Fraunhofer Institute Systems and Innovation Research

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RCN in the Norwegian Research and Innovation System

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Background report No 12
in the evaluation of the Research Council of Norway

Project leader: Erik Arnold, Technopolis Ltd.
Commissioned by the Norwegian Ministry of Church Affairs, Education and Sciences

November 2001

Reports in the evaluation of the Research Council of Norway

Synthesis report
Erik Arnold, Stefan Kuhlman and Barend van der Meulen, **A Singular Council? Evaluation of the Research Council of Norway**, Brighton: Technopolis, 2001

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Summary

RCN is one of a number of actors in the innovation infrastructure: the institutions which support the processes of creating and using knowledge. The other important actors include SND, which provides grants and loans for economic development; SIVA, which runs science and industry parks, providing needed infrastructure; and various sources of venture capital.

Norway faces significant challenges in industry and innovation policy. In order to maintain historical rates of growth in income and welfare, it can not simply rely on exploiting oil and gas reserves. A significant restructuring of industry is needed, building on existing strengths but also diversifying into newer and more knowledge-based industries. Existing industry is certainly capable of much further development, but its knowledge-intensity has natural limits, so Norway has at the same time to use the existing resources and give birth to new industries. Despite the openness of the economy, Norwegian industry has surprisingly poor knowledge links with abroad.

Tackling these challenges requires that there is a well-developed knowledge infrastructure in the form of colleges, universities and research institutes, that business capabilities are developed, and that new and existing firms have the 'absorptive capacity' needed to make use of externally generated knowledge. There are significant market and structural failures here, which is why many countries devote a lot of resources to helping these aspects of the innovation system to work well.

RCN, SIVA, the venture capitalists and SND together cover much of the needed policy spectrum. However, there is a gap in the area of an innovation policy authority – something like TEKES in Finland or the former NTNF, which links R&D-based knowledge directly into industrial activity and economic development. This gap currently coincides with the boundary between RCN and SND. These agencies run some joint programmes in this area, but there is little strategic interconnection and the partnership appears somewhat unloved at the operational level. If the gap widens, and the link between business development and technological capability development becomes weaker than it is today, this will create and important obstacle to company development, reducing the national ability to address the challenges described above. This is especially the case with the 'value creation gap' between likely GDP based on following current trajectories and the GDP growth needed to sustain welfare.

In the Norwegian institutional context, it is not clear that it would be useful to build a new innovation agency, for example on the model of Finland's very successful TEKES. We present four options for tackling the policy gap. We are not able in this study to analyse all aspects of the potential solutions. However, the option of transforming the present RCN/SND alliance from a 'nice to have' co-operation agreement into a managed cost centre, with its own budget and set of external links and responsibilities, is to us more attractive than alternatives.

Contents

1 Introduction

Norway is not one of the leading smaller industrial nations – neither with respect to the country's industrial performance nor to its innovation orientation. Analysts agree widely that in view of the coming post-oil-era the country has to invest considerably, today and in the near future, in its knowledge base in order to strengthen the national industry's technological competitiveness.

The Research Council of Norway (RCN) – besides and beyond its funding of basic science and research – is supposed to initiate research to promote the development of Norwegian industry and society, and also to support the exploitation of the results of research by the state, industry and society (see RCN statutes). The 1993 merger of the former Research Councils into RCN combined the existing mechanisms for industrially oriented research and technology-oriented funding (now to be found mainly in RCN's Industry and Energy Division, Bio-Production Division, and partly the Science and Technology Division) with those supporting basic and curiosity-driven science and research. Thus, RCN has to serve simultaneously quite diverse customers in the National System of Innovation (NIS). **Exhibit 1** depicts an illustration of what is understood among an increasing number of analysts by a NIS[1]. We use the NIS approach in this paper as a useful heuristic aid, not as a normative model.

This combination of quite diverse responsibilities under one institutional umbrella – rather unique in an international comparison – provided RCN with a source of "natural" intra-institutional tensions, not alleviating the interplay of RCN's industrially oriented research funding with the "innovation needs" in industry and the related infrastructure, i.e. support of IPR and related information, mobilisation of venture capital, innovation related training etc.

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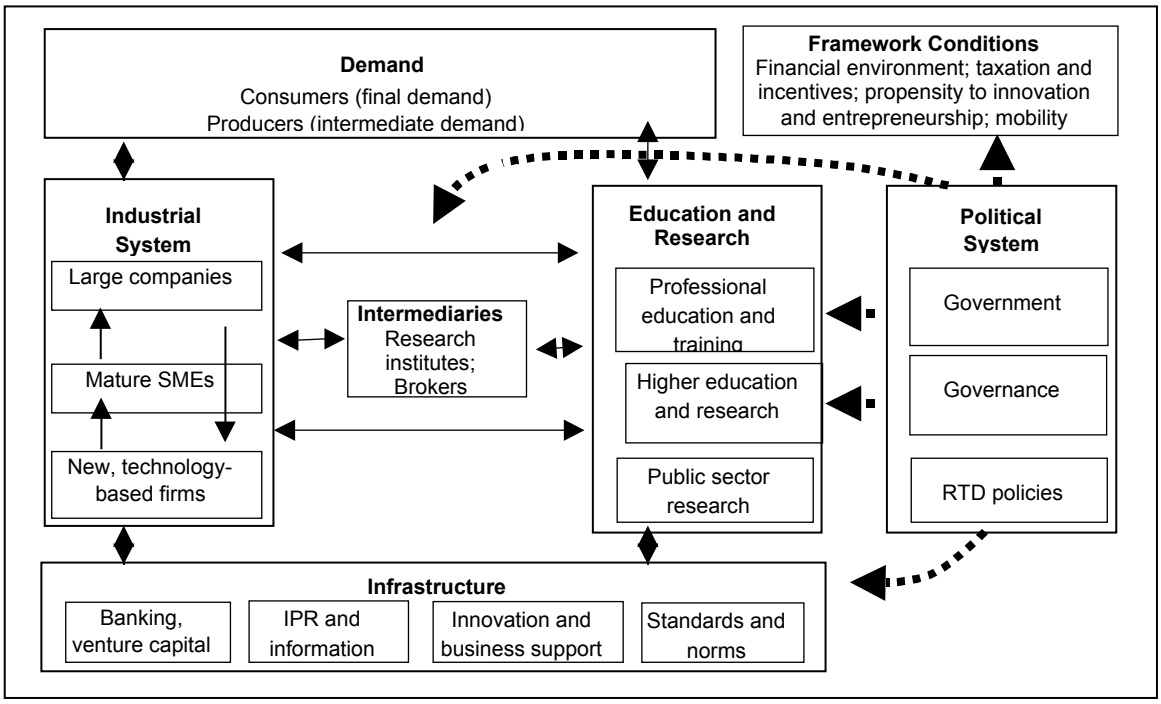
[1] National, regional or sectorial "systems of innovation" were discovered by social scientists (first of all by economists: Freeman, 1987: *Technology Policy and Economic Performance: Lessons from Japan*, London: Pinter; Lundvall, 1992: *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter; Nelson, 1993: *National Innovation Systems: A Comparative Analysis*, Oxford/New York: Oxford University Press; and Edquist, 1997: *Systems of Innovation. Technologies, Institutions and Organisations*, London/Washington: Pinter) as – with the increasing significance of international hi-tech markets – explanations for the varying degrees of competitiveness of economies, especially of their "technological performance" and their ability to innovate were sought. It was recognised that differing national, regional (e.g. Howells, 1999: Regional systems of innovation? In: Archibugi, D. /Howells, J. / Michie, J., eds.: *Innovation Policy in a Global Economy*, Cambridge: Cambridge University Press, 67-93) or sectorial (e.g. Kitschelt, 1991: Industrial Governance Structures, Innovation Strategies, and the Case of Japan: Sectoral or Cross-National Comparative Analysis? In: *International Organization*, 45, 4, Autumn, 453-493) "innovation cultures", each rooted in historical origins, characteristic and unique industrial, scientific, state and politico-administrative institutions and inter-institutional networks, crucially affected the ability of economic actors and policy-makers to produce and support successful innovations. Each innovation system is different, just as one society is not the same as the others. Efficient innovation systems develop their special profiles and strengths only slowly, in the course of decades, or even centuries. Their governance is based on a co-evolutionary development of, and stable exchange relationships among, the institutions of science and technology, industry and the political system (see also Kuhlmann, S: Governance of Innovation Policy in Europe – Three Scenarios. In: *Research Policy*, Special Issue „Innovation Policy in Europe and the US: New Policies in New Institutions“, edited by H. K. Klein, S. Kuhlmann, and Ph. Shapira, vol. 30, issue 6/2001, 953-976).

Exhibit 1: **A National Innovation System Model** (source: E. Arnold and S. Kuhlmann)



Besides RCN there are also other public bodies in charge of innovation policy (SND: risk capital, regional services; SIVA: science and industrial parks; Trade Council; etc). Formally, there are shared responsibilities between these bodies with respect to the research/innovation interface. Practically though, an innovation oriented interaction between and across these institutions still remains in an infant stage – according to many interviews in related institutions. Only recently, RCN and SND made some attempts at improving their cooperation vis-à-vis industrial clients in the regions: SND's District Offices started to offer access to some of RCN's funding mechanisms.

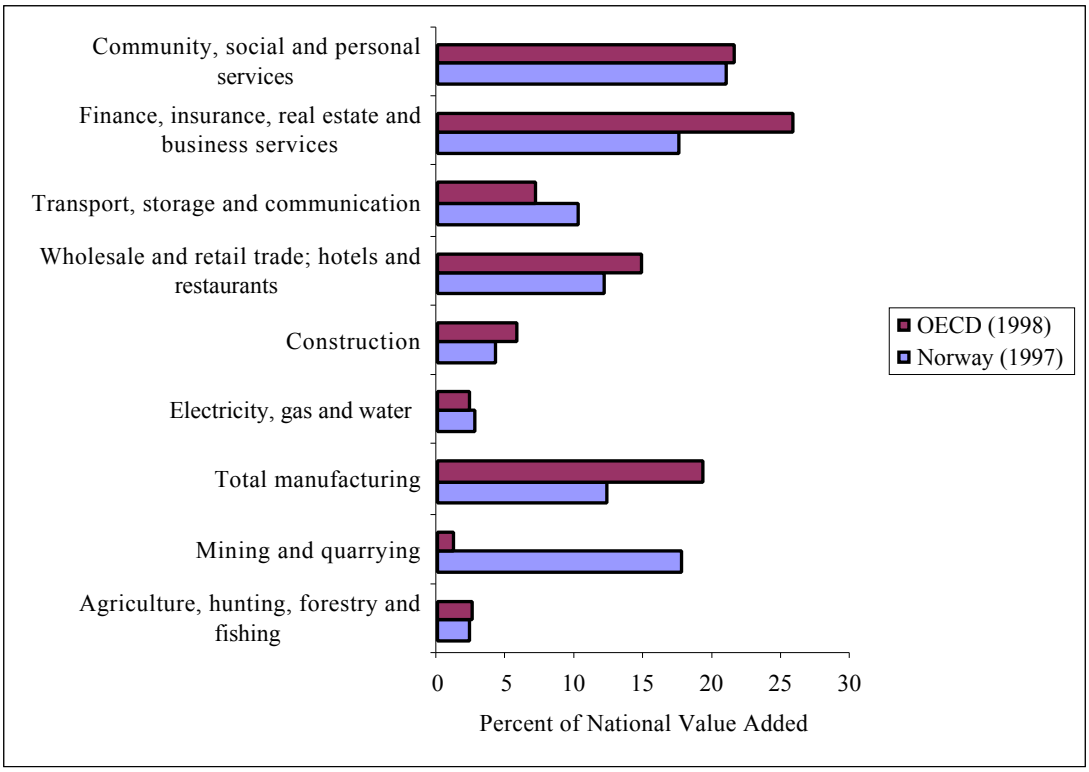
In the following, we will first characterize briefly Norway's industrial development and innovation performance (section 2) and then discuss the country's institutional infrastructure for innovation (section 3) and how well it works (section 4), before we draw some conclusions with respect to RCN's role in the NIS (section 5).

2 Industrial development and value creation

2.1 Industry structure and performance

The Norwegian industrial structure is unusual even among the more resource-intensive OECD countries for its heavy dependence on oil and other mineral extraction, which makes up 17.7% of national value added, compared with an OECD average of 1.1%. Manufacturing and services are correspondingly smaller contributors to the economy.

Exhibit 2 Structure of OECD and Norwegian Value Added, 1997/8



Source: OECD STAN and National Accounts databases, 2001

Norway has traditionally competed on factor endowments, with much industrial activity evolving around upstream activity, and adding value to resource-based sectors.[2] Total GDP in 2000 was some 1,400 BNOK, or 1,040 BNOK if we exclude indirect taxes and state services. As **Exhibit 3** indicates, there is a massive trade surplus in primaries, which is actually driven by 307 BNOK of unrefined oil and gas exports. Manufactures are in deficit and services roughly in balance, giving a 230 BNOK surplus. The economy overall is very open, with both exports and imports being very large in relation to GDP.

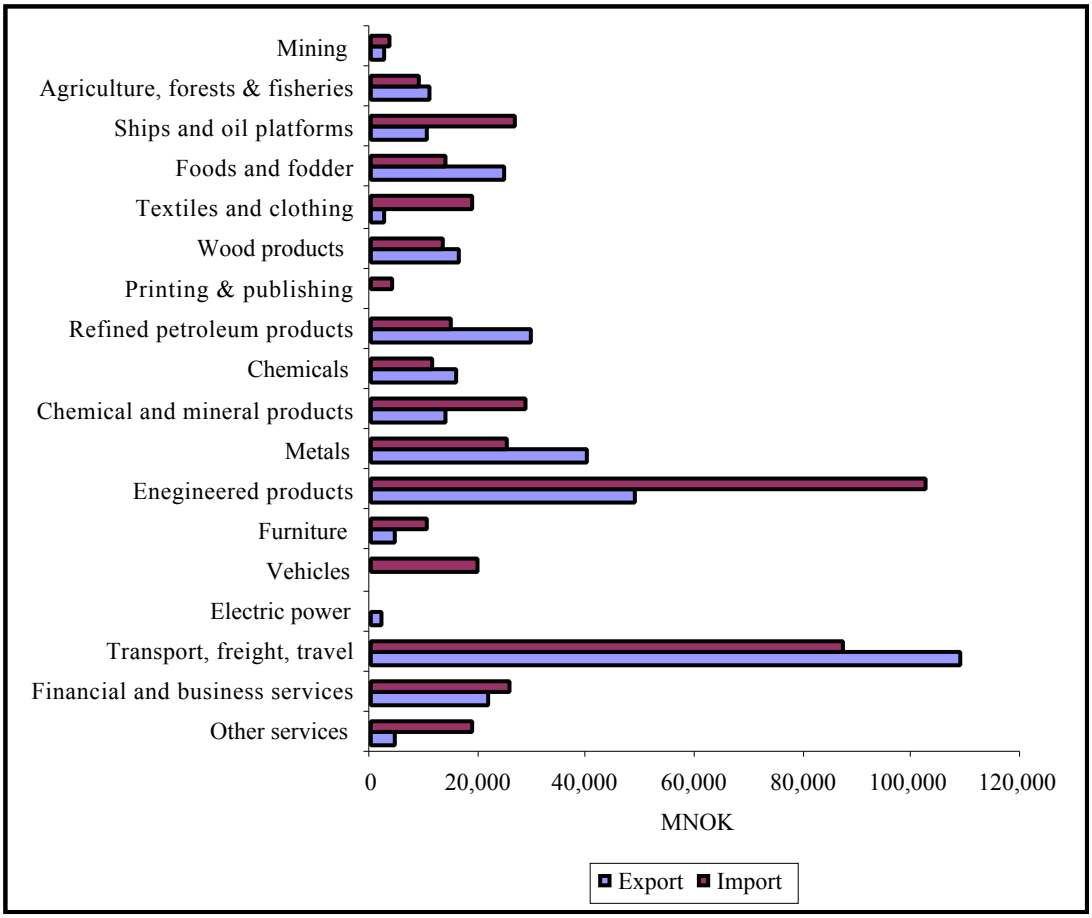
Exhibit 3 Norwegian Trade, 2000

	Export	Import	Balance
Primaries	320,121	14,181	+305,940
Manufactures	209,051	288,423	-79,372
Private Services	134,430	130,914	+3,516
Total	**663,602**	**433,518**	**+230,084**

Source: SSB

[2] (ref Et verdiskapende Norge)

Exhibit 4 Norwegian Exports and Imports, 2000 (Excluding Oil & Gas)



Source: SSB

Exhibit 4 disaggregates these numbers (omitting the massive oil and gas surplus, in order to make the chart readable). It shows a positive balance in traditional resource-based sectors. Norway's historical strength in shipbuilding has eroded, and the more value-adding sectors tend to be in deficit. This is most clearly the case with engineering. Transport and travel services – especially shipping – continue to be a Norwegian strength. The overall picture of the economy today is therefore not all that different from the traditional Norwegian one of a country with a huge merchant marine essentially making a living by trading low value-added resource-based products for higher value manufactures. As a crude indication of the importance of raw oil and gas exports (to which no value is added beyond lifting them from the ground), subtracting the value of these from the export numbers would leave an economy with a trade deficit of about 5% of GDP.

Norwegian industrial performance is poor – total factor productivity growth is amongst the lowest in the OECD.[3] The rate of innovation is low. According to the 1996 Community Innovation Survey, 20% of Norwegian firms had introduced new product within the three preceding years, compared with an OECD average of 31% [4].

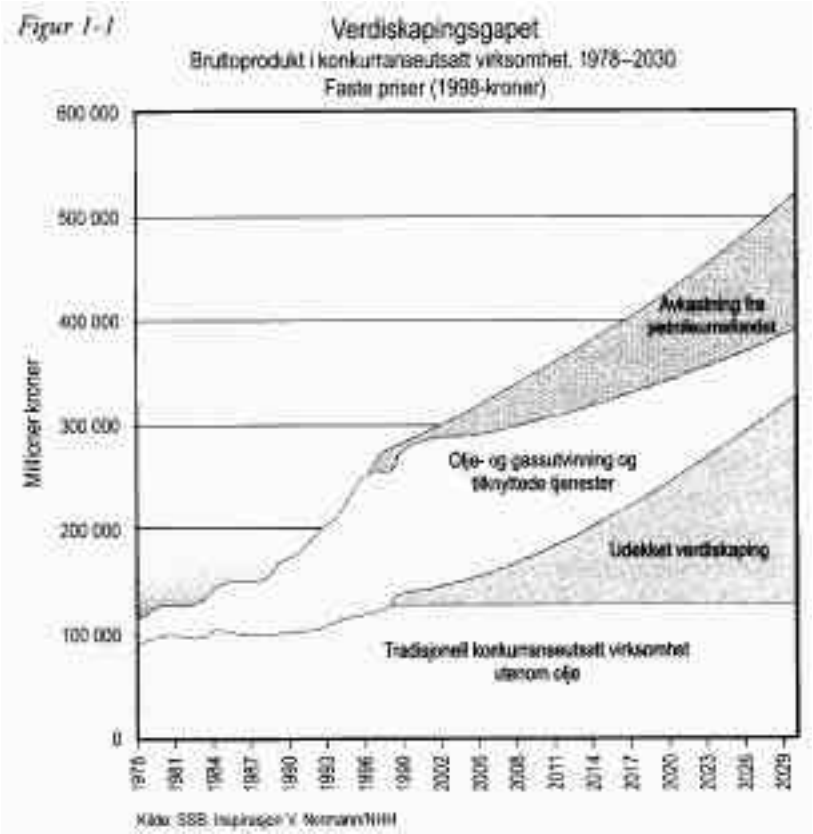
[3] see Reve and Jakobsen, 2001; also OECD STI Scoreboard at www.oecd.org

[4] The reader should note that there are important unresolved methodological problems in comparing national rates of innovation based on CIS data. However, the difference between

Knowledge-Intensive Market Services (KIMS) and medium-high technology manufacturing are generally seen as key contributors to competitiveness and growth. The contribution of these to value added in Norway is among the lowest in the OECD. The contribution of medium-high and high technology to Norway's manufacturing trade balance is correspondingly negative, while in low and medium-low technologies Norway has a trade surplus.[5]

There is increasing national agreement that Norway does not have an option to depend in the long term on petroleum revenues. The national reserves are now more than 50% used up. Even though large amounts of state oil revenue have been ploughed into an international investment fund, extrapolation suggests there is a considerable gap between the national income to be expected from national industry plus the oil fund, and the income needed to maintain historical rates of income growth (**Exhibit 5**). The major 'cluster' project, **A Value-Creating Norway,**[6] conducted with large industrial participation in 1999 and 2000, pointed to the need overall for higher innovation rates and for the development of actual and potential clusters in seafood, energy, maritime, ICT, trade and finance.

Exhibit 5 The Value-Added Gap



Source: Torger Reve and Erik W Jakobsen, *Et Verdiskapende Norge*, Oslo: Universitetsforlaget, 2001

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the Norwegian rate and the OECD average one appears so large that we think it should be taken seriously

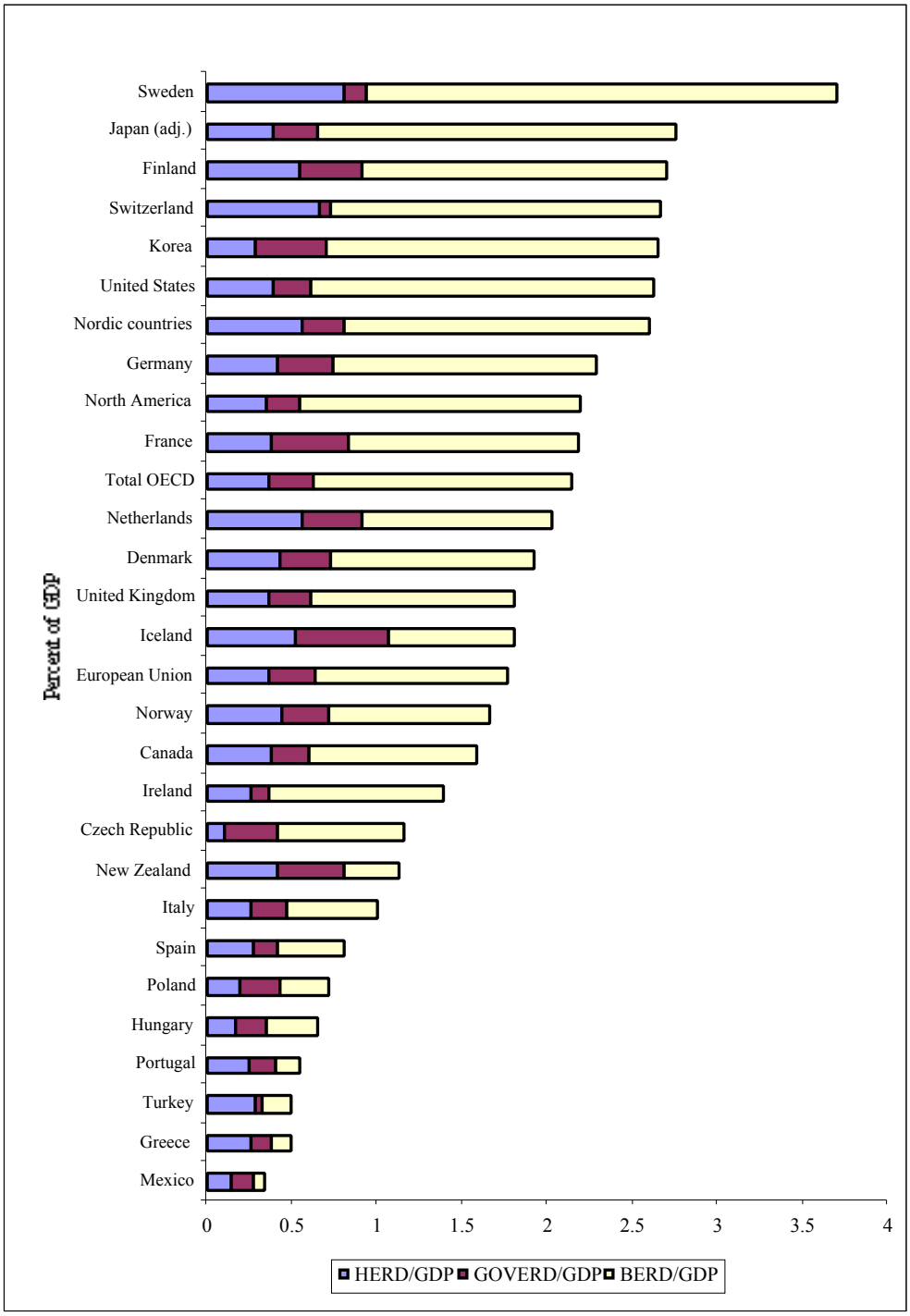
5 OECD, STI Scoreboard, 2001, at www.oecd.org

6 Torger Reve and Erik W Jakobsen, *Et Verdiskapende Norge*, Oslo: Universitetsforlaget, 2001

2.2 Industrial R&D in Norway

Norway is among the less R&D-intensive economies in the OECD. The share of GDP devoted to R&D is similar to that of Canada and a bit above that of New Zealand – resource-intensive economies with which it would be reasonable to compare Norway. R&D investment in all three countries lies below the OECD mean. Raising national R&D investment as a proportion of GDP to this average level has become a policy objective in Norway.

Exhibit 6 R&D/GDP, 1997



Source: OECD, Main Science Indicators

It is tempting to compare Norway's R&D-intensity with that of its neighbour Sweden, but the industrial structure there is very different from Norway's. The Norwegian and Swedish economies have little in common except trees. As **Exhibit 6** shows, business expenditure on R&D alone in Sweden dwarfs the entire Norwegian effort, even measured as a proportion of GDP, while the higher education sector in Sweden is twice as research-intensive as that in Norway.

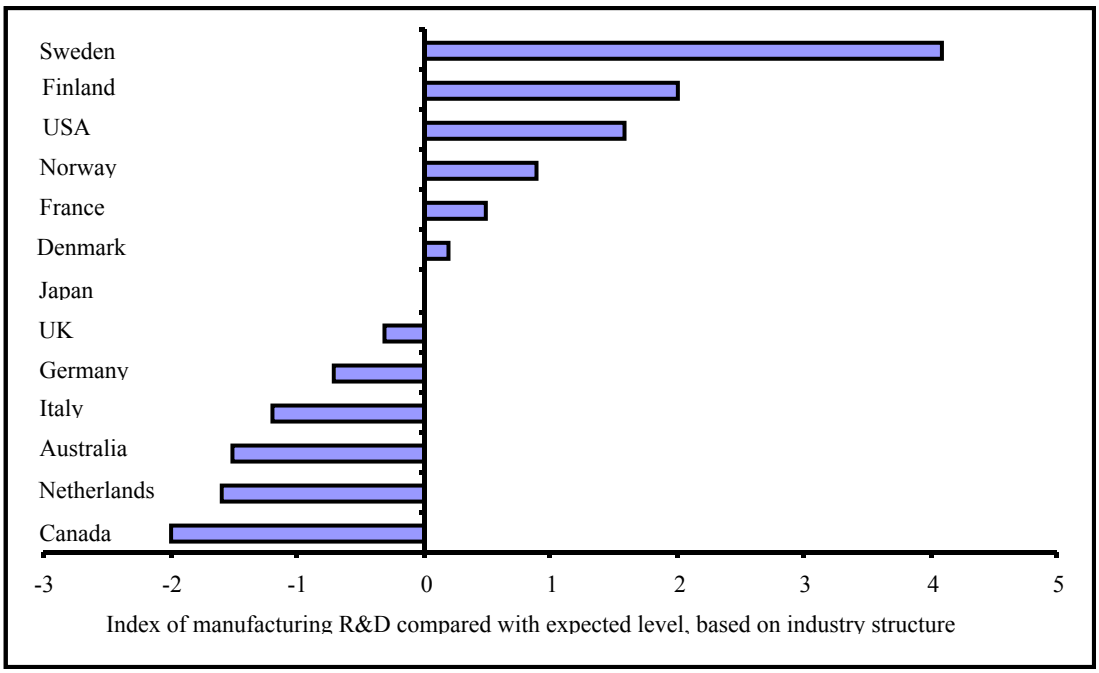
It is possible to make a 'fairer' comparison of industrial R&D expenditures in different countries by comparing the actual R&D intensity of each branch of industry with the global average for the same industry. The STEP group did this for a selection of OECD countries, and calculated an index which compares the actual R&D-intensity of each country with the R&D-intensity one would expect to see, if companies were 'averagely' R&D-intensive for their own industry.

Exhibit 7 shows the result. Sweden, Finland and the USA are countries where significant multinational companies have their headquarters, which is probably why they invest much more in manufacturing R&D than one would expect. (Typically, multinational companies do a disproportionately high share of their total R&D in their home country.) Australia and Canada are resource-based, 'branch-plant' economies, investing less in manufacturing R&D than their industry structure would suggest. According to this analysis, it turns out that Norway invests somewhat **more** than the average in manufacturing R&D, taking into account the structure of industry. This raises two important questions

1 If Norway's manufacturing R&D investment is more than we would expect, who is making the investment?
2 Regardless of the level of R&D investment, does Norway have the industry structure it needs in order to close the value-creation gap?

Reve and Jakobsen have already answered the second question with a definite "No." Relying on the existing, mature industries is not going to generate the growth needed. Norway has to build more knowledge- and R&D-intensive businesses, starting by making use of comparative advantages in existing clusters, but also diversifying the industrial structure.

Exhibit 7 Index of Actual Compared with Expected Manufacturing R&D, Selected OECD Countries, 1991

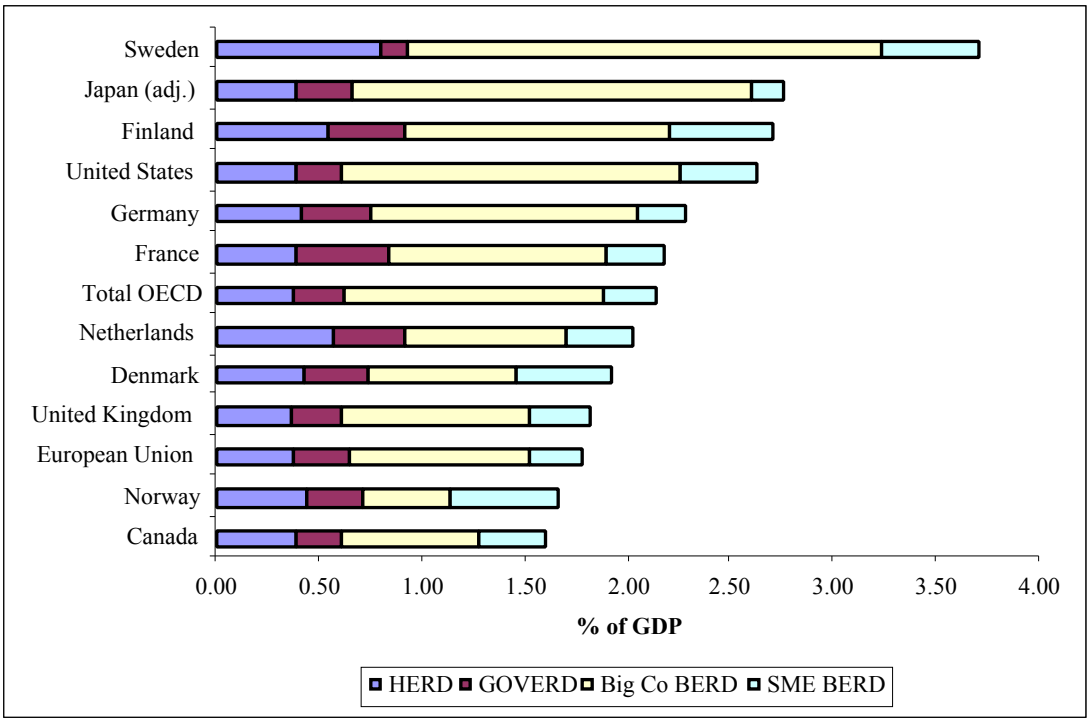


Source: STEP, *Kvikk-STEP* 1998, No 3

In regards to the second question, it turns out that surprisingly much R&D is done by smaller companies, and collectively little by the big ones who dominate the more traditionally Norwegian manufacturing branches (

Exhibit 8). These branches are themselves generally not R&D-intensive. In most developed economies, most of the industrial R&D is done by big companies: in the OECD as a whole, over 80% of industrial R&D is conducted by firms employing over 500 people. In Norway, the big firms do about one third of the industrial R&D. Of the 24 countries for which data are available, only in Poland, Portugal and Iceland do the big firms perform a smaller proportion of R&D than in Norway.

Exhibit 8 HERD, GOVERD and ERD by Companies Over and Under 500 Employees, 1997



Source: Main Science Indicators, STI Scoreboard

Is the Norwegian pattern of R&D expenditure then 'wrong'? **Exhibit 9** shows that Norway spends a little more on R&D in the Higher Education sector (HERD) than the OECD or EU in general, while other government expenditure on R&D is at about a normal level. The anomalies are in business expenditure on R&D (BERD). Norway's big companies would need to double their R&D expenditures collectively to reach the EU average, and treble them to reach to OECD mean (which is heavily influenced by the large-company dominated R&D expenditures of the USA and Japan). Small firms' expenditures on R&D would have to halve in order to reach the international Norms. However, it is also clear from

Exhibit 8 and **Exhibit 9** that there is a Nordic pattern of higher than average spending on R&D by small firms – probably because these are small economies with well educated labour forces.

Exhibit 9 R&D Spending in the Nordic Countries, EU and OECD as a Percentage of GDP, 1997

	HERD	GOVERD	BERD in Cos >500	SME BERD	GERD
Norway	0.44	0.27	0.43	0.52	1.66
Denmark	0.43	0.30	0.72	0.47	1.92
Finland	0.54	0.37	1.28	0.51	2.70
Sweden	0.80	0.13	2.30	0.47	3.70
EU	0.37	0.27	0.88	0.25	1.77
Total OECD	0.37	0.25	1.26	0.26	2.14

Source: OECD Main Science Indicators, STI Scoreboard

Another key point to bear in mind here is that the Norwegian industrial R&D sector is not very internationalised. Impulses from world research can be obtained through two kinds of internationalisation: 'outward,' where domestically-owned companies operate R&D facilities in many countries, benefiting from access to multiple innovation systems and research manpower labour markets; and 'inward,' from the R&D activities located in the country by foreign firms. Unlike its neighbours Sweden and Finland, Norwegian industry lacks the outward facing 'window' on world research that the highly internationalised R&D organisations of companies like Nokia, Pharmacia-Upjohn and ABB provide. The largest Norwegian-owned R&D unit operating outside the country appears to comprise 65 people.[7] Compare this with companies like Ericsson, Nokia or Astra, which employ tens of thousands of R&D staff, the majority of them outside the Nordic region. The amount of 'inward' internationalisation through the presence of R&D-performing foreign company subsidiaries is better but still limited, accounting for perhaps 10% of BERD and concentrated among ABB, Siemens, Ericsson and Alcatel.

Research on innovation and economic development[8] clearly shows the primary importance of technological capability **within industry** as the motor of economic growth. The notion of 'absorptive capacity' is key to learning and the development process. Crudely, it says that the ability of companies to learn depends on their internal capabilities, and that these capabilities can often be represented by the number and level of scientifically and technologically qualified staff in an organisation. Altering the balance of R&D (and, more generally, innovation) expenditure and effort between the business system and the state is therefore one of the key phenomena in economic development.

The economic and technical trajectories of countries in rapid development (such as the SE Asian 'Tigers') over the past few decades show a change from a pattern

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7 Rajneesh Narula, 'Explaining 'Inertia' in R&D internationalisation: Norwegian firms and the role of home country effects,' University of Oslo/STEP, July 2000

8 For a summary review, see Erik Arnold and Martin Bell, *Some New Ideas About Research For Development*, report to the Hernes Commission on DANIDA, Brighton: Technopolis and SPRU, 2001. The review can be downloaded from www.technopolis-group.com and from the Danish Foreign Ministry server

where the state undertakes most of the national R&D effort, to one where private industry dominates.

Exhibit 10 illustrates this for Korea, which is one of the best-documented cases, but also one of the most extreme, with large industrial groups targeting key sectors right across the engineering industries. By the end of the period considered in the **Exhibit**, Korean industry was investing as great a share of the national R&D effort as US industry did in the United States. With 57% of the national R&D effort being undertaken in the business sector, we can in this sense think of Norway as being today roughly where Korea was in 1985.

Exhibit 10 Transition In The Structure Of The Korean Technology Development System

	1970	1975	1980	1985	1990	1995
Total R&D Expenditure*	10.5	42.7	282.5	1,237.1	3.349.9	9,440.6
Of which, shares (%) of:						
Universities	3.8	5.2	9.2	9.6	7.3	8.2
Govt. Research Institutes	84.8	65.8	37.0	29.7	21.8	18.7
Private Sector	12.4	28.8	28.8	60.7	70.9	73.1
R&D/GNP (%)	0.38	0.42	0.77	1.58	1.95	2.69
Researchers/10,000 population	1.7	2.9	4.8	10.1	16.4	28.6
No. of Corporate R&D centres	1	12	54	183	966	2,270

* billion won

Successful catch-up and development trajectories emphasise reverse engineering and creative imitation in the company sector, supported by massive investment in engineering education. The higher education and research sectors do not play major roles as suppliers of ideas, but are crucial as providers of trained people. During the catch-up process, major investments in the basic research and scientific system risk creating capabilities disconnected from the economy and society, which are unlikely to have developed the absorptive capacity to make use of such investments. They also risk being below critical mass unless they are highly focused. Once at the scientific/technological frontier, the way forward is no longer so clear. Huge amounts of effort are devoted to R&D in the developed economies, and a very large proportion of this is 'wasted' – in the sense that it does not result in a commercialised product or process innovation. The absolute quantity of research in the higher education and research sector tends to become substantial at this stage.

The Asian experience with using large applied Research Institutes to speed industrial development has been mixed, and does not support the idea that these alone can drive industrial development. In the best cases (such as Taiwan's ITRI), they have turned out to be important as trainers of large numbers of people with industrially applicable R&D skills. They have not provided many products or product ideas.[9]

2.3 Lock-ins in Industrial R&D

In Norway, roughly 600 firms currently perform formal R&D. 80% of these have less than one full-time R&D employee. Fewer than 50 companies, 35 of which are Norwegian-owned, have more than 10 full-time R&D workers. Narula has recently explored[10] the structure of Norwegian industrial R&D through an interview-based study of 26 of these Norwegian-owned firms, a sample collectively accounting for almost two thirds of Norwegian BERD. Narula divides his sample into two groups (see **Exhibit 11**)

[9] Howard Pack, 'Research and development in the industrial development process,' in Linsu Kim and Richard R Nelson (eds.) T*echnology, Learning and Innovation: Experiences of Newly Industrialising Economies*, Cambridge University Press, 2000

[10] Narula, 2000

- Group 'A' firms, which come from the traditional raw-materials based sectors (eg Norsk Aluminium, Elkem, Norsk Hydro, Norske Skog, Kværner), or which have enjoyed state protection as 'national champions' (eg Norsk Jetmotor, Telenor, Dyno Chemicals, Lilleborg)
- Group 'B' firms, which are engaged in the more knowledge-intensive sectors, and can be regarded as science based or non-traditional firms

Both groups sell the majority of their products abroad, but in general Group A firms are bigger but less internationalised than those of Group B.

Exhibit 11 Narula's Sample of Norwegian R&D-Performing Companies

Sub-samples	% Sales Abroad	% of Sales in Low-Tech	Total Employees	% of Employees in R&D	% of R&D Done Outside Norway	RCN Subsidies as % of R&D Budget
Group A	59%	92%	52,000	3.2%	5%	3%
Group B	88%	46%	10,300	9.4%	29%	1.2%

As the employment numbers suggest, Group A is much the larger of the two groups. With R&D focusing on process questions, these low-technology firms co-operate within their domestic supply chains. Their other technology relationships focus on the Norwegian education and research system. The SMEs in Group B are more international and eclectic in their technology relationships. While both groups have good links to the Norwegian education and research system – especially NTNU and SINTEF – only Group A firms have the clout to influence curricula.

While pointing out that all innovation infrastructures suffer from inertia, Narula argues that the Norwegian system is especially locked in to the needs of the Group A firms. This reduces the diversity of impulses available to the population of innovating or would-be innovating firms in the economy. Most of the Group A firms continue to be large and successful, and to operate on the basis of accumulated technological and other advantages. But the many smaller R&D performers and innovative firms which are excluded from Narula's sample, therefore work within a system tuned to other needs than their own. Geography and the competence of the Norwegian research institute mean that when these firms seek technical help, it comes most readily from the Norwegian system. This tendency has been reinforced by NTNF and RCN supports for 'user-directed R&D,' which have effectively provided Norwegian firms with money to spend at Norwegian institutes. Narula therefore argues for increased competition and internationalisation of R&D supply – a need to which RCN's Industry and Energy Division has recently begun to respond.[11]

[11] see RCN Divisional Reviews, Background report No 5 in the evaluation of the Research Council of Norway

2.4 Conclusions for Industry and Innovation Policy

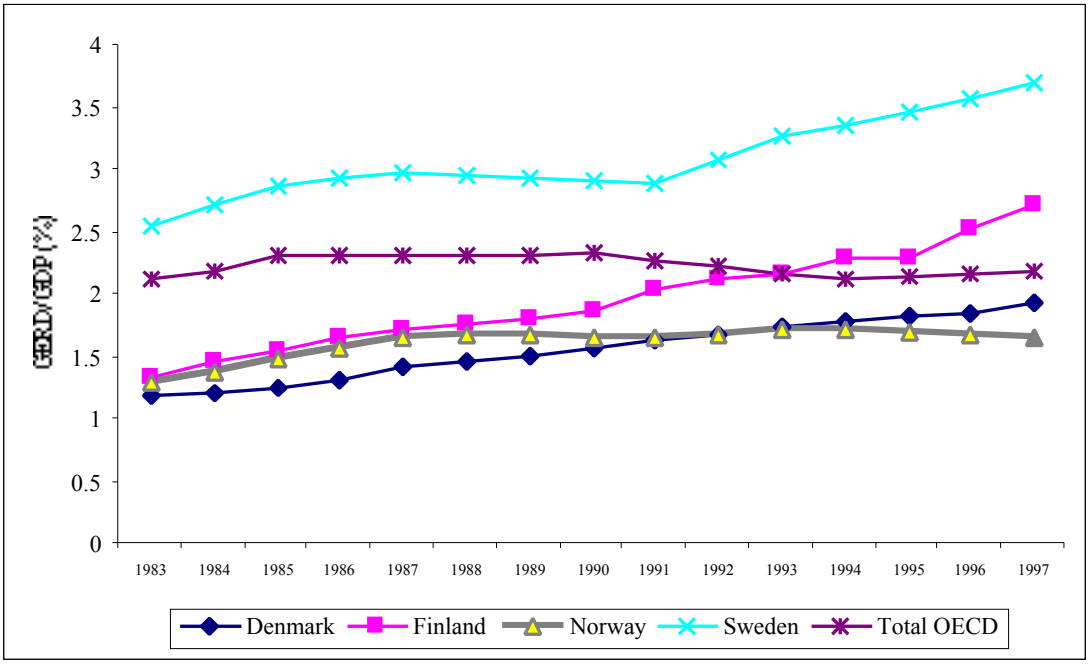
Moving out of the existing lock-ins requires substantial re-education, changes in incentive systems and a good dose of fear. Reforms are needed, which go well beyond the scope of our evaluation. Reorientation towards science-based industry is needed. This will require a willingness to focus 'basic' research resources in strategic directions, reform other parts of the state system and alter framework conditions. We suspect there must also be wider changes in culture and the public understanding of research and science. Our analysis so far suggests a number of conclusions for industry and innovation policy

- While there is every reason to nurture and build upon the now traditional strengths of Norwegian industry in raw materials and process based industries, policy needs also to foster the growth of new, knowledge-based branches
- Despite the large size and strong capabilities of the applied Research Institute sector, whose mission has been conceived as performing innovation on behalf of companies, the innovation rate of both large and small companies is generally low. This rate needs to be increased also by means that augment companies' **internal** technological capabilities or 'absorptive capacity'
- This is, in turn, only possible if the higher education system is producing an adequate number of scientific and technical workers at degree an doctoral levels
- Increased internationalisation is necessary, in order to access that great majority of the global research effort that is undertaken abroad, as well as to benchmark and quality control the Norwegian R&D effort

Exhibit 12 shows how Norwegian GERD/GDP has stagnated since the mid-1980s, while that of the other major Nordic countries has continued to rise, leaving the Norwegian economy as the least research-intensive by the mid-1990s. The most striking feature of the **Exhibit** is perhaps the way Finnish expenditure began to pull away from the Norwegian at the end of the 1980s, pulling further ahead through the economic crisis. This crisis was caused by the collapse of the Soviet Union, which had represented about 20% of Finnish exports before the fall of the Berlin Wall, followed by the global recession of 1991. At this crucial moment, Finnish policy makers decided to **increase** state expenditures on R&D, focusing the majority of the increase into industry.

Based on other countries' experience and national development needs, the required trajectory for Norway could involve tracing out a Nordic development path in R&D expenditures (see **Exhibit 9**). The first stage is to raise large companies' investments in R&D towards the Danish level. Given the Norwegian industrial structure, this will mean both increasing the R&D-intensity of existing large companies but also building new ones. As industry becomes more research-intensive, it makes sense to expand HERD, as has been done in Finland, to a level above the EU and OECD averages. We might think of the Swedish R&D investment structure as an 'endgame,' but one that will take a very long time to reach. Such a development trajectory cannot simply be laid down by the state. It needs the agreement and trust of industry and the research community. Above all, it requires the political will to make a major investment in R&D, initially led by the state sector, with a strong emphasis on industrial capability but accompanied by a significant expansion in basic and strategic HERD.

Exhibit 12 GERD/GDP in Nordic Countries and OECD, 1983-97



Source: OECD Main Science Indicators

3 The Norwegian Innovation Infrastructure

1993 was a year of important mergers. The five existing research councils were merged with the Norwegian National Committee for Environmental Research to form RCN. At the same time, SND was established by merging the main actors financing business development and innovation: *Industrifondet, Industribanken, Småbedriftsfondet* and *Distriktenes Utviklingsfond*. Together with SIVA, these three organisations make up the key components of the Norwegian innovation infrastructure: that is, the institutions that support industrial innovation.

3.1 Industry[12] and Innovation Policy in Norway[13]

Norway has a long tradition of government intervention in the structure of industry. From the mid-1950s, industry policy focused on building scale within key Norwegian sectors, in order to withstand the increasing forces of internationalisation, which were early visible in sectors such as light metals and chemicals. Mass production and the high standard of living in the USA functioned as paradigms. Against the Norwegian background of a fragmented industrial structure, the state planning apparatus sponsored large-scale 'structural rationalisation' in a number of manufacturing sectors in the 1960s and 1970s. (Many of Narula's 'Group A' firms

[12] Norwegian readers should note that English lacks a concise term for *næringspolitikk*. In English usage, 'industry policy' corresponds to *næringspolitikk* and 'industry' to *næring*. 'Manufacturing industry' should be read as *industri*.

[13] This account leans on the work of Olav Wicken, which provided useful background to our evaluation of SND and to the work of the Hervik Commission. See Johan Hauknes, Marianne Broch and Keith Smith, *SND og bedriftsutvikling – rolle, virkemidler og effekter*, Del I i evalueringen av SND, Oslo: STEP, 2000; *Ny giv for nyskaping: Vurdering av tiltak for økt FoU I næringslivet*, NOU: 2000:7

are in their current form the product of mergers and reorganisation in this period.) Eight different state funds financed this highly interventionist period in policy. From the end of the 1970s, however, policy makers lost faith in scale as the sole driver of competitiveness, and increasing policy emphasis was put on re-industrialisation in newer branches, through research and technology. The economic benefits of structural rationalisation began to wane. There was a feeling that state had done a pretty poor job of picking winners, so it was important to leave this to the market. State rationing and management of credit was largely brought to an end after the mid-1980s, in time for a dramatic oil price fall in 1986 and a stock exchange crash in 1987, closely followed by a crisis in the Norwegian banking sector.

From about 1990, industry policy became even more 'hands off.' The lesson of previous experience was understood in the Industry Ministry to be a need to be 'branch-neutral' and therefore to use general policy instruments. Partly owing to the growth of service sectors in the economy, technology was no longer seen as such a central force in industry policy, and there was a refocusing on the relationship between innovation policy and other industrial development instruments and priorities. A particular consequence of this change was that manufacturing industry lost its historical primacy in Norwegian industry policy.

Despite the comparatively 'hands off' policy line still pursued today, the legacy of Norwegian infant industry and national champion policies is still evident both in industry structure and in the high level of protectionism and government willingness to intervene to prevent foreign take-overs of major Norwegian companies. State ownership of industry remains at much higher levels in Norway than is the case elsewhere in Europe. The OECD estimates that barriers to trade and investment are still on average at least double those in most EU countries and three times as high as those in larger OECD economies such as Germany, the UK and Italy.[14]

Spatial considerations are key in Norwegian industrial development. Crucial raw materials are spread out over the long coastline, which is itself an essential asset for the marine and tourist industries. Defence was one reason for maintaining population levels along the coast in the Cold War period, but the preservation of communities around the country in the face of socio-economic trends to centralisation has a high political value in itself. The period of 'structural rationalisation' from the 1960s was also one of labour shortage in the cities, and this encouraged the state to pursue a policy of 'decentralised centralisation' – promoting the growth of smaller towns and, incidentally, the strengthening of a political constituency for 'district policy.' During this period (in 1968), the regional ministry established the Industrial Development Corporation of Norway (*SIVA – Selskapet for industrivekst*), inspired by the industry parks then being established in the UK and elsewhere.

Much of Norway's 'district policy' in this period consisted of a mixture of allocating and restructuring national industrial assets combined with the delivery of subsidies determined at the national level. The regional ministry's 'district development fund' (DU) was a key channel for such grants and loans, which included support to start-up companies. From the early 1980s, DU's financing activities were supplemented by

[14] OECD, *Economic Survey of Norway*, Paris: OECD, 2000

programmes aiming to improve companies' business and innovation capabilities. During the 1980s more widely, there was a gradual transition towards a more 'regional' policy, recognising the need for regionally based capabilities and infrastructures (for example, in further and higher education) to underpin regionally sustainable development. A reform in local government, which created larger counties (fylkeskommuner) provided an administrative basis for this increased decentralisation. During the 1990s, there has been further emphasis on the need to create regionally based clusters and innovation systems with reduced dependence on the 'central areas,' especially Oslo. As a result, the long-standing centre-periphery debate in Norway has, if anything, become more intense in the last decade. In policy making, this is reflected in tension between the missions of different ministries. On the one hand, the Local Government Ministry (KAD) is trying to promote self-sustaining regional development across a very large geography, and therefore the provision of a full set of capabilities and infrastructures in many places. On the other hand, the Education (KUF) and Industry (NHD) Ministries have a natural desire to centralise to build critical mass in what is at the same time a very small economy.

Concern that the national R&D spend (and especially that of industry) was too low has been a matter of policy discussion since the OECD started collecting national R&D statistics in the 1960s. It appeared formally in the government's long term review (Perspektivmeldingen) in 1987, and was reiterated in the 1989 research white paper (Forskningsmeldingen). By 1993, when the next research white paper[15] was published and this objective remained distant, the government took comfort in the fact that **its** spending on R&D was in line with OECD practice. The need was to increase that of industry. An explicit goal of increasing R&D to the OECD average level within 5 years was set out in the 1999 research white paper.[16]. The Hervik Commission was set up in the same year with a mandate to study how this might be achieved, based on the hypothesis that a general R&D tax incentive might be one of the necessary instruments.

The key state institution funding industrial R&D in the post War period was NTNF, established in 1947 to fund a mixture of strategic research and industrial development. At the time, Oslo was the only University in Norway, although the national Polytechnic in Trondheim had been in existence since 1909. Bergen University was established only in 1948. NTNF set up a succession of applied research institutes during the following two decades, in no small part with the idea that they should conduct R&D **for** parts of industry. Key among these was the Central Institute for Industrial Research (SI), set up in 1949, a wide-ranging institute (which was split up into a number of smaller ones in the early 1990s). The Norwegian Technological University (NTH) found this development so threatening, that it established its own applied research institute – SINTEF – which is now the dominant force in the sector.

The desire to increase industrial R&D has been the main reason to promote the growth of the applied institutes in the post-War period. NTNF was required to divest itself of its institutes in 1985 in what amounted to the Norwegian equivalent of the

[15] St Melding nr 36 (1992-93) *Forskning for fellesskapet*
[16] St Melding nr 39 (1998-99) *Forskning ved et veiskille*

'Rothschild' reform, to separate customers and contractors in state R&D – a reform that has spread widely through Northern Europe. However, the applied institutes remained central in NTNF's policy and in that of RCN's Science and Technology (NT) and Industry and Energy (IE) Divisions following the research council merger of 1993. Indeed, the applied Research Institutes are the major performers of research and innovation activities funded by IE. With the exception of the national Polytechnic – now NTNU – the universities continue to have very low levels of interaction with industry.

3.2 RCN

RCN's present industrially oriented research, technology and innovation policy is deeply rooted in the missions of the former Royal Norwegian Council for Scientific and Industrial Research (NTNF). NTNF's activities during the 1950s and 1960s were largely devoted to the idea of the importance of building up a sector for the development of "science-based technology" as a foundation for industrial development. During this period, quite a number of R&D institutes were established to address the task of technological development in various fields.

In the 1960s pressure was put on NTNF to give industry more control over projects financed by the Council's funds. The implementation of Industrially-Operated Projects (1967) was a response. Later in the 1970s, when "key" technologies were regarded as driving forces for the renewal of the economy, NTNF's R&D policies were – as in most industrial countries – conceptualized as technology polices. "Main target areas" were defined starting in 1986 - 1987, lasting until 1990 - 1991. In ideological terms there was a shift towards greater emphasis on the role of the market in industrial development. This had significant consequences for the institute sector in NTNF. In the mid 1980s, the institutes were detached from the Research Council, i.e. they were no longer owned by NTNF, but in most cases were reorganised as independent foundations.

When NTNF was merged with the other Councils to form RCN in 1993, the new Council was organised into six divisions. Ideally, everything from basic research to applied research could be managed under one same roof. In principle, RCN's **Industry and Energy (IE)** and **Science and Technology (NT)** divisions have been organised as one single division. For the sake of balance in the Council and the (budgetary) size of these two areas, industrial research was divided between IE and NT, in that IE was given responsibility for applied industrial research, and NT for basic and strategic scientific research, including strategic institute and university programmes. This was a significant problem, in so far as it separated responsibility for strategy about the institute infrastructure from those with responsibility for the institutes' users.

Since 1993, the new RCN's industrially oriented R&D policies have been labelled as 'innovation policy'. The Norwegian economy's crisis around the end of the 1980s had consequences for the country's economic policy. Industrial policy formed part of a broader political framework, the aim of which was to make "Norway Ltd" more productive and efficient. Industrial policy also extended to regional policy, and SMEs were given a place. **'User-driven research'** had already been introduced as a concept by NTNF at the beginning of the 1990s, and this soon became the

predominant means by which also RCN organised its industrially relevant R & D support. This system gives industry a leading position in R&D collaboration, since it is up to industry to submit applications for research grants. In general, more emphasis has been placed on measures related to building bridges between companies, universities and colleges and the research support system, as well as on the commercialisation of R&D results. Examples of such programmes and sub-programmes in include BRIDGE, TEFT, SME-Competence, SME-College, RUSH, REGINN and FORNY. These programmes have been developed in close co-operation with the Ministry of Local Government and Regional Development, which has also provided a significant proportion of their funds, together with NHD (the Ministry of Trade and Industry).

Programmes were launched to develop management, strategic and organisational competence in companies (e.g. BU 2000). All in all, there seems to have been a tendency to broaden the scope of the measures under the category of "knowledge". The combination of industrial and regional policy designed to promote companies and industries has also created **links between SND and IE** at the local level, where SND's regional offices are now being used to involve local companies in IE's programmes (see section 3.3. below).

When RCN was set up in 1993, IE took over a portfolio of 50 predominantly sector-oriented programmes from NTNF, each of which had its own programme board and programme manager. By 1996, the number of IE programmes had been reduced to 16 broader programmes.

An evaluation of the user-oriented R&D support to industry in 1996 and a customer survey in 2000 recommended a number of changes

- Improved co-ordination of the Research Council's various instruments
- Closer collaboration between divisions with regard to the long-term building up of knowledge and approaches to meeting trade and industry's needs for knowledge.
- Greater openness, flexibility and competition with regard to project funding
- Better adaptation of programmes (designs) to variations in target group needs and supporting R&D institutions' areas of expertise

As a consequence, since the late 1990s a **new strategy** for the overall industrial R&D support has been developed. The Executive Board approved the "Strategy for Industrial R&D" in February 1998 conceiving two pillars: the user-oriented programmes as the first; and support for industrially relevant strategic basic research as the other. The vision is to stimulate 'winning R&D coalitions'. The strategy has been labelled R&D structure for value creation (FFNV). It involves all divisions of the Council, but mainly IE and NT. The new structure is supposed to be put into operation in 2002, then concentrating all efforts on only 10 programmes. These programmes will address broader target groups than the previous, and are thus expected to foster a fiercer competition, thus raising project quality. The programmes are supposed to be partly cluster-oriented and partly technology oriented

- User-driven projects represent the most important instrument. Commercial beneficiaries are responsible for the conduct of projects, financing at least 50 per cent of the costs
- "Enabling strategic projects" (KMB projects) could be launched in areas where the business community perceives a need for strengthened expertise. IE would provide up to 80 per cent of the funding for a project, provided commercial beneficiaries provide at least 20 per cent in cash. R&D-institutions apply to and serve as contract partners for these projects. This instrument will focus on a number of enabling technology and knowledge areas

The success of the new strategy, mainly driven by IE, will depend very much on a close participation of the other divisions, and with SND. Not at least, though, it will be influenced heavily by the recently **changed political situation** in Norway: The new, conservative coalition government has just cut 150 MNOK from IE's user-oriented R&D budget and taken away almost all the industry ministry money from SND. The government objects to selective measures, and will probably bring forward the timetable for replacing FUNN with a tax incentive.

3.3 SND

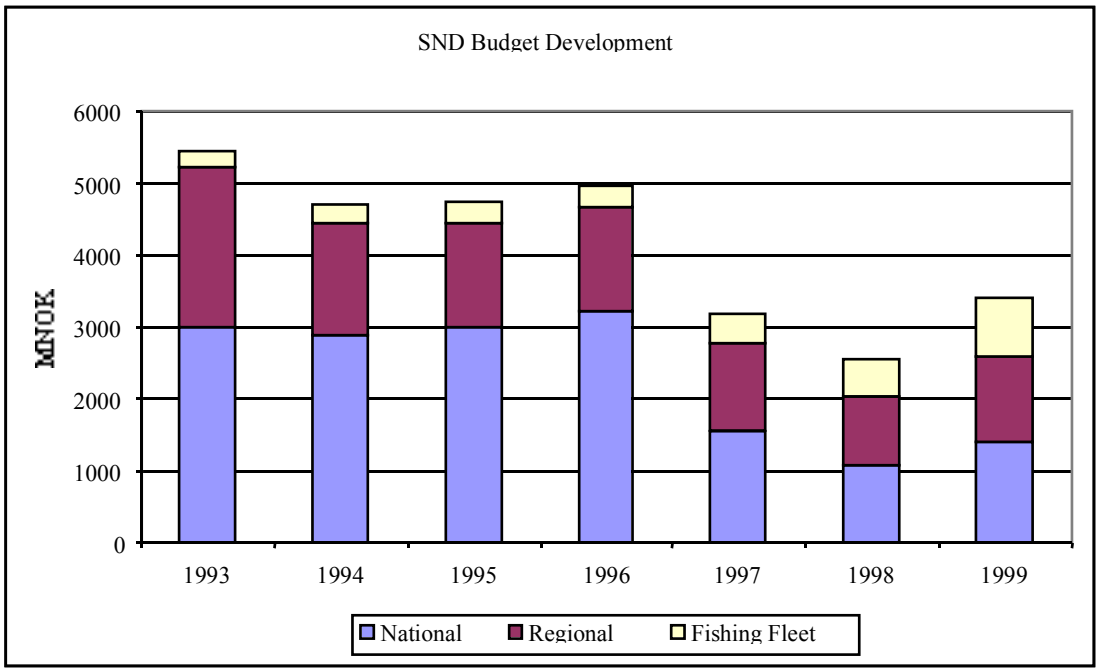
SND was created in 1993 by merging four organisations. It has continued to serve as an agency into which additional organisations (notably the fishing bank in 1997 and the agricultural bank in 2000) and functions have been added in an effort to simplify and rationalise the provision of business development aids. Formally owned by the Industry Ministry, the bulk of its budget is provided by the Industry and Local Government Ministries. **Exhibit 13** shows developments in SND's budget.[17] SND has suffered from declining budgets, with most of the decline being in the national aids to business development funded by its owner.

SND does not finance research. However, it often provides grants or soft loans, which finance innovation-related activities, and it continues to provide programmatic aids to business development developed by its predecessors, especially DU and Industrifondet. These include

- Grants to start-up firms (etablererstipend), and a separate grants scheme for technology-based start-ups (ENT)
- Innovation grants for potential suppliers to the public sector and major enterprises (OFU/IFU – run jointly with RCN))
- Training in management, strategy development and profit improvement for entrepreneurs in micro firms and small companies (FRAM)
- Support to collectives of users of branch-specific IT systems (BIT)
- A programme to identify and fund the commercialisation of research-based inventions from the universities and Research Institutes (FORNY – run jointly with RCN)

[17] The figure includes the budget of the national fisheries bank (Fiskarbanken), which was absorbed by SND in 1997

Exhibit 13 SND Financing Budgets 1993-99 (Grants plus Loans) in Current Kroner



Source: SND

At the outset, SND was largely centralised to Oslo. It inherited a small number of regional offices from a predecessor organisation (*Industrifondet*), which were mostly located in the Northern half of the country. SND has since decentralised its operations to regional offices in each of Norway's counties (*fylke*). It has developed co-operation agreements with other providers of business supports, in order to offer its regional customers a 'first stop shop' able to provide – or broker – as full a range of business development services as possible. Key partners include RCN, the Design Council and the Export Council. This decentralisation is fully consistent with best international practice in business support provision.

The SND merger was an important step towards simplifying the support system. It brought together national and regional aspects of business development support into a single system, simplifying the 'offer' made to the business community. Initially focusing on the creation of a common, quality-controlled process for making decisions about support at the project level, the organisation then successively reorganised itself to create a 'front office' function as close as possible to the customers.

3.4 SIVA

SIVA's mission has been evolving fairly continuously since it was established by the local government ministry in 1968 to run industry parks. A dynamic policy entrepreneur, SIVA currently has two divisions: Real Estate; and Development. Via the Real Estate division, SIVA is a co-owner of 44 industrial parks in Norway and one in Murmansk. It has an ownership stake in 34 science parks, many including incubators, and is currently working to establish itself in the Baltic states.

The Development division undertakes four main activities

- It operates a venture and seed capital activity by encouraging the creation of region funds for this purpose. SIVA normally provides some of the capital involved. (In many cases, SND is another state capital provider to the same funds.)
- It runs innovation and development companies within SIVA's science parks, providing advice and support to resident companies
- Industrial parks (næringshager) focusing on small, knowledge-intensive firms, which have extended functions in the regional community; projects; networking among companies and knowledge producers; and property investment
- Running development companies, which may not be tied to individual science or industry parks

SIVA is rather different from the other organisations considered here, in that it focuses its efforts on spatial clusters where research is present and can be considered a potential growth node. The range of services it offers are the normal ones offered in science and research parks, though it is internationally unusual to see these parks and services operating in effect as a national 'chain.' Inevitably, SIVA's non-property activities overlap with those of others, and observers question whether this is a good way to organise the support system, but SIVA's focus on science and research parks appears to be unique in Norway. Good science park management requires the services SIVA provides. Experience in particularly successful science-based clusters (Cambridge, UK: Cambridge, Mass; the biomedical cluster in Munich, and so on) is that having multiple sources of finance and advice strengthens the hand of developing companies. It is therefore important within the Norwegian system to ensure that local service – and, especially, venture capital – monopolies do not arise. Both the SIVA parks and other parts of the Norwegian system working with venture capital could do well to develop closer links with foreign sources.

3.5 Venture Capital[18]

There are five kinds of state venture capital arrangements in Norway

- The START fund, where SND is in partnership with Norsk Investorforum and other private-sector investors (320 MNOK) Half the capital is provided by SND
- The regional seedcorn (såkorn) funds – currently in the process of raising capital to grow from 20 MNOK to 100 MNOK each (400 MNOK). Half the capital is provided by SND
- Regional venture funds, where the state is a minority shareholder together with private and (sometimes) local government owners (about 132 MNOK). SND Invest has recently taken over the state's main holdings in these funds, holding out a possibility of extending its regional distribution apparatus[19]
- Investment funds connected to SIVA's science parks (about 208 MNOK)

[18] This section is largely taken from Erik Arnold and Philip Sowden, *SND Organisation and Structure, Del 4 i evalueringen av SND*, Brighton: Technopolis, 2000

[19] SIVA also has smaller holdings in some of these funds

- EKD/SND Invest, organised nationally but with a regional contact network via SND's DKs. (This was originally 2000 MNOK, but now stands at 1810 MNOK after repayment of part of the fund to the state)

In terms of company life cycles, all the first four claim or have claimed to be engaged at the 'seed corn' stage. SND itself offers grants and loans to start-up companies, which it claims in practice have a similar function to seedcorn capital, often allowing entrepreneurs the breathing space needed to develop an idea to the point where a more serious commercial assessment of its prospects can be made. SND Invest is a more mainstream venture capitalist, entering at the stage where a company exists and there is a clear track record on which to base an investment decision.

Few of the funds had been able to focus their investments on single branches or clusters. None was big enough to manage portfolio risk. Most were driven over time to make successively less and less risky investments, moving away from the seed corn role and towards more classical venture capitalism. Ernst & Young were deeply skeptical about the rentability of the funds, and pointed out that the state – as minority owner – was not in a position to steer their policy or development.

There have been similar experiences in other countries, notably Finland. The problems to which an Ernst & Young evaluation [20] points arise because such small regional funds are simply trying to operate below critical mass – both in terms of analysis capacity and in terms of the absolute amount of money in the funds. This problem has been tackled in Finland by letting out the management of collections of regional funds to private sector managers, effectively raising the analytical critical mass. It is too soon to say whether this approach also lets the funds tackle significant portfolio risk.

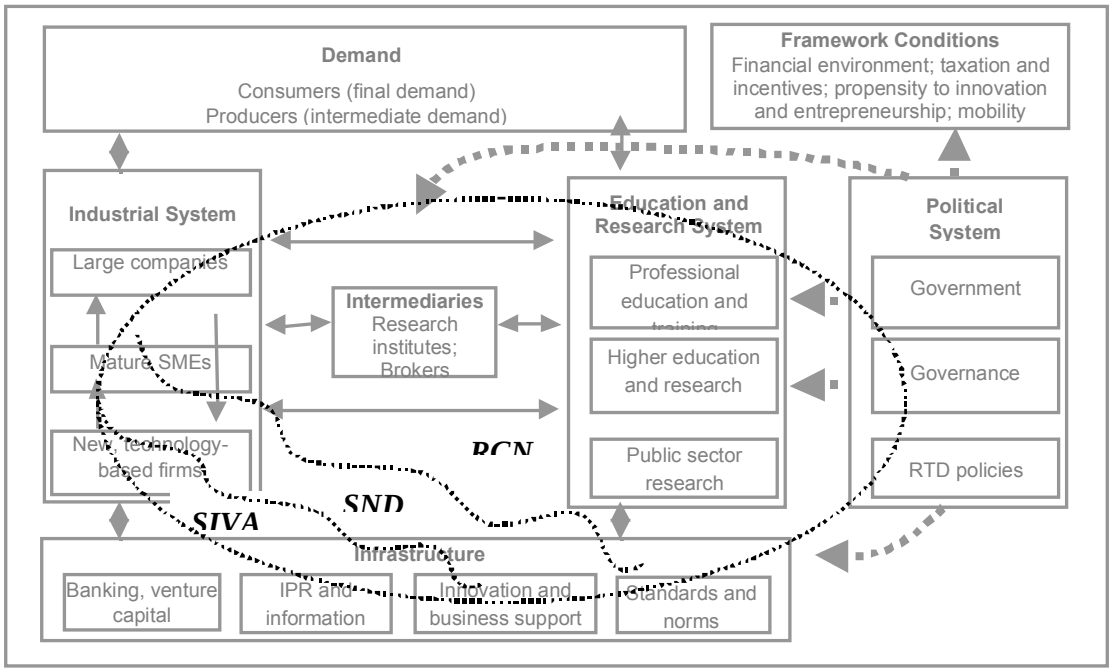
The available evidence is patchy. It appears that the combined effect of the state's interventions via investment funds is to improve capital availability to existing companies, but to make only a limited difference to the company formation and pre-commercialisation phases, which are, to some degree, served by SND's mainstream grant measures. SND Invest is one to two orders of magnitude bigger than other venture capitlists, and is clearly doing its job effectively. Improving the ability of the other funds to contribute, especially at the intended early stage in the company life cycle, depends on creating critical mass. Co-ordination, and in smaller cases probably also merger, is needed.

4 How well does the innovation infrastructure work?

This section looks at evidence about the respective roles played by different organisations in the innovation infrastructure. Roughly, a potential division of responsibilities, functions and clients in the national system of innovation is depicted in **Exhibit 14**. The guiding question is whether there is evidence that would call for changes in institutional responsibilities.

[20] Ernst & Young Management Consulting, *Evaluering av myndighetenes deltaking i regionale såkorn- og venturefond*, Oslo, 1998.

Exhibit 14: Shared responsibilities of RCN, SND, and SIVA in the Norwegian Innovation System?



Source: E. Arnold and S. Kuhlmann

4.1 The Customer Perspective

4.1.1 SIVA

The STEP Group has recently evaluated SIVA. Using the Norwegian part of the Community innovation Survey as a control, the study shows that SIVA's tenants are generally more innovative and better networked than other firms. Two-thirds of them are located in the Northern part of Norway – from Møre og Romsdal and Northwards. They are younger than the average and about one third are start-ups, but few are attracted from outside the *kommune*. SIVA's success in providing 'soft' infrastructure to the bulk of its tenants and in embedding them in regional supply and innovation networks appeared limited. At the same time, case examples show that SIVA can be effective, especially in the small number of examples where it is possible to 'capture' a significant customer, who can act as a 'locomotive' for local industry.

As indicated elsewhere in this Chapter, SIVA's role as a venture capitalist supported local industry but involved only modest amounts of novelty and risk. We suspect this is because there are limited numbers of risky investments available in the places where SIVA works and because the small size of the funds makes it difficult to make risky investments.

STEP concludes that while SIVA makes a positive contribution to regional development and innovation, it should operate in a more focused way in order to be more effective. A key finding for this evaluation is that SIVA's activities do not overlap in any meaningful way with those of other key organisations working with similar objectives.

4.1.2 RCN[21]

4.1.2.1 User oriented R&D

The user oriented (or 'user driven') research and development programmes of the RCN are to contribute to wealth creation, profitability and competitiveness in industry. By involving companies as partners and co-funders of RCN programmes, the authorities want to encourage increased industrial R&D activities and R&D investments. The users are to initiate, manage and partly finance R&D activities, in order to ensure that the research is relevant to the needs of industry, and that the results are used.

Although the programmes originally focused on *financial* support for research and technological development only, the activities have gradually absorbed aspects of modern innovation theory. This means that the Research Council – in addition to traditional objectives like the production of new products, processes and services – also takes other factors into consideration, like for instance networking, general competence building and the companies' ability to learn (i.e. absorb new knowledge and technologies). Any attempt at mapping the effects of user oriented research and development, must take these variables into consideration.

There is a consensus in Norwegian politics regarding the need for an increase in national investments in R&D. If Norway is to reach the goal of an investment level comparable to the OECD-average as measured as a proportion of GDP, industry must take its part. Given that there is no industrial organisation that can force companies into investing more in R&D, the government must find ways of encouraging such investments. User driven research programmes may be one relevant measure, provided that they actually do succeed in increasing company R&D investments.

One way of measuring the success of a policy instrument is to determine its 'additionality', meaning to what extent the measure is encouraging activities that would otherwise not have taken place. If the companies would have carried out this research in the same way regardless of RCN support, the additionality is low. On the other hand, if the RCN programmes stimulate significant amounts of new R&D activities and investments, as well as networking and learning, one could say that the additionality is high. One important yardstick for RCN success must therefore be the organisation's ability to bring forth new R&D activities and investments in industry.

The main conclusions of an evaluation made in 1997 (Hervik/Waagø 1997) was that user driven research had been quite a successful instrument in financing industrial R&D. The authors noted significant positive effects from investments in competence building and networking. The programmes had probably given fair social returns. However, there was too low additionality in the overall portfolio, and there was a relatively high uncertainty as regards economic return/profitability.

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[21] This section is largely taken from the STEP Report: Heidi Wiig Aslesen; Marianne Broch; Per M. Koch; Nils Henrik Solum *User Oriented R&D in the Research Council of Norway*, 07-2001

Møreforskning has conducted a study of user driven research[22] that shows that companies do consider the programmes important. Half of them expect economic results after two years time, and 40 percent of the companies say that these R&D projects would not have been implemented without the support of the Research Council. It also seems that public support leads to larger and more daring projects.

Møreforskning finds substantial social returns. Most important are effects like competence building, networking and technology diffusion. They find it harder to measure the direct economic effect of the projects. However, a small number of successful projects lead to a large overall profitability.

A customer survey made by AIM[23] reveals a certain lack of administrative transparency, meaning that 'new' companies find it hard to get on the inside of the RCN apparatus. There is little renewal in the RCN company 'customer base'.

STEP carried out two new studies for the 2001 RCN Evaluation: (1) a presentation of data from the RCN databases, including information on the distribution of resources and on how the RCN staff perceive the various projects; (2) a survey of Norwegian receivers of RCN user oriented funding.

Data from the RCN databases (Foriss and Provis) reveal that more than 1500 firms took part in user-oriented R&D projects financed by the Industry and Energy Division in 2000[24], out of which 385 were contract partners, i.e. firms responsible for the implementation of the project. The rest were co-operating partners (**Exhibit 15**).

The distinction between contract partners and co-operating partners is important. We know for sure that the contract partners are heavily involved in the project R&D activities. The RCN databases do not contain information about the contribution of the co-operating firms, however. They may be mere suppliers of data or technology or they may be taking actively part in the R&D project.

The largest proportion of company participants are small and medium sized firms. This is reflected in the RCN statistics as well as in the surveys performed by STEP. STEP's survey of contract partner firms shows that as many as 60 percent of the responding firms have less than 50 employees.

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22 Bræin, Lasse; Hervik, Arild; Bergem, Bjørn G 2000-A.: *Brukerstyrte prosjekter i Norges forskningsråd, analyser av prosjektporteføljen 1999 basert på data fra Provis*. Møreforskning, Molde,(draft version). This report has been included in Bræin 2001.
Bræin, Lasse; Hervik, Arild; Bergem, Bjørn G 2000-B: *Brukerstyrte prosjekter i Norges forskningsråd, trendanlyser for nystartede bedriftsprosjekter i 1995-99*, Arbeidsrapport M0006, Molde August 2000 (draft version). This report has been included in Bræin 2001.

23 Verde, Patrick and Juel, Erik 2000?: *Kundetilfredshet i Industri og Energis Brukerstyrte Programmer*, AIM AS, Oslo and Nesoddtangen 2000

24 The 457 projects of the BRO/BRIDGE programme included. BRIDGE is often not reckoned as a traditional user-oriented programme.

Exhibit 15: Participating Norwegian companies IE user-oriented programmes 2000

Number of employees	Number of participating companies	Percentage participating companies
0 - 100	583	56%
101 – 250	193	18%
251 – 500	133	13%
> 500	144	14%
Total	1053	

Source: RCN/IE - BRO/BRIDGE

The STEP survey of contract partner firms shows an even distribution between firms belonging to the service and industry sectors respectively. Half of the companies are located in the eastern parts of Norway, while 25 percent belong to the western or central parts of the country.

As mentioned the number of companies taking part in RCN user driven R&D amounts to some 1500 companies, if we include the BRIDGE programme for competence building and networking. As the Research Council has pointed out, this probably means that a majority of the companies that are registered as R&D performers ("FoU utførende") by Statistics Norway are participants in one or more of the IE projects[25]. This fact in itself does not necessarily lead to the conclusion that IE is unable to engage new companies in R&D activities. It might be that most of the companies Statistics Norway classify as R&D performers, are involved in R&D *because of* the RCN involvement. If this is the case, the Research Council has clearly succeeded.

One should also keep in mind the industrial structure of Norway. The country has many small and medium sized companies in industries that traditionally invest only small sums in R&D in most industrialised nations. This means that there is a limited number of companies that are able to perform any meaningful research in the traditional sense. It is therefore hard to ascertain whether it is possible for the Research Council to reach more companies. It could be that RCN has reached the 'ceiling'. On the other hand, it could also be that RCN is facing some kind of 'lock-in', as that the programme structure may make it difficult to reach companies outside the boundaries of the major industrial branches and branch organisations. Moreover, the AIM survey indicates that the entry threshold is high, meaning that it is hard for new companies to gain the insight needed to take advantage of the RCN services.

Møreforskning points out that the largest proportion of the IE portfolio contains traditional research projects, while the "D" for "development" is less important. As noted, this result is in accordance with our findings. This might indicate that it could be possible to recruit more small and medium sized companies that have the competences needed to take part in development activities.

On the other hand, one important argument for user driven research is that it is to compensate for the companies' unwillingness or inability to invest in long term

[25] *Norges forskningsråd: Årsrapport 2000*, Området for Industri og Energi.

competence building, i.e. research in the more narrow sense. At the same time: the further out you move towards the "D-portion" of the research and development axis, the closer you are to the policy instruments administered by SND. Any policy shift in this area must take the relationship between RCN, SND and other relevant institutions into consideration.

It seems that RCN is able to reach small and medium sized companies. 74 percent of the participating companies have less than 250 employees. Some 60 percent of the RCN funding going to contract partner companies was allocated to companies of this size. Whether RCN has reached a sensible balance between small and large companies is a political question. Under any circumstances, small and large companies should not been considered in isolation. The systemic nature of the Norwegian innovation system means that small and large companies make use of each other in competence development, not only in concrete R&D co-operation, but also in supplier/customer relationships.

4.1.2.2 Allocation of funding

The IE total budget was reduced by 16 percent in the period 1993 to 2000, and the funding of user driven R&D declined quite dramatically form 1997 to 1999. Still, the STEP survey shows that there has actually been a rise in the RCN share of innovation financing. This may be the result of the Council's strategy to focus on larger and more long-lasting projects.

Especially the smallest firms have experienced a rise in the RCN share of total innovation costs. The relative RCN share is much higher for the small firms, indicating that RCN support is decisive for the implementation of their projects.

A significant proportion of the RCN funding is allocated to small and medium sized firms. There are no figures for the final distribution of RCN funding on companies and research institutions, as the contract partners redistribute some of this funding to co-operating partners. Still, 34 percent of the Industry and Energy Division's funding for user-oriented R&D was allocated to small and medium sized contract partner companies in 2000[26]. 23 percent went to contract partner companies with more than 250 employees and 43 percent went to other types of contract partners, research institutes and university and colleges included.

Møreforskning[27] report that in 1999 the funding of companies with strong R&D experience increased significantly in relative terms. Møreforskning finds that the largest proportion of the IE portfolio contain projects with research topics focusing on the development of new knowledge – as opposed to regular development and support activities. These findings correspond to the findings of our own surveys.

Møreforskning report a shift from a strong demand for economic returns and limited risk to more long-term projects with less emphasis on direct economic returns. High-

[26] SMEs defined as companies with 0 to 250 employees.

[27] Bræin, Lasse; Hervik Arild, Bergem, Bjørn G. 2001: *Brukerstyrte prosjekter i Norges forskningsråd 1999, Porteføljeanalyse (PROVIS), trendanalyse av nye proesjekter 1995-99 og undersøkelse av et utvalg avsluttede prosjekter 1999,* Møreforskning Arbeidsrapport M012, ISSN 0803-9259, January 2001 (preliminary version) - p. 7

risk projects may fail more easily, but they may also give rise to more radical innovations and competence building, as well as greater social return in the long run. Since the evaluation of user driven research of 1997, the message from the government has been that RCN should allow higher risk in these programmes.

4.1.2.3 Innovation activities

Almost all contract and co-operation partner firms in the STEP-surveys must be considered innovative (as defined by OECD and Eurostat), meaning that they have recently introduced products, services or processes that are new *to the company*.

Moreover, among the innovative contract partner and co-operation partner firms, around one third report to have introduced products or services that are new *to the market* as well. In general only one third of Norwegian innovative firms report such innovations.

This suggests that the largest share of participants in RCN user oriented programmes are among the most innovative firms in Norway. This, however, is not necessarily a result of RCN involvement only. It could be that strong innovators are more likely to implement R&D activities, and that firms of this kind are more prone to take advantage of RCN services and funding.

4.1.2.4 Company R&D activities

In the present policy debate the distinction between internal R&D activities and external (i.e. commissioned) R&D activities is blurred. This may be caused by a remnant of "linear" thinking, meaning a belief that companies can easily transform R&D results into new products, processes or services, regardless of whether this R&D is done in-house or by someone else. However, one should keep in mind that internal R&D activities improve the companies' ability to solve problems and make use of new knowledge and technologies, regardless of the outcome of this or that particular R&D project.

Almost all the companies responding to our surveys conduct *internal* R&D activities. Three out of four firms engage in external (commissioned) R&D and in training linked to technological innovations.

A large proportion of the firms also take part in several other forms of innovation activities, including acquisition of machinery, equipment and software. Nevertheless, the largest share of company innovation costs is allotted to internal R&D, close to twice as much as the proportion used by 'normal' Norwegian innovative firms[28]. The share of contract partner firms with external R&D is almost three times higher. Again: This does not in itself prove that the programmes are causing this focus on R&D. It might be that RCN is attracting the most R&D savvy companies in the country.

[28] As defined in the Eurostat/Statistic Norway's CIS-survey. Cp. footnote on page.

4.1.2.5 Networks and collaboration

All firms in the STEP surveys report innovation collaboration, meaning that they take part in operative external networks to a larger degree than the 'average' innovative Norwegian firms (**Exhibit 16**). Only 31 percent of the IE user oriented projects of 2000 had one participant only. This indicates that the Research Council has succeeded in making the user oriented programmes vehicles for networking and competence diffusion. However, according to the participants, the networking is a result of their own efforts, not a product of RCN guidance.

Exhibit 16: RCN/IE user oriented R&D projects based on networks

Co-operation between…	Number	Percentage
Norwegian company and Norwegian research institute	343	43%
Norwegian company and Norwegian university/college	182	23%
Several Norwegian companies	344	44%
Norwegian company and foreign R&D institution	19	2%
Norwegian company and foreign company	42	5%
Norwegian company and other types of co-operation partners	195	25%
Projects with one participant only (no network)	248	31%

Source RCN/IE.
(BRIDGE/BRO not included) 2000. Total number of projects 790. Projects may include co-operation of more than one type.

Knowledge transfer between the partners in the R&D projects is mainly linked to meetings and presentation and practical work. Few firms report on exchange of personnel or training schemes.

4.1.2.6 Effects

The trend analysis of the R&D projects of the Research Council for the period 1995 to 1999[29] shows that the company expectations regarding the overall importance of the user oriented projects for company development are declining in the period 1997 to 1999. So do – to a certain extent – the expectations of the projects' influence on economic results. In 1995 almost 70 percent of the companies expected economic returns from the projects after two years; in 1999 only half of the firms had such expectations.

On the other hand the staff of the Research Council expects only 28 percent of the projects to show notable social economic returns (i.e. company returns plus economic benefits from spin off effects). Half of the projects are expected to show significant effects from scientific results and the involvement of R&D institutions. Moreover, RCN believes that RCN support will lead to earlier results in half of the projects.

[29] Bræin, Lasse; Hervik Arild, Bergem, Bjørn G. 2001: Brukerstyrte prosjekter i Norges forskningsråd 1999, Porteføljeanalyse (PROVIS), trendanalyse av nye proesjekter 1995-99 og undersøkelse av et utvalg avsluttede prosjekter 1999, Møreforskning Arbeidsrapport M012, ISSN 0803-9259, January 2001 (preliminary version).

RCN expectations for direct returns for the participating companies are more modest. The executive officers of the Council expect 17 percent of the projects to result in significant effects of this type, including larger economic returns, improved products and processes, competence building and networking.

In the STEP survey participants were asked to evaluate both effects already achieved and future results. All types of actors report that they expect more effects to materialise within two or three years than the 'amount of' effects that have already been achieved. This is not surprising. Many of the projects covered by our surveys are ongoing or have just recently been finalized. It takes time before a company can harvest the effects of R&D investments.

All respondents report that the most important effect already achieved is a strengthening of the existing knowledge base of the participants. The firms in addition report an improved ability to solve practical problems as one of the most important effects.

The contract partner firms (143) report that their specific projects have resulted in a diverse set of industrial results (patent applications, prototypes, products and services etc.). Obviously, the real value of the various types of individual 'results' may vary tremendously. These numbers therefore make sense only on an aggregate level. Altogether contract partner firms report that the projects have given birth to 348 different industrial results; in average this gives more than 2 industrial results per project.

When the project leaders evaluate the industrial results for the project as a whole, the number of industrial results rise from 348 to 597. This indicates that several industrial results can be attributed to the collaboration partners, and not only to the contract partners firms. Only half of the projects had come to an end at the time of the survey. Still, firms that have finished the project report no more results in average than those that have not yet finalized the undertaking.

114 of the contract partner firms report that they have got some scientific results from the project. By those companies that have answered this question, in average 1.6 scientific results (including conference papers, reports and articles in professional journals/trade press) have been reported. Firms that have taken part in a collaboration project are more likely to report that they have made a report or article. Projects that have been terminated in general report more scientific results than those that are not yet finalized. When evaluating the whole project (partners included), the project leaders report that there have been 313 scientific results from 111 projects (2.8 scientific results per project).

Both the contract partner firms and the institute based project leaders report that the companies have improved their ability to use research based knowledge and technology from universities and research institutes. Similarly, it seems the institutes get an improved understanding of the market's need for R&D-based knowledge and technology, and they become better at co-operating with firms.

Another important *expected* effect reported by all respondents is an increased likelihood of developing new R&D projects.

Furthermore, a large number of contract partner firms report competence building in the form of longer term R&D, improved ability to use science based knowledge, to co-operate more with the scientific community and to explore new or alternative technology paths. This applies not only to the contract partner but also to the project as a whole.

4.1.2.7 Additionality

The user driven R&D programmes must be judged on the basis of more than company returns. Social returns must also be taken into consideration, general competence building and networking included.

One of the main findings of the evaluation of 1997 is that 37 percent of the projects report full additionality – i.e. the projects would not have been implemented without RCN support[30]. The 1995-99 trend analysis made by Møreforskning[31] concludes that for the most recent period (1997-99), 40 percent of the projects would have been cancelled or postponed without RCN support. Only 1 to 2 percent report low additionality. When asked about the significance of RCN support, only 5 percent feel that RCN has been of small importance as regards the realisation of the project, while as many as 70 percent believes that RCN support has had great significance.

STEP's main finding is that the additionality of RCN funding is considered particularly high by the institute based project leaders. If one looks at all the company respondents, about 15 percent report that they would have dropped the projects entirely with no RCN funding. However, close to 30 percent of the company respondents hold that the projects would have been postponed, and another 35 percent that the projects would have been reduced in the case of no RCN funding. Less than 4 percent of the firms report that the projects would have been carried out unaltered. These number are in harmony with the ones reported by Hervik/Waagø and Møreforskning.

Of the contract partner firms reporting full additionality, it is particularly the firms with between 20 and 49 employees that hold that the projects would *not* have been executed without RCN funding. Almost 30 percent of the firms in this category report this, which indicates that the medium sized contract partner firms are most dependent on RCN support. Distributed by size, additionality is particularly low among large *co-operating* firms with more than 100 employees.

One of the main findings of the Hervik/Waagø evaluation of 1997 is that the RCN funding leads to larger projects and to a faster implementation. The trend analysis also conclude that the funding leads to longer, larger and more 'exciting' projects.

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30 Hervik, Arild and Waage, Sigmund J 1997.: *Evaluering av brukerstyrt forskning, på oppdrag fra Nærings- og handelsdepartementet*, Handelshøyskolen BI og NTNU, Oslo and Trondheim 1997.

31 Bræin, Lasse; Hervik Arild, Bergem, Bjørn G. 2001: *Brukerstyrte prosjekter i Norges forskningsråd 1999, Porteføljeanalyse (PROVIS), trendanalyse av nye proesjekter 1995-99 og undersøkelse av et utvalg avsluttede prosjekter 1999,* Møreforskning Arbeidsrapport M012, ISSN 0803-9259, January 2001 (preliminary version). - p. 71

All the STEP respondents expect an increased engagement in R&D as an important effect of programme participation, meaning that the RCN funding might stimulate companies to invest more in R&D also outside the framework of these particular user driven research programmes. Furthermore, the institute based project leaders hold that one of the expected effects for participating firms is that the companies will shift their focus from short-term to longer-term R&D.

The 'STEP companies' report low levels of agreement with the statement that RCN has contributed to the establishment of important relations with other companies and institutions. As in the AIM survey the respondents report that they are not satisfied with RCN assistance in the field of network building. This might indicate that the achieved and expected effects from co-operation is a result of the participants finding each other without the help of the Research Council.

Considering the contract partners only, there has been a rise in the proportion of innovation costs financed by RCN. In 1998, RCN in average financed 11 percent of firms' total innovation costs. In 2000, RCN share had risen to 15 percent. RCN funding as share of total innovation cost is higher for the smallest firms, especially for firms with less than 20 employees, suggesting that RCN plays an important role for these firms' ability to engage in innovation. For this size group, RCN's share has risen during the last three years from 12 to 18 percent in this period.

One important idea behind the concept of user driven research is that the users (i.e. the companies) know the needs of industry better than the RCN bureaucrats. However, only half of the STEP respondents agree that the research priorities of the RCN fit well with the research needs of the companies. One should keep in mind, however, that the RCN staff might have tried to reach branches of industry outside the groups that normally take part in these programmes. There could also be a conflict between company demands for quick, short-term solutions and RCN strategies for long-term competence building.

4.1.2.8 The advisory function of RCN

In the Hervik/Waagø evaluation half of the companies report that they have received advice and guidance to a small degree only. Still, one of the main conclusions is that the RCN plays a significant role as a *funding* adviser, and that it also helps bringing firms and R&D institutions together. The AIM customer survey executed in 2000 on behalf of the RCN Industry and Energy Division shows that most of the IE customers have discussed organisational and technological issues with the RCN, but that they are not satisfied with this function[32]. One of the main conclusions from the AIM survey is that the advisory role is not an important part of the IE customer relationship.

In the STEP surveys between 50 and 60 percent reply that the RCN has provided advice and guidance to the design of the project. The RCN particularly play an important advisory role as regards project design at the time of the application. Only one out of four report the same for the rest of the project period. Large proportions of

[32] Verde, Patrick and Juel, Erik: *Kundetilfredshet i Industri og Energis Brukerstyrte Programmer*, AIM AS, Oslo and Nesoddtangen 2000? (undated)

both firms and institutes hold that the RCN has failed to give advice and guidance regarding further development of the project, regarding the use of other business and technology support measures or about the dissemination of scientific results.

It should be noted, though, that the more general remarks given by the RCN 'customers' reveal a positive attitude towards the Council. The participants seem particularly satisfied with the way the RCN handles applications and payments.

4.1.3 SND

The recent evaluation of SND focused on SND's main activity, which is to function as a development bank. Some key findings from the questionnaire survey[33] of user firms include

- 38% of sales were exported. While this is a high figure in international terms, in the Norwegian context the figure is low – suggesting that those receiving funds tended to be more locally embedded than most
- 70% of SND's customers had introduced product or process innovations in the preceding 3 years, indicating that they were much more innovative than the overall Norwegian firm population
- Customers indicated that while SND had had a major effect on their long term competitivity, this resulted from the finance SND provided, rather than from counselling or brokering contact with other knowledge organisations. In particular, SND did not help them make better use of the national knowledge infrastructure
- Companies explained SND's limited advice and brokerage role as a result of the capabilities of its staff, whose understanding of project goals and companies' networks was limited

SND's programmes aimed at raising the capabilities of SMEs (FRAM, BIT, OFU/IFU and so on) have received very positive reviews by external evaluators. It was clear from our own SND evaluation, that the programmes were very highly appreciated by users, but were not strongly associated with SND in customers' minds. This was because they were delivered by third parties on SND's behalf. They were organised from SND's national headquarters in Oslo, and this meant they were 'owned' less than the financial instruments by the regional offices. They were nonetheless seen as key parts of the growing portfolio of products offered to customers through the regional offices, alongside products from SND's partners – RCN, the design and Export Councils. A significant effort was to be invested in broadening the capabilities of regional staff, in order to provide an effective regional distribution apparatus for these products and a 'first stop shop' for local businesses.

Our evaluation[34] criticised SND for weak performance of its role as a national policy advisor. While SND is limited by its parent ministry's principle of 'branch neutrality,' there is nonetheless a need to make strategic choices and to reinforce regional clusters, which make a completely neutral stance both unhelpful and

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[33] Johan Hauknes, Marianne Broch and Keith Smith, *SND og bedriftsutvikling – rolle, virkemidler og effekter*, Del I i evalueringen av SND, Oslo: STEP, 2000

[34] Erik Arnold, Lillian Hatling, Johan Hauknes, Keith Smith og Tor-Jørgen Thoresen, *Evaluering av SND: 1993-99*, Oslo: NHD, 2000

impractical. We understand SND is devoting effort to improving its strategic capabilities. Clearly, its development priorities need to have some consistency with those pursued by RCN, which funds the needed knowledge infrastructure.

4.2 Co-operation between SND and RCN

The co-operation agreement between SND and RCN builds on a history of running joint programmes and of close co-operation over programmes, which deal with SMEs' innovative capabilities. Relations at head office level appear to work well, and the process of extending them by using SND's regional District Offices (DKs) to a greater extent to retail Foskningsrådet's R&D programmes is making significant progress. This requires more technical skills than exist in the DKs today, and it may be useful to consider following the Finnish example of placing a person from the R&D agency (in this case, RCN) in at least some of the DKs.

SND and RCN have had co-operation agreements in place since 1996. A key idea is the linear one that it is natural for RCN to finance R&D, notably under its user-directed R&D programmes, and that SND should them follow this up with risk capital for a commercialisation phase. In many cases SND is able to pay the type of innovation costs (investments, capabilities upgrading, marketing research) that are outside the scope both of the formal definition of R&D and of RCN's funding instruments. The partnership between the two organisations is, indeed, in this sense a natural one.

During 2000, the number of areas over which RCN and SND were to co-operate was expanded from 6 to 14. However, implementation plans, intended to be delivered by February 2001, were mostly not available by that time. The main aspect of the co-operation, which has become effective has been the cluster of activities under the 'SME Innovation' umbrella (SMB-Innovasjon). There is more generally goodwill and *ad hoc* co-operation between the two organisations, especially with RCN's IE Division. Important public shows of unity between the organisations have included national conferences organised by them, together with the Export Council.

We interviewed people concerned with the interface research/innovation policy in RCN, SND, NHD, and KRD. Our findings are very much in line with Thoresen's review[35] of experiences of the RCN/SND co-operation at the start of 2001. Key points from our interviews and the review are summarised here.

Our interviews confirm that the (central) parts of SND and RCN that work together succeed in doing so partly because they have a common understanding of the innovation process. Cultural differences within the organisations hamper co-operation. These differences have quite concrete manifestations, especially in the DKs, where case officers often lack the skills needed to deal with research-based innovation projects. Such skills exist in SND's headquarters but not to a sufficient extent in the field. Concrete measures are needed to train more case officers to understand innovation processes, and to develop some ability to identify situations where a research-related project may be relevant. Within RCN, too, there is greater cultural distance between the Industry and Energy Division and the rest of the

[35] Tor-Jørgen Thoresen, *Erfaringsnotat – samarbeid mellom SND og Norges forskningsråd*, Oslo: Albatross Consulting, 2001

Council than there is to SND. The lower threshold for 'scientific quality' that has to be accepted when dealing with SND clients is difficult for the Council's research-dominated culture to handle.

There remains at present some disappointment within RCN about the way the co-operation with SND is working. Despite the unexpectedly high volume of projects already generated, the research council is interested in yet more effective use of the DKs as a distribution channel. The intended new focus within RCN's Industry and Energy Area on larger, more targeted projects and on handling the mass of companies through network projects opens up the possibility of a bigger role for SND in fostering network creation. However, SND's effectiveness as a partner in the short term as being hampered by

- Inappropriate skills in the DKs, of which only a third are seen as effective distributors today
- The seemingly constant funding cuts to which SND has become subject
- The huge amount of reorganisation work that SND has had to undertake in order to decentralise and to integrate the Agricultural bank
- SND's lack of a research and analysis staff able to play a clearer role in policy debates and agenda-setting

It is difficult to see how a co-operation between the operating agencies can develop to its full potential unless NHD – which owns SND and is the main funder of RCN's Industry and Energy Area – is prepared to back the partnership with a more stable financial and organisational framework for innovation.

Principal impressions from some 35 interviews within SND and RCN were that SND regional offices had high expectations of the co-operation, but felt they had seen few results. In SND's view, the growing focus on research, as against innovation, within RCN impedes co-operation by making a growing number of joint projects ineligible for RCN funding. RCN seems unable to think in terms of regional innovation systems, as opposed to Science. RCN is highly bureaucratic and customer-unfriendly. The recent introduction of deadlines in calls for proposals for user-directed R&D is a key example of this, which makes co-operation very hard. Proposal acceptance rates are so low in RCN that SND project officers often avoid making applications. They may adapt SND measures such as OFU/IFU to suit the case instead. The relevant target groups for RCN research programmes were not clear to SND personnel. Programmes such as TEFT, SMB-Kompetanse and FORNY work well in the regional offices. (These are respectively programmes of technology audit, placement of qualified personnel and commercialisation of inventions from the research and higher education system. They focus on a clear deliverable to a single firm, based on interaction with a specialist.) Research projects fitted poorly with the capabilities of the offices. RCN personnel were needed in the field, in order to deliver these. Without simplification of the funding instruments and the development of a shared administrative process, the prospects for increasing practical co-operation seemed poor.

RCN's perspective was that the SND regional offices' ability to handle RCN programmes was highly variable. Their capabilities in relation to innovation are too weak. SND as a whole is seen as highly risk-averse. A number of RCN programme

chairs felt they had bent RCN rules significantly in order to accept SND-originated projects with little or no research content.

While the RCN/SND co-operation agreement was well understood at top management level, this was not the case at operative levels within the organisations. Joint measures and reporting were not being delivered, and it was not felt that the co-operation was serious. Both organisations internally appear to have difficulty in seeing the common repertoire of SME-oriented programmes as a package, and to visualise how this can be delivered. Successful co-operation at project level often arose from good personal relations between the relevant project officers.

Both RCN and SND have the responsibility to act as policy advisors to government in their respective fields. In the area of industrial development, these fields overlap strongly, but the degree of exchange between the strategy functions in the two organisations had been limited.

Thoresen offers a number of judgements, to the effect that the co-operation is not living up to its potential, but does not make strong recommendations. Based on our field work in the SND and RCN evaluations, we interpret his findings as follows

- The co-operation agreement is well intentioned but poorly implemented. It covers too large a spectrum of activities to be implementable without the addition of significant resources
- The subject of 'innovation services for SMEs' is the most active area of co-operation but sits a little uncomfortably with both organisations. SND needs to increase innovation understanding in its regional offices in order to improve the offer to SMEs. Innovation assistance is not quite 'respectable' within RCN, which in any case lacks a distribution network for such services. Together the two organisations already possess quite a broad range of instruments, which could be delivered better as a package
- Co-operation in the policy advice function would bring benefits, without requiring big organisational changes. Also, in our interviews the idea was put forward to establish a joint RCN/SND research group focusing on analyses of the national innovation system (NIS) as a basis for the development of systematic policy advice. As a starting base, one could use RCN's programme of research on the NIS and the evidence base for research and innovation policy.

5 Conclusions

Our analysis of the Research Council of Norway's role in the Norwegian national innovation system has been based on two major lines of consideration: (1) an analysis of the specific profile and strengths and weaknesses of the Norwegian system, and (2) an assessment of the institutional responses to identified needs for public policy.

The strengths and weaknesses analysis led us to the identification of a number of challenges for industry and innovation policy

- While there is reason to build upon the now traditional strengths of Norwegian industry in raw materials and process based industries, policy needs also to foster the growth of new, knowledge-based branches
- Despite the large size and strong capabilities of the applied research institute sector, whose mission has been conceived as performing innovation on behalf of companies, the innovation rate of both large and small companies is generally low. This rate needs to be increased also by means that augment companies' internal technological capabilities or 'absorptive capacity'
- This is, in turn, only possible if the higher education system is producing an adequate number of scientific and technical workers at degree and doctoral levels
- Increased internationalisation is necessary, in order to access that great majority of the global research effort that is undertaken abroad, as well as to benchmark and quality control the Norwegian R&D effort

In short, there is a need for organisational forms for public policymaking which build on the old industries, work together to build new ones (ideas, money) increase internationalisation and push yet more absorptive capacity into the firms, so they **want** to do more and strategically appropriate R&D.

Our analysis provides hints[36] pointing to an **uncovered gap** within the institutional setting and scope of responsibilities, between the (relatively successful) provision of "classical" industrially oriented R&D programmes by RCN on the one hand and of business development (SND) or science park type of support (SIVA) on the other (see **Exhibit 17**).

In face of the structural challenges sketched above the 'gap' could be filled by a variety of quite heterogeneous initiatives like

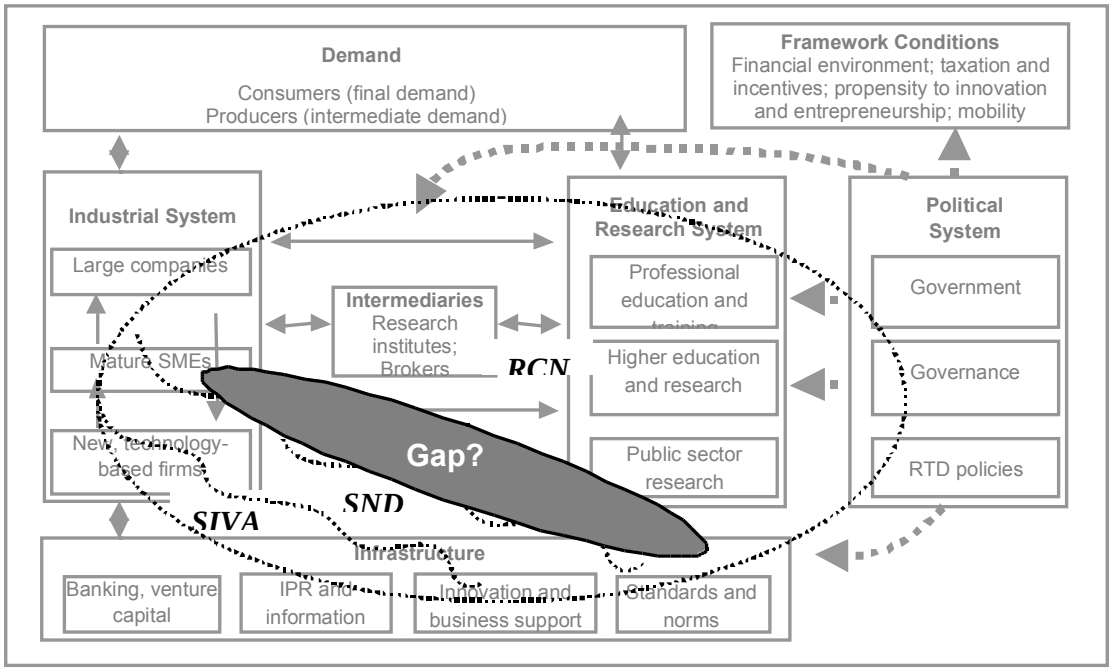
- Targeted measures aiming at strenghtening the **absorptive capacities**, in particular of less R&D oriented SMEs
- Targeted support for the **internationalisation** of R&D and innovation strategies of companies
- National or sectoral **foresight exercises** (future technologies, societal demand, markets), raising the awareness of industry, in particular of larger companies.

The unresolved policy issue is not only a lack of programmatic initiatives of the above character (i.e. additional or strengthened funding streams) but also, and in particular, a **lack of institutional responsibility for strategically oriented innovation policies**! A strategic innovation policy mission could either be located within RCN – which would require an extended scope of innovation policy orientation inside the Council – or outside. If outside, consequently, the industrially oriented divisions or units within RCN should be linked strongly to the outside authority. There are quite a number of examples of strong innovation policy bodies

[36] Hints – not exhaustive evidence: The resources available in the context of the RCN evaluation did not allow for a broad and systematic study of the appropriateness of the overall innovation performance in Norway and of related needs for public policy.

located outside of the classical Research Council model, take e.g. the Ministry for Economic Affairs in the Netherlands (MinEZ) as a government body, or TEKES in Finland as an agency type of body. It is noteworthy, however, that TEKES and the Academy of Finland are increasingly working together on strategic programmes linking their areas of interest. The recent review of the role of the state in the Danish National Research and Innovation System proposed integrating the strategic innovation function with the research councils in a new organisation that will look remarkably similar to RCN. Both organisational forms appear to be possible.

Exhibit 17: A Structural Gap in Norwegian Innovation Policies?



Source: E. Arnold and S. Kuhlmann

If such a strong innovation policy authority would exist – inside or outside of RCN – coordination problems at the interface of RCN and SND, as they have been revealed by our evaluation as well as by a couple of other studies – would be easier to cope with or not even exist any longer

- RCN's research programmes have their own national frames of reference and applications timetables. User-directed R&D projects in IE division formerly had a continuously open call. Now, there are specific submission deadlines, making it more difficult to 'sell' this through the regional offices. An exception is made by IE for first-time users of user-directed R&D – for them the call is effectively open all the time
- The innovation capability programmes seem to be a bit unloved in both RCN and SND, because they fall outside these organisations' self perceptions as respectively a bank and a Research Council. All experience nonetheless shows that these kinds of programmes are needed. Decentralisation means SND is moving these programmes into its core business. RCN seems to be doing the opposite, with its increasing focus on Research and with the trend for IE Division to get a declining share of the budget

- SND offices are likely to be able to 'sell' programmes like SMB Kompetanse, which deliver a clearly-identifiable product or capability to an individual firm. The regional offices are close to the customer and can situate these programmes among other needed business supports
- Our evaluation – as well as the SND evaluation – made clear that most SND regional offices did not have people familiar with research who could be of much use to companies wanting to know about research funding. SND was nominating a 'lead' person in each office to be responsible for RCN programmes, but only in one or two cases did them seem likely to be up to the job

How should such a strong innovation policy agency function be organised? This is a sensitive question, not least because in Norway it is positioned at a place where the responsibilities of the industry, education and regional development ministries converge. We have no interest in joining in exploiting the ample opportunities this provides for engaging in turf battles.

One thing is clear: namely, that this is not a task for SIVA. SIVA appears to be doing a very good job in a regionally rooted way. Its strengths include its bottom-up organisation of its core competences and its geographical dispersion of its resources.

Historically, the strong innovation policy function was one of NTNF's roles, and the combination of RCN's Industry and Energy division with the now much bigger resource provided by the other five divisions is NTNF's natural heir. The alliance between RCN and SND reflects the major weakness of NTNF in the innovation policy role: namely, its lack of access to capital. The discomfort being felt in the SND/RCN alliance reflects the fact that capital provision and research or R&D are quite different core competences. At the same time everyone concerned understands that where these functions meet – in the innovation and company start-up processes – they need to be tightly integrated. Merging SND and RCN is not an answer. The core competences are fundamentally different and important aspects of SND's regional policy role are in direct conflict with good research policy. A bureaucratic compromise between these would damage both and reduce the variety in the innovation environment, creating a monster.

There appear to be four options. One is, obviously, to leave the situation as it is. It has many imperfections, but the RCN/SND alliance is also achieving progress. However, the joint activities are politically exposed in both organisations, because they are at the edge of the core missions while at the same time representing areas of reduced control for management.

A second option is for RCN to take over the programmatic innovation activities of SND, leaving SND with its current mixture of innovation financing and more conventional financing and venture capital. This would separate the development of innovation capability programmes (such as BRO) from complementary business capability development programmes (such as SND's excellent FRAM programme). It would rob the innovation programmes of their distribution channel (SND's district offices), which brings them close to their customers and, therefore, rob them of their sales force in those offices. This would be a major backward step. RCN does not

have a regional distribution apparatus, and for most of its activities it does not need one.

A third option is for SND to take over the innovation capability programmes. This would isolate SND's work to develop company capabilities from one of the most central sets of capabilities: innovation and R&D. It would allow increasing concentration in RCN on research and the issues of large, established industry, increasing RCN's distance from the needs of much of the economy. SND does not have the capabilities to develop innovation programmes, and would struggle to link its help to low-capability firms into the broader process of developing firms' technological capabilities. In short, it would be likely to widen the structural gap we identify in the business and innovation infrastructure.

None of these first three options seems to us especially attractive. The fourth is to reinforce the activities at the interface of RCN and SND by dedicating specific budgets to them and allocating joint strategic responsibility to the two organisations. This would make the internal politics of both organisations exciting, by forcing compromise – and, perhaps, improved co-operation – at the boundary between the two. This improvement is only likely to happen if there is money attached, and a corresponding external reporting relationship. This would transform the activity from being 'nice to have' to becoming part of the core business.

Another issue of division of labour is the respective roles of institute, university and industrial researchers in the National Research and Innovation System. There are reasons to think that it is time to modernise the university sector, bringing it into closer connection with other parts of the knowledge-producing and using system and increasing the role of external funding. At the same time, we suspect that Norway has reached a stage in industrial development where research effort should be moving more from the institutes into companies. Taken together, these ideas would involve significant redefinition of the university and applied technology institute roles in Norway. These should be considered in much more detail by a subsequent study.