises in the manufacturing sector above, where the numbers for the Nordic countries were 71% for Denmark, 36% for Finland, 48% percent for Norway and 54% for Sweden. (The high number for Denmark may be caused by a statistical aberration). Hence Norway, with the weakest R&D investments, can actually compete with Sweden as regards industrial innovative capabilities. Moreover, it performs better than Sweden in opportunity based entrepreneurship.

What this tells us is *not* that R&D does not matter. It does. These figures do emphasize, however, the need to develop a more nuanced view of innovation processes. R&D will help, but not if the innovation is unable to bridge the gap between research and the market in an efficient way. Moreover, there is much more to innovation than research, something the policy makers must take into consideration. Especially Sweden must look into its own innovation system and find out why the large investments in R&D are not followed by an even larger increase in entrepreneurship and innovative capabilities.

The main policy recommendations

Industrial learning

All the Nordic countries have now accepted the systemic view of innovation "on paper". The main focus is on learning, i.e. the companies' ability to find, understand and make use of knowledge. The keyword is competence, not information, as information is of no value unless the innovators are able to understand and make use of this information in a practical setting.

Even if many politicians and policy makers express support for this complicated – but nevertheless common sense – view of innovation, in practical policy they often fall back to a more linear, old fashioned view of how innovation takes place. There is a tendency to promote research as the solution to all innovation problems, as if research can solve all the problems industry and society are facing. Moreover, there is also a tendency to use the words research and innovation interchangeably, as if these two concepts are synonymous.

Research and development is important, and there are many good arguments for increasing the R&D investments in at least some of the Nordic countries, but this promotion of research and development must be integrated into a broader policy that also

takes into consideration other forms of innovation. In other words the main objective must not be an isolated increase in national R&D expenditure, but the need for an innovative industrial sector that can contribute to the development of social welfare.

Many companies – especially in the so-called low-tech industries – do not innovate through investments in R&D, but by other means. They focus on incremental improvements in products and production techniques, they invest in branding, design and marketing and they make active use of new knowledge and new technologies developed elsewhere. The technology "developed elsewhere" may indeed be based on R&D, which is why a country's total investments in R&D is of importance, but encouraging these companies to do more research will not necessarily lead to more innovation.

Moreover, innovation is often understood as meaning "first in the world", not new to the company or the branch of industry, which is a more productive approach seen from a welfare creation perspective. There is for instance a need for incentives encouraging companies to copy improved technologies and methods developed in other countries, and especially large resourceful countries like Germany, France, U.S. and Japan.

It is possible to develop policy measures that stimulate the learning and innovation capabilities of these firms. Actually, the Nordic countries are "best in class" when it comes to testing out such policy meansures. These may be instruments that help companies organise their own activities in a more sensible way, instruments that encourage networking between firms and knowledge institutions or measures that stimulate mobility between firms and institutions. After all, the most valuable form of knowledge is the competences embedded in the individual.

GoodNIP proposes that national authorities take a close look at their innovation policy instrument portfolio and see if the following functions are covered, either in separate programs or institutions or as part of others:

Measures aimed at improving the absorptive capacities of firms.

Small firms find it hard to set aside resources for systematic learning and use of R&D. There is a need for instruments that aim at improving their ability to organize their activities in such a way that the necessary learning takes place. This will help society get more out of each krone or euro spent on education, research and non-R&D innovation activities.

Measures aimed at broadening the activity base of the firms.

During recessions companies have a tendency to focus on their core competences, and avoid investing in more risky – but potentially rewarding – projects. This means that these companies may harbour valuable ideas and competences that are not brought to life.

The authorities may bring about the birth of these innovations by supplying high risk capital and by finding potential partners that may help bringing them to the market.

Measures targeting "unborn" industries or technologies

Current policy instruments are normally servicing existing types of firms and technologies, with programme boards often manned by representatives of traditional industries. This makes it hard for newcomers to get the support they need. Policy makers

should develop policy instruments that guide radical entrepreneurs to sources of finance, R&D institutions and commercial partners.

There is a need for an "undergrowth" of new firms that may – ultimately – replace existing companies. Many of these will grow out of existing companies and knowledge institutions, but there is also need for the creative entrepreneur who with enthusiasm and creativity decides to create something new. Many of these companies will not – and probably ought not – survive. However, too many of them meet a premature death due to too much red tape and lack of funding. Often the demise is caused by the entrepreneur's lack of business competences and a poor understanding of public rules and regulations.

The governments should continue to develop measures that help the entrepreneurs over the first hurdle, for instance by developing services that guide them through establishment procedures and that brings them in contact with private and public funding agencies.

The need for an active policy for seed capital for upstarts and SMEs vary. Finland and Sweden have rather robust structures for venture capital, the other countries do not. However, all governments should note that a lack of high risk venture capital is a major stumbling block for innovation and entrepreneurship. Innovation is an uncertain endeavour, a risk traditional financing institutions like banks are not willing to take. Unless there are enough private investors available, governments must consider the implementation of public schemes.

Measures aimed at improving the interaction between knowledge institutions and industry

In order to make the large public investments in education and research pay off, policy makers should look at alternative ways of facilitating knowledge transfer and co-operation. This applies to research institutes, universities and colleges as well as other educational institutions.

However, one should respect the unique qualities of the relevant types of institutions. The strength of the universities are their ability to focus on long term fundamental research, a type of research that cannot be supplied by small and medium sized enterprises. Moreover, universities and colleges have objectives that go far beyond the needs of industry. Hence it would be a grave mistake to turn the universities into servants of industry only.

Moreover, universities and colleges are nor homogenous institutions; the industrial relevance of various institutes, disciplines and cultures will wary a lot, as will the research units' ability to co-operate with companies. In some areas one should aim at a close co-operation between university units and companies (especially as regards technologies close to the market), in others one should look at alternative ways of technology transfer.

All Nordic countries should implement a university and college IPR[17] policy that encourages relevant researchers to patent and commercialise their inventions. Besides, assessment of the effects of the existing rules should be implemented.

[17] Intellectual property rights, including patents.

All Nordic countries should develop policy measures that encourage interaction and co-operation between companies and relevant university and college units. However, this should not be made an overall objective relevant for all types of companies and university disciplines and units. Small companies will often not have the competence base and resources necessary to take part in this kind of co-operation, which means that other forms of technology transfer is needed. Moreover, the unique role of universities as havens for long term fundamental research must be protected.

Measures targeting the institute sector

Policy makers should go beyond the focus on industry/university relationships, and take all knowledge institutions into consideration when developing their innovation policies. This especially applies to the research institutes. The institutes normally perform applied research and development work or function as advisers to companies and public institutions.

The fact that they are "closer to the market" than most university units, may give them a better understanding of the practical needs of companies. They may also function as bridges between academia and industry. Hence the institutes may play a valuable role innovation wise that is different from the one played by the universities and colleges.

Norway is now preparing an evaluation of its large institute sector, to see if there is a need for a new institute policy and a restructuring of this part of the knowledge sector.[18] Some of the other Nordic countries may also benefit from a review of the role the institutes are to play in the innovation system.

Sweden may for instance consider whether the fact that their large investments in R&D in the university sector and large high tech companies do not lead to the rate of innovation and entrepreneurship one should expect, may be at least partly caused by the lack of a significant institute sector. It might be that the lack of such institutions make it harder to diffuse technology and knowledge throughout the economy.

One idea would be for Norway and Sweden to carry out a parallel evaluations of their institute policies. This evaluation could include a comparison of the institutes and the universities role in these innovation systems. Such a study would probably give us valuable insight into how different types of research institutions influence the innovative capability of industry.

The development of a holistic innovation policy

To say that "everything is connected with everything" is definitely true, but not always that helpful policy-wise. It is hard to co-ordinate policy areas, from practical as well as social and cultural reasons. Ultimately the governance structure will have to be compartmentalized in order to make it workable.

That being said, a lack of sufficient co-ordination will ultimately lead to a waste of resources, and may also lead to counter-productive behaviour: policies in one area negates the positive effects of policies implemented in another.

[18] Source: The Norwegian Ministry of Education and Research

The companies do not care about departmental boundaries. To them the government with all its rules and regulations is part of its business environment, and whatever affects their innovative capabilities will by necessity influence the productivity of the economy as a whole. This is the main reason governments will have to develop a more broad-based, "holistic", innovation policy that goes beyond the traditional areas of industrial and economic policy, research policy and regional development policy.

This is why for instance the Swedish and Norwegian governments are now looking into the effects transport policy and educational policy have on innovation, even though industrial innovation is not the main target for these policy areas.

GoodNIP will recommend that all the Nordic countries implements policy initiatives in this area. In order to make the new policies visible in political and public forums, they should be presented in separate white papers or action plans.

The fact that the development of cross-ministerial policies is demanding, underlines the need for deliberate strategies for policy learning. The different ministries (and agencies) represent different cultures and communication will fail unless there is established a common understanding of the basis for the new policy (see Policy Learning, below).

General policy advice

When developing national innovation policies, the national governments must take the uniqueness of their own innovation systems into consideration and not blindly adapt strategies developed for other industrial structures and different political systems. Different types of institutions or companies may fulfil similar functions.

Differences in innovation system structures may lead to the need for different policies. There are no "best practices". Nor do the Nordic countries necessarily have to adapt strategies developed in larger European countries. This especially applies to regional policies. These are all small nation states, comparable to counties or *Länder* in other countries. One cannot expect Finish or Icelandic counties to act in the same way as French *departements.*

Policy makers should also be careful not to put too much emphasis on statistical comparisons between countries. The fact that a country lags behind as regards one or two indicators does not necessarily mean that the innovation system is not functioning. It could be that deficiencies in one area are compensated by stronger performance in others.

GoodNIP will warn against innovation policy reductionism, meaning that innovation policy objectives are reduced to reaching a certain number on a particular investment scale. We appreciate the fact that policy makers need measurable goals to inspire politicians and others to make the investments that are necessary. It is hard to communicate the complex needs of an innovation system. Nevertheless, by focusing on one type of investment only, e.g. R&D investments, the policy can have unforeseen and unwanted consequences. Given that the majority of Nordic companies are small and in industries that do normally not invest much in R&D, an increase in national R&D investments will have to be the result of a change in industrial structure, i.e. one will need a larger number of new R&D intensive companies.

There are arguments for replacing low tech enterprises – i.e. enterprises with low investments in R&D – with high tech R&D intensive enterprises. One may argue that the economy as a whole may benefit from the technology developed by these new high tech companies. For instance: All modern countries need ICT companies that can find, understand and adapt new technologies to local needs.

However, it is important to keep in mind that so-called "low tech" companies may be knowledge intensive – i.e. they make use of advanced technologies – as well as profitable. By transferring manpower from these companies to so-called "high tech" companies one may actually undermine thriving sections of the economy. Hence it is probably wiser to aim for a balance between investments in R&D intensive activities and the absorption of new technologies and new knowledge in all kinds of companies.

Policy learning

Policy makers, including politicians and civil servants, are always faced with uncertainty and limited knowledge. Social systems are tremendously complex, and any theory that tries to reduce this complexity to a few numbers or factors is exactly that: a *theory* with limited practical usability.

This means that innovation policy development must be based on a broad competence base that includes formal knowledge (education and research) coupled with hands-on experience from policy practice.

Innovation policy ministries and agencies focus on learning and innovation in companies. In the same way they must develop conscious strategies for their own learning and their own innovation practices. This is, in our experience, seldom the case. Instead, policy development practice is based on inherited practices, often accepted as they are, without any deliberate reflection on their validity or value.

Policy discussions are – and to a certain extent must be – shaped by political struggles and a strategic use of rhetoric. Political texts cannot always be taken at face value, as they are created in an environment that has to compromise, not only on the actual political proposals, but also as regards the world view or philosophy that underpins these policies. This means that policy learning in ministries and agencies also entails enculturation or socialization: Budding bureaucrats and politicians must learn the language of the tribe and the rules of the game – this is a necessity if they are to function in their work environment.

The downside to this socialization is that many of them are led to believe that their perspective and their view of reality – what we in GoodNIP have called a *rationality* – is the only view worth defending. In some cases we also see that policy makers fail to take into consideration that other parties may look upon innovation policy from another point of reference. This leads to misunderstanding or even worse: a breakdown of communication. Entrenched rationalities may also stop policy organisations from innovating. If the policy makers are unable to comprehend new ways of thinking, they will oppose them, consciously or unconsciously.

Policy makers are under a lot of pressure. They are to produce results – fast. Moreover, Nordic ministries and agencies are relatively small as regards the number of employees, which means that many of the leading policy developers will have to cover a wide policy area. There is often insufficient time for reading and studies and for interactive learning with other policy makers and researchers. This may lead to despair, but it may also lead to a more strategic approach to policy learning.

Nordic innovation policy makers make use of economic theory, innovation theory and research on innovation processes in the economy. One important part of the policy learning process must be for policy makers to engage in an active dialog with researchers, both on the theoretical level and on the "factual" level.

Innovation research is both used and misused in the Nordic countries. It is used as a valuable input to innovation policy processes and decisions, and policy makers actively commission new evaluations and new reports. However, if the policy maker does not understand the theoretical basis for the report, he or she may misinterpret it or it may not be used at all. There are also examples of policy makers who consciously or unconsciously misread especially statistics in order to serve their own arguments. Rhetoric is a part of the political game, but oversimplifications and misinterpretations may undermine the foundation of a sensible innovation policy.

GoodNIP proposes that all relevant ministries and agencies develop strategic plans for policy learning, plans that include:

Concrete measures for life-long learning

Policy institutions should make active use of workshops, sabbaticals, courses and other forms of training. There should be exchanges of employees for a limited period of time, so that policy makers may learn to know other institutions more intimately. Furthermore, there should be implemented more radical recruitment policies, in order to avoid the clone problem (leaders employing people sharing the same rationality only) and in order to get a more even distribution as regards age, gender and educational background.

Moreover, policy learning should be made an obligatory part of work descriptions and employment contracts, and the institutions should identify the resources that are to be allotted to such learning.

Strategic use of participation in international organisation like the Nordic Council, the OECD and EU, and in international conferences

It is important to distribute the participation between more policy makers, so that more of them get the benefit from international experience and learning. International travels should not be seen as a fringe benefit for senior civil servants, but should be used as a tool for the training of new employees. It is important that the experience gained by these policy makers is shared with others.

The establishment of new forms of cross-organisational working groups

Informal networks are an important part of policy learning, but they cannot be the only form for co-operation across departmental and organisational borders. High level forums are important tools for making the necessary policy decisions, but will often not give the necessary room for in depth discussions and extended policy learning. One way of

improving such communication is to establish ad hoc or permanent medium to low level working groups given the concrete task of producing policy analysis and recommendations. Not only may such working groups lead to policy learning by themselves, they also contribute to lower the fences between institutions.

The establishment of social arenas.

It has been said that the most important part of any conference or work shop is the coffee breaks. During intermissions and meals delegates learn to know each other. They gain useful information and establish new venues for communications. Policy organisations should be encouraged to use this phenomenon actively. One way of doing this is to arrange common conferences for several departments or institutions. One should see to it that the arrangement takes place at a distance from the ordinary work place and that there is ample time for social interaction.

Coherent plans for the commissioning of innovation research and evaluations.

In all the Nordic countries the authorities make active use of evaluations and commissioned reports. However, this is often done on an ad hoc basis, without taking the needs of other relevant policy institutions into consideration. In some areas – but not all – it will therefore make sense to coordinate such commissions in a better way. It is also important to systemize the use of already existing evaluations and reports and see to it that they are distributed to all relevant policy makers.

Closer interaction with relevant research institutions.

Research institutions should not be understood as "report factories" that can produce policy advice on a totally independent basis. Innovation policy research institutions should indeed uphold the standards of unbiased and critical research, but they cannot gain an understanding of policy development without a close interaction with policy makers. Such interaction will also gain policy makers, as they are more easily kept up to date on the latest developments in innovation theory, methodology and research.

It is a common joke among researchers and policy makers that every sensible researcher will end his or her report with recommending more research – after all this is what he or she lives and breathes for. However, in this report we will make a small alteration to this mantra. We believe there is need for more *learning* in the broad sense of the word, both in the relevant research institutions and in the policy apparatus.

By all means, there is a need for more research. We are just beginning to understand the complexity of industrial innovation or innovation policy learning. But this research must be part of a dual process, including both researchers and policy makers. Policy makers have knowledge about the social and cultural processes underpinning policy development that most researchers lack, and that they need in order to be able to give sound advice on policy matters. No reform will succeed unless the parties involved take human nature and the cultural context into consideration. On the other hand, the researcher may as an outsider add new perspectives to this understanding, given that the policy maker (as all of us) tend to become blind towards his or her own environment. What seems self evident, may actually not be so.

It is our hope that GoodNIP may contribute to such a learning process.

Litterature

Given that this report is based on the two other reports in the GoodNIP series, the reader should refer to literature lists in those reports as well.

Arrow, K. J. (1962): *The Economic Implications of Learning by Doing*. In "Review of Economic Studies" vol. 29, 1962, s. 155-173.

Baumol W. J. (2002): *The free-market innovation machine: Analysing the growth miracle of capitalism*, Princeton University Press, Princeton and Oxford.

Carlsson, B. and Jacobsson, S. (1997): *In Search of Useful Public Policies: Key Lessons and Issues for Policy Makers*. In Carlsson, B. (ed.): *Technological Systems and Industrial Dynamics*. Kluwer Academic Publishers 1997.

Edquist, C. and Johnson, B. (1997): *Institutions and Organisations in Systems of Innovation*. In Edquist, C. (ed.): *Systems of Innovation: Technologies, Institutions and Organizations*. Cassel, 1997.

Lipsey, R. (1998): *Technology Policies in Neo-Classical and Structuralist-Evolutionary Models*. "STI Review" No.22, 1998, pp. 31-73.

Malerba, F. (1998): *Public Policy and Industrial Dynamics: An Evolutionary Perspective*. ISE report project 3.1.1, ISE CD-ROM, Systems of Innovation Research Programme, Department of Technology and Social Change, Linköping University, 1998.

Metcalfe, J. S. and Georghiou, L. (1998): *Equilibrium and Evolutionary Foundations of Technology Policy*. "STI Review" No 22, pp. 75-100.

OECD (1998): *Technology, Productivity and Job Creation – Best Policy Practice*. OECD, Paris, 1998.

Smith, K. (1998): *System Approaches to Innovation: Some Policy Issues*. ISE report project 3.1.1, ISE CD-ROM, Systems of Innovation Research Programme, Department of Technology and Social Change, Linköping University, 1998.