STEP Working Paper **ISSN 1501-0066**

A-01
•
1998

Finn Ørstavik
Svein Olav Nås

Institutional mapping of the Norwegian national system of innovation

Finn Ørstavik
Svein Olav Nås
STEP
Storgaten 1
N-0155 Oslo
Norway

Paper prepared for the National Innovation Systems programme
OECD/The Norwegian Research Council

Oslo, January 1998

STEP gruppen
Studies in technology, innovation and economic policy
Studier i teknologi, innovasjon og økonomisk politikk

Storgaten 1, N–0155 Oslo, Norway
Telephone +47 2247 7310
Fax: +47 2242 9533
Web: http://www.sol.no/step/

STEP gruppen

STEP publiserer to ulike serier av skrifter: Rapporter og Arbeidsnotater.

STEP Arbeidsnotater

I denne serien presenterer vi viktige forskningsresultater som vi ønsker å gjøre tilgjengelige for andre, men som ikke har en form som gjør dem egnet til publisering i Rapportserien. Arbeidsnotatene kan være selvstendige arbeider, forarbeider til større prosjekter, eller spesielle analyser utarbeidet for oppdragsgivere. De inneholder data og analyser som belyser viktige problemstillinger relatert til innovasjon, teknologisk, økonomisk og sosial utvikling, og offentlig politikk.

STEP maintains two diverse series of research publications: Reports and Working Papers.

STEP Working Papers

In this series we report important research results that we wish to make accessible for others, but that do not have a form which makes them suited for the Report Series. The Working Papers may be independent studies, pilot studies for larger projects, or specific analyses commissioned by external agencies. They contain data and analyses that address research problems related to innovation, technological, economic and social development, and public policy.

Preface

This working paper gives a very brief overview of the Norwegian innovation system. The paper has been written as part of the "horizontal mapping activities" of the National Systems of Innovation research effort coordinated by the OECD.

The authors wish to thank the Norwegian Research Council for the financial support that made the work possible.

Oslo, January 1998

Table of contents

Institutional mapping of the Norwegian national system of innovation

1. Introduction

This note gives a very brief overview of the Norwegian innovation system. In the main part of the text, organisations in the innovation system are ordered in a spectrum between "Public policymaking" and "Commercial operations". This way of structuring the exposition should not be taken to imply that in the economy, private firms alone make up the backbone of industry and business, while the State merely lays down the main rules of the game. The functions of the State are many and complex, and public policy efforts are as much directed towards supporting, assisting and pursuing specific policy goals, as they are directed towards rule-making. Furthermore, there is no unambiguous dividing line between public and private businesses, and organisations outside public government may often have a big say over policies and policymaking.

A simple classification of organisations in modern economies can be constructed on the basis of these considerations. If we tentatively distinguish between public and private ownership on the one side, and organisational purpose in terms of for-profit and for-common-good on the other, we get the following scheme:

Table 1.1: A simple classification of organisations in modern economies, with examples

Purpose / Ownership	For-profit	Mixed	For-common-good
Public	Ex.: State owned industry		Ex.: Government
Mixed			
Private	Ex.: Business firms		Ex.: Humanitarian organisations

In modern economies very much is *mixed*, and the dynamics of the economies depend a lot on what is going on in the "grey cells" in table 1.1 above. *The innovation system and its dynamics are strongly related to the organisations and the motivations that are "in-between" with respect to ownership and organisational purpose.*

Thus, an adequate mapping of the innovation system should in our view take into account not only the organisations of the innovation system, but also its *institutions*, in the sense of norms, problem definitions and shared modes of thinking.[1]

[1] See for example Edquist 1997, chapter 2.

In this paper we only confront a part of this broad overall challenge. We characterise the main organisations of the Norwegian innovation system and their relationships, and defer the discussion of institutions (in the sense of norms etc. introduced above). Also, we do not in this note detail the structure of the goods and services producing sectors in Norway and the innovation efforts taking place there. However, in order to move a bit further than the rather conventional policy system overview that follows, we introduce a company centred map of the innovation system towards the end of the document, in section 3. While we do not develop this perspective in much detail in this research note, it is our belief that a more comprehensive *institutional mapping* of the innovation system should be constructed on the basis of the company-centred perspective which is introduced here.

2. A policy-centred organisational map of the Norwegian innovation system

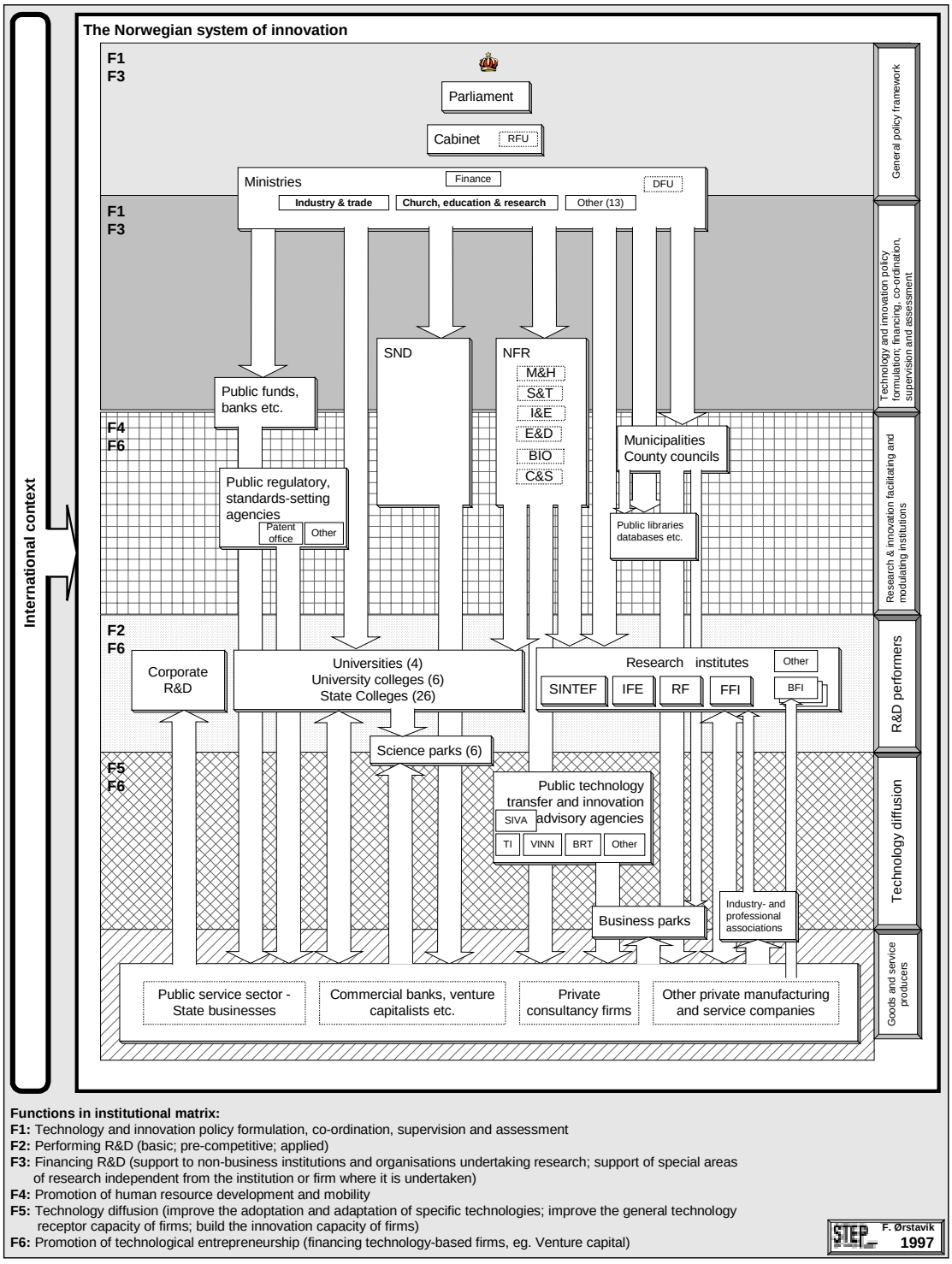
We here distinguish 6 levels in the policy system:

- Institutions laying down the general policy framework
- Technology and innovation policy formulating institutions (including financing, co-ordination, supervision and assessment)
- Research and innovation facilitating and modulating institutions
- R&D performing institutions
- Institutions promoting technology diffusion
- Goods and service producers

Thus, we lay out our map of the institutions of the innovation system between two poles: Private and public production of goods and services, and public policy making.

In this organisational universe, the general policy making institutions make up the apex of a pyramid. There are layers in this pyramid corresponding to the relative authority and autonomy they have in the overall system. (However, the borders between layers are fuzzy, and there are interactions between layers, both adjacent and more distant layers influence each other.) This model of the innovation system is reproduced graphically below.

Figure 2.1: A policy-centered organisational map of the Norwegian system of innovation[2]



[2] The following abbreviations are used in the figure:

RFU - Regjeringens forskningsutvalg [The Government's research policy board]
DFU - Departementenes forskningsutvalg [The interministerial committee on research policy]
SND - Statens nærings- og distriktsutviklingsfond [The Norwegian Industrial and Regional Development Fund]
NFR - Norges forskningsråd [The research council of Norway]

2.1. Institutions defining the general policy framework

2.1.1. The system of government

The apex of our organisational pyramid is the Norwegian government system. In the Storting (parliament), the day to day business is handled by party groups and in the committee system. All the members of the Storting are distributed among the following 12 committees:

Table 2.1: Standing committees in the Storting

The Standing Committee on Energy and the Environment
The Standing Committee on Family, Cultural Affairs and Government Administration
The Standing Committee on Finance and Economic Affairs
The Standing Committee on Defence
The Standing Committee on Justice
The Standing Committee on Education, Research and Church Affairs
The Standing Committee on Local Government
The Standing Committee on Scrutiny and Constitutional Affairs
The Standing Committee on Business and Industry
The Standing Committee on Transport and Communications
The Standing Committee on Health and Social Affairs
The Standing Committee on Foreign Affairs

The Parliamentary committees dealing most directly with innovation policy issues are

- the Committee on Education, Research and Church Affairs

S&T - Science and technology [Board under NFR]
M&H - Medicine and health [Board under NFR]
I&E - Industry and energy [Board under NFR]
C&S - Culture and society [Board under NFR]
BIO - Bioproduction and improvement [Board under NFR]
E&D - Environment and development [Board under NFR]
TI - Teknologisk insititutt [National Institute of Technology]
VINN - Veiledningsinstituttet i Nord Norge [Partly state supported advisory office for Northern Norway]
BRT – Bedriftenes Rådgivningstjeneste [Regional advisory services in economic and administrative disciplines for private businesses]
BFI - Bransjeforskningsinstitutter [Industry joint-owned research institues; for instance The paper industry research institute]
SINTEF – Stiftelsen for industriell og teknisk forskning ved Norges tekniske høgskole [The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology]
IFE – Institutt for Energiteknikk [Institute for Energy Technology]
FFI – Forsvarets forskningsinstitutt [Norwegian Defence Research Establishment]
RF – Rogalandsforskning [Rogaland Research]

- the Committee on Business and Industry
- the Committee on Energy and the Environment
- the Committee on Finance and Economic Affairs

As a result of the sector oriented division of committees, research and innovation policy issues are dealt with in several committees; there is no single Parliamentary forum with an innovation policy responsibility where these issues are focused and co-ordinated. The Committee on Finance and Economic Affairs has an overall responsibility for economic policy, but only indirectly impact on the innovation system as it deals with businesses related to general economic policy, public finances and credit policy, taxes etc. The Committee on Education, Research and Church Affairs has a particularly important role as it handles the budget for education and research *including research related to agriculture, fisheries and industry*.[3] The Committee on Energy and the Environment handles oil and energy businesses; the Committee on Business and Industry handles businesses related to industry and business, but also fisheries, agriculture, subsidies of ship building and tourism is the concern of this committee. Both of these committees handles matters of importance for innovative performance, like funding of the Norwegian Industrial and Regional Development fund (Business and Industry).

2.1.2. High level research policy committees

At Governmental level however, there are two high level committees focusing on science and technology policy related issues: the Inter-ministerial Research Forum (*Departementenes forskningsutvalg - DFU)* and the Governmental Research Commission (*Regjeringens forskningsutvalg - RFU).* The first is an inter-ministerial committee with regular meetings at administrative level. Its primary function is to support the Ministry of Church Affairs, Education and Research in its role as inter-ministerial coordinator of public R&D funding and policies. The RFU is a commission of government ministers, appointed by the Government and headed by the Minister of Church Affairs, Education and Research. It's term of reference is to advice the Government on R&D policies and decisions, but in practice its main function has been in the setting of annual R&D budgets.[4]

2.1.3. The ministries

The current list of ministries is the following (November 1997):

[3] Information on the parliamentary committees found on:

http://odin.dep.no/html/nofovalt/offpub/statskalenderen/1997/0604.htm

[4] Under the Jagland-government (1996-1997) the RFU was not functioning. Whether the committee will be permanently dismantled probably depends on choices made by the new Bondevik government, which took office in mid-October this year (1997).

Table 2.2: Ministries in the Norwegian government system

Ministry of Children and Family Affairs	Ministry of Agriculture
Ministry of Finance and Customs	Ministry of the Environment
Ministry of Fisheries	Ministry of Trade and Industry
Ministry of Defence	Ministry of Petroleum and Energy
Ministry of Justice and the Police	Ministry of National Planning and Coordination
Ministry of Education, Research and Church Affairs	Ministry of Transport and Communications
Ministry of Local Government and Labour	Ministry of Health and Social Affairs
Ministry of Cultural Affairs	Ministry of Foreign Affairs

In a general sense, all the ministries have a direct or indirect impact on the Norwegian system of innovation. However, measured in terms of funding of industrially related R&D and innovation, the Ministry of Education, Research and Church Affairs (KUF), the Ministry for Trade and Industry (NHD) and the Ministry of Regional Affairs and Labour Relations (KAD) are the largest ones[5].

Norwegian R&D policy formulation is based on a 'sector-principle'. Each ministry has the responsibility to promote and fund research activities within their own areas, in line with specific sector policy objectives. One ministry though, The Ministry of Education, Research and Church Affairs (KUF), is responsible for the overall R&D policies and for coordinating the R&D policies of all the sectors. Several ministries have established and continue to finance one or more research institutes, or have collaborative relationships to such contract research organisations. Over the last years, the trend has been to transform research institutes into (at least formally) independent, non-profit organisations, which ministries support on the basis of program- and project-agreements in which the research institutions commit to perform short-term or longer term research. A large share of the ministries' long-term support to research institutes is left to the Norwegian Research Council to prioritise and distribute.

In contrast to the situation concerning R&D policies, there is no general coordination of more general technology and innovation policies. Explicit innovation policies beyond innovation-related R&D policies is primarily the responsibility of the Ministry for Trade and Industry and the Ministry of Regional Affairs and Labour Relations. Together these ministries are the sources of the main parts of innovation policy funds and initiatives accessible for business firms.

*The Ministry of Education, Research and Church Affairs (***Kirke-, Utdannings- og Forskningsdepartementet - KUF***)*

The Ministry of Education, Research and Church Affairs and its affiliated institutions make up a major component in the R&D related innovation policy system. The main axes of this component is the Norwegian Research Council, funding both basic and applied research, and the higher education institutions (HEI). Corresponding to this, the R&D budget of KUF is a two-tiered system, consisting of the general university funds to higher education institutions, and the science budget, that mostly concerns funds for the Norwegian Research

[5] An attempt to estimate the ministerial expenditures motivated by innovation and technology policies has been done in J. Hauknes, STEP Report 14/94 and STEP Working Paper 1/95.

Council. Broadly speaking, the science budget concerns long-term basic research and institutional support. In addition to R&D funding the KUF has responsibility for the overall organisation of the research system, a prime dimension of which is the general funding principles and policies towards the large sector of autonomous contract research institutions. From the innovation policy perspective this concerns mostly the industrial and technological research institutes.

The Ministry of Trade and Industry (Nærings- og Handelsdepartementet - NHD)

Although the Ministry of Education, Research and Church Affairs has the administrative responsibility for the Research Council, the Ministry of Trade and Industry (NHD) is the largest contributor of R&D funds to the institution. R&D funds allocated by the Ministry of Trade and Industry has as its prime objective to support R&D based innovation in Norwegian industry, either directly through project funding or indirectly through development of an appropriate technological infrastructure. In terms of overall public funding of innovation activities in the Norwegian economy, the NHD is the main provider of funds directed at individual business firms. In the State Budget for 1995 the total of these funds have been estimated to be approx. 4,2 bill. NOK, of which 1,8 bill. NOK, or 42%, originate with NHD[6]. The total technology policy related funding of NHD in 1995 was about 3,3 bill. NOK, of which less than half was direct R&D funds. The main vehicles for distributing funds are two institutions: The Norwegian Research Council, and the Norwegian Industrial and Regional Development Fund.[7]

The Ministry of Trade and Industry has an even wider impact on the Norwegian system of innovation. Its areas of responsibility covers:

- Legal issues related to industry, trade, foreign ownership and immaterial property rights.
- Industry and trade policy issues related to the structure of industries, to public financing and venture capital for industry, small- and medium sized businesses, export credits and guarantees, and to the handling of government ownership in joint-stock firms.
- Loans, warrants and funds for financing industrial development at firm and industry level.
- Co-ordination of industrial policies with policymaking in EU, EEA, WTO and OECD, and bilateral technology and industrial co-operation with other countries.
- R&D policy, including funding of NFR, space research, ship research, public procurement and public R&D contracts.
- The public advisory services.
- Administrative responsibility for standards setting agencies, ship control, shipping registers, the Norwegian patent office and for mining related exploratory and regulatory bodies.

---

[6] These numbers, referring to the ministerial structure as of 1995, are for the Ministry of Industry and Energy, see J. Hauknes, op. cit. With a reorganisation of the ministerial structure in 1996, this ministry was split into the NHD and OED mentioned in the text.

[7] See section 2.2.

The Ministry of Petroleum and Energy (*Olje- og Energidepartementet - OED*)

Direct innovation and R&D funding may in some cases be seriously misleading as a measure of the significance of the ministries for the innovation system. The most important Norwegian example of this is the Ministry of Petroleum and Energy. This ministry, which among other things represents the Norwegian State in the offshore oil and gas business, has had great influence on offshore related technical research in Norway, and on innovation capabilities of the related industries, through criteria used for giving concessions for oil exploration to foreign and national firms[8]. The efforts have led to very significant investments being made by private firms in offshore related R&D in Norway.

The Ministry of Regional Affairs and Labour Relations (*Kommunal- og arbeidsdepartementet - KAD*)

The Ministry of Regional Affairs and Labour Relations has played a role in formulating regionally oriented industrial and innovation policies, and is playing an active role promoting regional innovation capacities. Its main role as a provider for funds for innovation related activities is as a sponsor of SND, the Norwegian Industrial and Regional Development Fund. (NHD is the second main sponsor of this institution.) The ministry also supports the establishment of science parks. These budget allocations are all positioned within the framework of Norwegian policies for regional development.

2.2. Institutions which formulate technology and innovation policies, and implement policy by financing, co-ordinating, supervising and assessing innovation efforts

Several institutions span more than one level in our organisational pyramid. Among the most important innovation and technology policy formulating institutions are the ministries. These were described in the previous section. The focus here is other institutions where implementation of policy is the dominating activity.

2.2.1. The Research Council of Norway (*Norges Forskningsråd - NFR*)

The Norwegian Research Council was established in 1993, as a merger of the former five research councils. The institution bears overall responsibility for national research strategy, and manages nearly one third of public-sector research funding. One of the principal tasks of the Research Council is to promote co-operation and co-ordination among Norwegian research institutions. Other important objectives include raising the general level of knowledge in society, and encouraging innovation in industry and the public sector. The Research Council identifies important fields of research, allocates funds and evaluates R&D. It is also called upon to offer strategic advice to the Government on science and technology issues.

[8] This concerns primarily the arrangement of the so called 'technology agreements', where oil companies would get 'goodwill' points contributing to the basis for concessions on oil field exploration, by contracting oil and gas related R&D to national research institutions or carrying out such research in Norway. See Nås & Wiig 1993.

NFR, in addition to the administrative functions and a strategy department, has relatively autonomous sub-councils (*Områdestyrer*) taking responsibility for resource allocations in six sub-areas: Natural Sciences & Technology, Medicine & Health, Industry & Energy, Culture & Society, Bio-production and -processing and Environment & Development.

Its overall annual budget amounts to about 2 bill. NOK. The Council draws its funds from several ministries, of which the main providers of funds are KUF and NHD. *Business development* is specified as a goal for about half of the Councils annual spending.

2.2.2. The Norwegian Industrial and Regional Development Fund (*Statens nærings- og distriktsutviklingsfond - SND*)

The Norwegian Industrial and Regional Development Fund, also established in 1993 as a reorganisation of previously existing institutions, is now the central institution for public funding of industrial and regional development in Norway. Its main supporters, the Ministry of Trade and Industry and the Ministry of Regional Affairs and Labour Relations, provide the general financing of SND's main instruments. These include *grants* for innovation related activities, *loans* for such activities and for other 'change-generating' activitieslike development and acquisitions of new capital goods, *warranties* that enable firms to get loans from private financial institutions, and a general *venture fund*.

The overall budget of SND is in the order of 2,5 bill. NOK. Of this some 2/3 are funded through the Ministry of Regional Affairs and Labour Relations as a main instrument of national regional development policies. These are targeted at small and medium sized enterprises (SME) and at business development in general, in particular outside the large metropolitan areas. The funds from the Ministry of Trade and Industry are not subjected to similar restrictions, but the political pressure legitimise spending as *support* for *SMEs* is also here notable. SND is funding the establishment of new companies, and supporting newly created firms in the early high risk period. Support is given on the condition of significant private participation. The institution also finances innovation related re-engineering or diversification in larger, more established firms.

2.2.3. Other public funds, banks etc.

Some public financial institutions are still retained outside the SND structure, among them is the State bank for agriculture (*Statens Landbruksbank*), the State bank for housing (*Den norske stats husbank*) and the State bank for the municipalities (*Norges kommunalbank*). Although these funds may be elements in the Norwegian system of innovation, they appear not to pursue systematic *innovation policies* as such.

Another public fund which is a major investor in Norwegian industry is *Folketrygdfondet* - the Norwegian public security fund. This fund is operating as a large and significant financial investor, and over the last years the fund has been playing an active role as a strategic investor in Norwegian businesses.

Of other funds, the recently proposed *seed-capital fund* and *technology fund* were both proposed on the basis of a strong industrial or technology policy motivation, and may come to play important roles in the Norwegian innovation pol-

icy system in the future. The establishment of these funds, as suggested by the late Jagland government, have not been approved by the new Bondevik government.

2.3. Research and innovation facilitating and modulating institutions

Under this heading we have collected institutions that are not primarily taking initiatives to do R&D nor financing such activities, but which still facilitate or in other ways modulate or give direction to research efforts and innovation processes. Among these are public regulatory, standards setting or appropriability agencies, and municipalities and county councils.

2.3.1. Public regulatory, standards setting or appropriability agencies

Public regulatory and standards-setting agencies

As part of the general framework within which firms and innovators operate there exist a system of supervisory public agencies taking care of public interest. Their main areas of work relate to problems of health, security for the workers and the users of products, and environmental problems. Mainly on the basis of law they develop detailed regulations for different kinds of products, or they issue concessions for use, production or outlet of hazardous products or materials. In effect, this establishes a system of minimum standards for products and processes, thus influencing firm behaviour and technology development and use. Examples of such agencies include the pollution control agency (*Statens forurensningstilsyn - SFT*), the product- and electricity supervisory agency (*Produkt- og elektrisitetstilsynet*), the bureau for supervision of building technology (*Statens Bygningstekniske Etat*) and the Drug administration (*Statens Legemiddelkontroll*).

There is a formal system of standards that sets the framework within which innovation can occur, or which innovators have to change in order for the innovation to be successful. This system is partly national, but to an increasing extent international. Standards are normally the result of long processes of negotiation where it is important for national representatives and private firms or research institutes to be present in order to pursue their interest. Standars are taken care of and coordinated by the Norwegian Standards Association, which also represents Norway in international standardisation work. It operates on the basis of advice from five independent technical standardisation organisation. They cover the fields of general standards (NAS), construction (NBR), electrotechnics ((NEK), technology (NTS) and post and telecommunications (PT).

A special bureau has been set up to take care of standards relating to measurement and controlling measurement equipment in practical use (*Justervesenet*). This institution also certifies laboratories that are able and qualified to certify products and institutions according to different standards.

The Norwegian Patent Office

The Patent Office offers protection for inventions, trademarks and designs and offer information services, guidance and training in the area of industrial property rights. The annual budget is about 105 mill NOK (1997). The Norwegian Patent Office is not part of the Europe-wide collaboration in EPO.

2.3.2. Municipalities and county councils

Municipalities and county councils have traditionally played an important role for business development by way of infrastructure building and maintenance, and by providing public services in general. Over the last years, counties and some municipalities have taken up the challenge to stimulate business development and innovation within their geographical area. Among the current policy issues under debate is how and to what extent the Norwegian Industrial and Regional Development Fund ought to be organisationally coupled up with the municipalities in the effort to stimulate innovation and business development.

2.3.3. Public library services, databases etc.

Information is a crucial ingredient in innovation and in research, and libraries play an important role in making information available. The national library services, and the library services at the universities, are independently funded.

With the advent of electronic databases, CD-ROMs and online systems, a flora of data-bases and access systems have been built up beside the libraries. One example of such a database is the public road-database and the electronic map databases that are being built up by public agencies and is being made available for commercial use.

2.4. R&D performing institutions

In the middle of our institutional pyramid are the R&D performing institutions. The Norwegian R&D performing system is a tripartite system; with corporate R&D accounting for about 46% of national R&D performance, HEI institutions accounting for about 26% and a conglomerate sector of public and private contract R&D institutions with 23%[9]. Of most direct importance from an industrial innovation policy perspective is the autonomous technological and industrial contract R&D institutes, accounting for nearly 14% of national R&D. In these institutions R&D is co-funded over the public science budget and by the corporate sector. Public funding is overwhelmingly supplied by the Norwegian Research Council, mainly within its primary industrially oriented instrument, so-called user-led research and technology development (RTD) programmes. Industry-owned research institutions (*Bransjeforskningsinstitutter*) may play an important role particularly in less research-intensive industries. However, they represent a small share of the overall R&D endeavour, accounting for less than 8% of contract R&D in the sector of technological and industrial institutes.

Linkages from industry to research is dominated by the R&D institutes. There are not much direct contacts between industry and higher education institutions

[9] Other institutions performing R&D account for the remaining 5%. All these numbers are based on the R&D statistics for 1995.

like universities. An exception is research based industrial activities, such as the pharmaceutical industry and oil exploration. Science parks around higher education institutions do exist, but have so far remained a marginal phenomenon in the Norwegian system.

2.4.1. Universities, university colleges and state colleges

There are 4 universities in Norway:

- University of Bergen
- University of Oslo
- University of Tromsø
- Norwegian University of Science and Technology (Trondheim)

The university colleges are the following:

- Norwegian School of Economics and Business Administration (Bergen)
- Norwegian University of Sport and Physical Education (Oslo)
- Norwegian State Academy of Music (Oslo)
- Norwegian College of Veterinary Medicine (Oslo)
- Agricultural University of Norway (Aas)
- Oslo School of Architecture

The universities have by their institutional size and weight considerable impact on the actual science and technology policy as it is implemented. To coordinate activities the universities have established a common council, The Norwegian Council of Universities, which aims to

- develop strategies for the Norwegian system of higher education and research
- improve the national coordination in the educational and research sector,
- serve as a common instrument for the member institutions in their international cooperation.

In addition there are 26 state colleges, offering education and carrying out research and development mainly within the fields of engineering, administration, health care, social sciences and education.

2.4.2. Research institutes

The research institute sector is significant in Norway, and a significant part of it used to be placed under the authority of various research councils. Today most institutes operate as independent institutions, but many have a limited number of longstanding contract partners. There are also a few institutes specialised on research in areas with relevance for specific industries. Some such institutions have been established and supported by specific constellations of industrial firms. A 1995 catalogue over the institute sector listed 128 institutions, of which 60 are considered to be research institutes. The rest are institutions with some research in addition to other activities. Business oriented contract research institutes make up the larger share of the activity. Many institutions are active in the field of social sciences, working to a large extent for the public sector. Of the 16 billion NOK spent for R&D in 1995, the institute sector amounted to 4,5 bil-

lion; more than the share of the University sector (4,1 billion), but smaller than the business sector (7,3 billion).[10]

The SINTEF-group is the biggest R&D performing organisation in the institute sector, with an employment of about 2000 and an annual budget of about 1,4 billion NOK. It consists of 9 institutes (1996) plus 3 research firms, and most of its activities are taking place in close contact with the central engineering education institution in Norway, NTNU in Trondheim.

2.4.3. Corporate R&D

In financial terms, corporate R&D makes up approximately one half of the total R&D effort in Norway. In terms of the undertaking innovation projects and realising innovations, it is the goods and services producing sectors which play the commanding role. This very significant part of the innovation system is not covered in this research note. However, in any comprehensive analysis this part of the national innovation system must be given serious attention. Although we cannot do this here, we have in Appendix 1 offered an alternative, *company centred* perspective, which we believe would be a good starting point for the kind of analysis we have in mind.[11]

2.5. Institutions promoting technology diffusion

Towards the bottom of our institutional pyramid are innovation promoting institutions that focus on diffusion of new technology. There are a number of institutions, both public and private, which work on diffusion problems. We divide them into three groups: Science and business parks, public technology transfer and innovation advisory agencies, and private consultancy firms.

2.5.1. Science- and business parks

There are 7 science parks in Norway and a number of business parks. In science parks private businesses and university research share the same physical premises. SIVA and municipalities have been among the key contributors to building up of science parks, and municipalities also support less R&D intensive business parks where small and medium sized enterprises and entrepreneurs are given facilities and support to be able to survive and grow. Business parks are more oriented towards physical facilities for localisation and operation of business firms, but do in practice contribute to creating industrial milieus where technology diffusion and cooperation is likely.

[10] *Instituttsektoren. Katalog over forskningsenhetene.* Rapport 9/95. Oslo: NIFU

[11] For a discussion of innovation in Norwegian industry see Svein Olav Nås, Tore Sandven, and Keith Smith: *Innovasjon og ny teknologi i norsk industri: En oversikt.* STEP-report 4/94. The STEP-group is presently working on analyses which more fully accounts for the role of the goods and services producing sectors and corporate R&D in the Norwegian innovation system.

2.5.2. Public technology transfer and innovation advisory agencies

SIVA (Selskapet for industrivekst)

SIVA is controlled by the Ministry for Local Government and Labour,[12] and is oriented towards developing new and profitable industrial activities regionally, by being a catalyst and an investor. SIVA has invested in a number of business parks in Norway.

The National Institute of Technology (*Teknologisk institutt - TI*)

The National Institute of Technology (TI) is a private foundation with approximately 270 employees. TI receives public support in order to be able to offer small and medium sized enterprises relevant expertise to improve company know-how, productivity and profitability. TI offers consultancy and development services, training, expertise and technology transfer programmes and laboratory tests and certification services. TI works in areas such as manufacturing technology, environment and safety technology, business development and internationalisation.

In the case of internationalisation TI is coupled up to another institution, namely the network of Norwegian Industry Attachés administered by the Ministry of Trade and Industry. The Attachés offer assistance to make connections and transfer technology. They are stationed in London, Paris, Stuttgart, San Francisco and Tokyo.

The Advisory Institute in Northern Norway (*Veiledningsinstituttet i Nord-Norge –VINN*)

VINN is a consultancy institute, organised as a private foundation and receiving public support for parts of its activity. The foundation offer services within several technical and economical/administrative areas. The purpose is to improve the competitive strength of companies through increased productivity, improved profitability, stronger market orientation and profitable environmental and quality management measures. VINN's operations and competences are particularly aimed towards industrial companies, work shops and some service industries. They serve as advisors and offer elementary and post educational training, laboratory and testing services. In addition, they offer an extensive information service to the businesses.

The main part of the revenue comes from assignments and projects carried out for the businesses. In addition, the Norwegian Ministry of Trade and Industry buy advisory services in the fields of technology transfer and dissemination from VINN. These sponsored activities are aimed at the smaller enterprises in the North of Norway.

[12] SIVA is a so-called *statsforetak* - an institutional construction somewhat similar to *statsaksjeselskap*; that is, a joint-stock company owned by the state but with independent budget responsibility. SIVA is owned fully by the state, but without the use of stocks.

Regional business advice services (*Bedriftsrådgivningstjenesten - BRT*)

Administered by the Ministry for Trade and Industry a grant totalling about 57 mill NOK a year is transferred to county councils for business advice within the fields of administration and economics.

Norwegian Government Consultative Office for Inventors (*Statens veiledningskontor for oppfinnere -SVO*)

SVO is a public body to support inventors. The organisation offers advice and scholarships to inventors, and may support patent applications and building of prototypes. Total budget is about 12 million NOK (1997).

Appendix 1: A company-centred perspective

The above description has been strongly oriented towards the public innovation- and policy system. Producers of goods and services and corporate R&D have not been accounted for. Thus, it is important to note that the perspective we have developed is a particular one, and even though the national innovation system potentially is relevant for the whole of the goods and services producing sectors, it appears that only minor shares of companies are actively and consciously involved in innovation. For the majority of firms, thus, the innovation system we depicted in figure 2.1, and which we have described throughout the above exposition, may appear to be of limited relevance with respect to their own efforts to develop their business.

We believe that the situation of firms with respect to the national innovation system may be better understood when we consider the illustration of the *innovation-system-as-seen-from-the-innovating-firm* shown in figure A1.1 below. Here the public system of innovation appears to play a considerably less prominent role. In the innovating firm, the activities of the firm itself and the processes and interactions taking place within the business organisation take up a lot of employees' time and attention. Much resources may also be devoted to deal with competitors (monitoring, strategy making, negotiations, etc.). In the majority of cases, innovation processes involve collaborating firms or other organisations undertaking complementary activities which have to be closely followed. Furthermore, in some way or other, customers are important to firms. For firms in competitive and dynamic markets, customer monitoring and interaction with customers may be crucial. Similarly, suppliers of materials and human resources are critical for many firms, and significant resources may be spent locating and building suitable relationships to both competent suppliers of materials and to institutions where people with relevant knowledge and skills are trained.

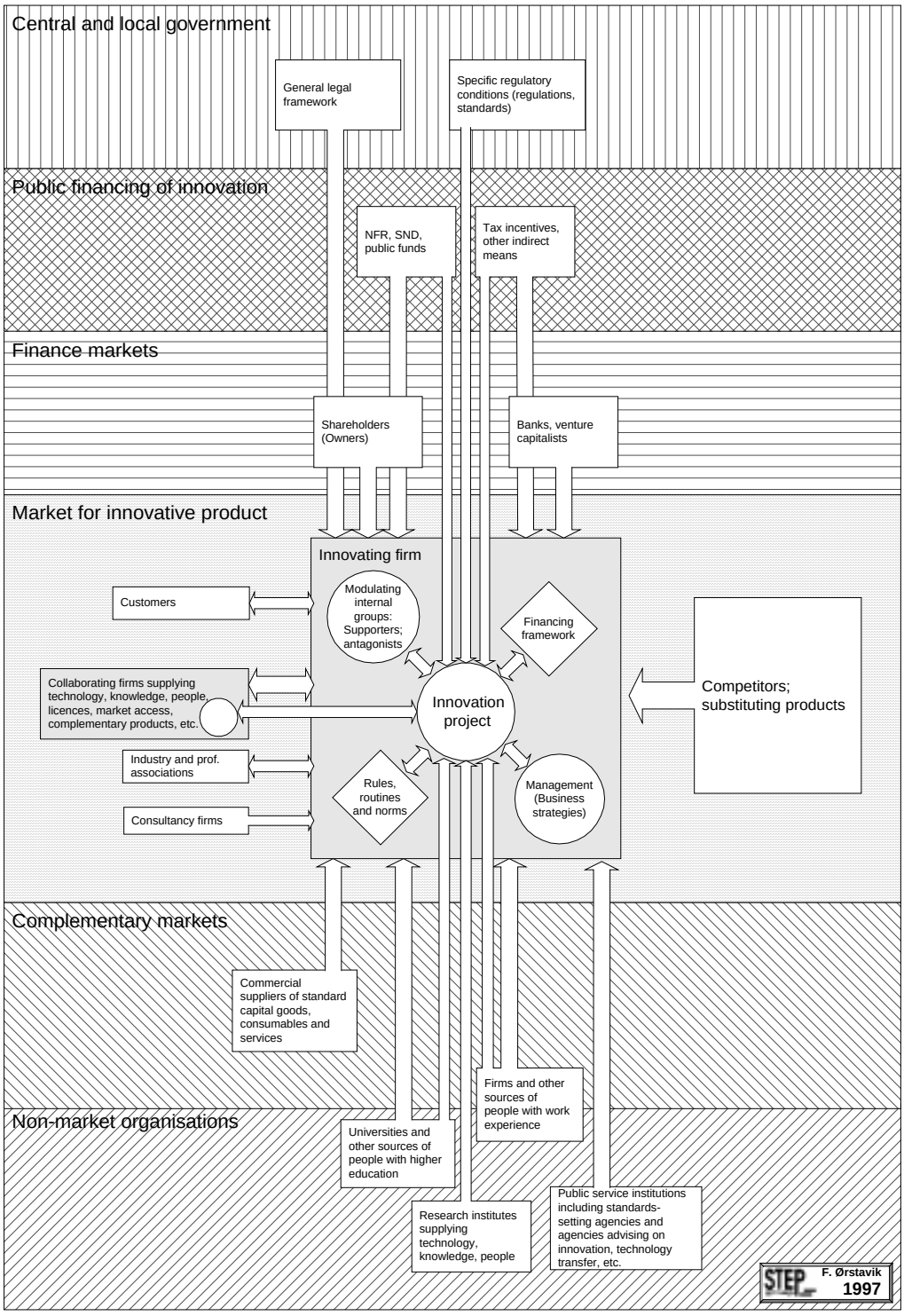
Seen from inside a company, the running of the day to day business in itself is usually a very complex task. Looking ahead, developing informed, long term strategies and doing reflexive critical thinking about the company and the business, demands more resources (human and other) than many - especially small - companies actually have available. There are routines in place for solving the day to day business problems, but ad-hoc decision making and informed guessing often take care of what doesn't fit into the established procedures. In such a context, research and development, and the public system to support innovation, may appear to be merely a theoretical option or a distant opportunity. It is a challenge for innovation policy to design the public system to support innovation in such a way that an increased number of firms can take advantage of it.

In a more comprehensive study of the ***institutions*** of the Norwegian system of innovation, differences in the approach to different kinds of knowledge sources is one of the aspects that ought to be analysed in more detail. Which firms are innovating, what characterises their employees and their contact networks? Which institutions deliver the human resources that populate innovative firms, and what are the characteristics of norms and culture governing their behaviour? How are they socialised, and in what way do they approach issues related to

technological innovation after entering business? The same questions have to be asked regarding different NIS institutions and their employees.

Although the NIS research effort directly or indirectly addresses several of these questions (and many more), we are not yet in a position to answer them fully. Rather, they serve to remind us that the *institutional mapping* which is called for when we wish to understand the complexities and specificities of national innovation systems is more than an organisational map of the public innovation system, and we need to keep focus on the more comprehensive goals as we carry our efforts forward.

Figure A1.1: A company-centred graphical map of the Norwegian system of innovation



Appendix 2: Tables

Table A2.1: National R&D expenditures in the private and public sectors

	Private sector		Public sector					
			Universities		Other public sector			
Year	Mill. NOK	% of total	Mill. NOK	% of total	Mill. NOK	% of total	Total	GERD/ GDP
1993	7632,0	53,5	3893,7	27,3	2736,9	19,2	14262,6	1,72
1995	9021,2	56,7	4139,1	26,0	2747,3	17,3	15907,6	(1,61) 1,72

Source: NIFU/Statistics Norway, R&D statistics 1993 and 1995.

Note: There is a break in the series between 1993 and 1995 due to an expanded sample of companies in the private sector for 1995. GERD/GDP for 1995 is 1,72. In order to compare with 1993 it is necessary to correct for the increased sample. With this correction, the comparable number for 1995 is 1,61.

Table A2.2: Research performing institutions: financial resources and main areas of activity

Institution	Expendi-ture NOK million	Public support NOK million	Number of institutes/-units	Number of employees	Main areas of research
Universities , university colleges, state colleges	4139,1	3702,2	4+6+26	18192	
Research institutes	4490,7	2771,3	60	10092	
-SINTEF group[1]	1360		12	1995	Mathematics; Construction; Electornics; Telecommunications; Energy; Chemistry; Material technology; Petroleum technology; Marine technology; Medical technology; Technology management
-Institute for Energy Technology[1]	400		1	600	Energy systems; Nuclear energy; Petroleum Technology; Physics
-Norwegian Defence Research Establ.[1]	320		1	530	Electronics; Weapon systems; Toxicology
-RF[1]	157		1	248	Petroleum extraction technology; Geology; Information technology; Environmental technology
Other institutions with research			71		
Museums and nonuniversity hospitals					
Corporate R&D excl. Contract research[2]	7340,6	465,2	1934	12631	

[1] Figures for specified institutions include total costs. The R&D component is generally close to 100, but may be slightly different. SINTEF group includes three joint stock research companies owned by SINTEF. [2] Number of units refer to number of research performers. The unit is "branch-unit", meaning main activitiy area within the same company, independent of localisation. Number of employees refer to R&D-personnel only.

Table A2.3: Functional Institutional Matrix

INSTITUTION → / ↓ FUNCTION	Parliament, Cabinet, Ministries	Regulatory, standardscertifying	NFR	SND	TI, VINN, BRT	Other public funds, banks etc	SVO	Patent	Universi-ties, higher educ.	R&D institutes	Corp. R&D	Librariesdatabases	Com-mercial banks, venture capital	Private consul-tancy firms	Industry and prof. Assoc.	Science, And, Business, Parks
-Technology and innovation policy formulation and co-ordination……	X	(X)	X	X					(X)	(X)						
-supervision and assessment……		X	X	X	X		X	X	X	X					X	
Performing R&D																
-basic……									X	(X)	(X)					
-pre competitive……									X	X	X					
-applied					(X)				(X)	X	X			X		
Financing R&D																
-support to non-business institutions and organisations undertaking basic or applied research……	X		X			X										
-support of R&D projects in the business enterprise sector (direct and indirect)……			X	X												
-support of special areas of research independent from the institution or firm where it is undertaken……	X		X	X		X					(X)		(X)			
Promotion of human resource development and mobility			X	X	X		X		X	X				X	X	X
Technology diffusion																
-improve the adoption and adaptation of specific technologies……		X	X	X	X	(X)				X				X	X	
-improve the general technology absorptive capacity of firms……			X	X	X				(X)	X				X	X	X
-build the innovation capacity of firms……			X	X	X	(X)		(X)	(X)	X				X	X	X
Promotion of technological entrepreneurship																
-financing technology-based firms (eg. Venture capital)				X		X							X			
-other……		X	X	X			X	X	(X)	X	X		X			X
Publicly available information	X	X	X	X	X		X	X	X	X		X			X	X
Standards and regulations	X	X						X								
Other (physical) infrastructure	X	X		X								(X)				X

References

Edquist, Charles (ed.) 1997: Systems of innovation: Technologies, institutions and organisations. London: Pinter.

Hauknes, Johan 1994: Teknologipolitikk i det norske statsbudsjettet. STEP Report 14/94. Oslo: The STEP group.

Hauknes, Johan 1995: En sammenholdt teknologipolitikk? STEP Working Paper 1/95. Oslo: The STEP group.

Instituttsektoren. Katalog over forskningsenhetene. Rapport 9/95. Oslo: NIFU.

Norges forskningsråd: Det norske forskningssystemet. Statistikk og indikatorer 1997. Oslo, Norges forskningsråd 1997.

Nås, Svein Olav; Sandven, Tore and Smith, Keith 1994: Innovasjon og ny teknologi i norsk industri: En oversikt. STEP-report 4/94. Oslo: The STEP-group.

Nås, Svein Olav and Wiig, Heidi 1993: Goodwill - good business? Analyse av goodwillavtalenes betydning for næringslivets FoU. Notat STEP/02/03. Oslo: Norsk Regnesentral.

Statistisk Årbok 1996. Oslo: Statistics Norway.

STEP arbeidsnotater / working papers

ISSN 0804-8185

1994

1/94
Hans C. Christensen
Målformulering i NTNF i Majors tid

2/94
Hans C. Christensen
Basisteknologienes rolle i innovasjonsprosessen

3/94
Erik S. Reinert
Konkurransedyktige bedrifter og økonomisk teori - mot en ny forståelse

4/94
Johan Hauknes
Forskning om tjenesteyting 1985-1993

5/94
Johan Hauknes
Forskning om tjenesteyting: Utfordringer for kunnskapsgrunnlaget

1995

1/95
Johan Hauknes
En sammenholdt teknologipolitikk?

2/95
Hans C. Christensen
Forskningsprosjekter i industriell regi i Kjemisk komite i NTNF i 60- og 70-årene

3/95
Anders Ekeland
Bruk av EVENT ved evaluering av SKAP-tiltak

4/95
Terje Nord/Trond Einar Pedersen
Telekommunikasjon: Offentlig politikk og sosiale aspekter for distributive forhold

5/95
Eric Iversen
Immatrielle rettigheter og norsk næringspolitikk: Et kommentert referat til NOE seminaret

Arbeidsrapportene 6/95 til og med 15/95 består av empiriske analyser av blant annet innovasjonsaktivitet i nøkkelbransjer i Norge

6/95
Innovation performance at industry level in Norway: Pulp and paper

7/95
Innovation performance at industry level in Norway: Basic metals

8/95
Innovation performance at industry level in Norway: Chemicals

9/95
Innovation performance at industry level in Norway: Boxes, containers etc

10/95
Innovation performance at industry level in Norway: Metal products

11/95
Innovation performance at industry level in Norway: Machinery

12/95
Innovation performance at industry level in Norway: Electrical apparatus

13/95
Innovation performance at industry level in Norway: IT

14/95
Innovation performance at industry level in Norway: Textile

15/95
Innovation performance at industry level in Norway: Food, beverages and tobacco

16/95
Keith Smith, Espen Dietrichs and Svein Olav Nås
The Norwegian National Innovation System: A study of knowledge creation, distribution and use

17/95
Eric Iversen og Trond Einar Pedersen med hjelp av Erland Skogli og Keith Smith
Postens stilling i det globale informasjonssamfunnet i et eksplorativt studium

1996

1/96
Tore Sandven
Acquisition of technology in small firms

2/96
Johan Hauknes
R&D in Norway 1970 – 1993: An overview of the grand sectors

1997

1/97
Johan Hauknes, Pim den Hertog and Ian Miles
Services in the learning economy - implications for technology policy

2/97
Johan Hauknes and Cristiano Antonelli
Knowledge intensive services - what is their role?

3/97
Hans C. Christensen
Andrew Van de Vens innovasjonsstudier og Minnesota-programmet

1998

A-01/1998
Finn Ørstavik and Svein Olav Nås
Institutional mapping of the Norwegian national system of innovation

Storgaten 1, N-0155 Oslo, Norway
Telephone +47 2247 7310
Fax: +47 2242 9533
Web: http://www.sol.no/step/

STEP gruppen

STEP-gruppen ble etablert i 1991 for å forsyne beslutningstakere med forskning knyttet til alle sider ved innovasjon og teknologisk endring, med særlig vekt på forholdet mellom innovasjon, økonomisk vekst og de samfunnsmessige omgivelser. Basis for gruppens arbeid er erkjennelsen av at utviklingen innen vitenskap og teknologi er fundamental for økonomisk vekst. Det gjenstår likevel mange uløste problemer omkring hvordan prosessen med vitenskapelig og teknologisk endring forløper, og hvordan denne prosessen får samfunnsmessige og økonomiske konsekvenser. Forståelse av denne prosessen er av stor betydning for utformingen og iverksettelsen av forsknings-, teknologi- og innovasjonspolitikken. Forskningen i STEP-gruppen er derfor sentrert omkring historiske, økonomiske, sosiologiske og organisatoriske spørsmål som er relevante for de brede feltene innovasjonspolitikk og økonomisk vekst.

The STEP-group was established in 1991 to support policy-makers with research on all aspects of innovation and technological change, with particular emphasis on the relationships between innovation, economic growth and the social context. The basis of the group's work is the recognition that science, technology and innovation are fundamental to economic growth; yet there remain many unresolved problems about how the processes of scientific and technological change actually occur, and about how they have social and economic impacts. Resolving such problems is central to the formation and implementation of science, technology and innovation policy. The research of the STEP group centres on historical, economic, social and organisational issues relevant for broad fields of innovation policy and economic growth.