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**SMEs and the new role of academic research:
Case Norway**

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ABSTRACT

The main aim of this report is to explore the changing relationship between academic research and small and middle-sized enterprises (SMEs) in Norway. The focus is on this country's policies and institutions (formal and informal) that are designed to promote the commercialisation of academic research and/or knowledge exchange between SMEs and universities. This national report provides an overview of the current interaction between the university sector and the large population of Norwegian SMEs (the 'U-SME relationship'), it describes the instrumental regulatory and institutional factors that shape the U-SME relationship in Norway, and it discusses relevant policy-measures with an eye to further improving the relationship. It complements the national reports of other Nordic countries in a project supported by the Nordic Industrial Fund (2002-2003).

(see <http://www.step.no/Projectarea/SMESACAD/SMESACAD.pdf>).

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1 Introduction

In the 1980s, efforts to improve the climate for commercializing university research explicitly recognized the importance of the link with small and middle-sized enterprises (SMEs). At that time, a major premise for policy was in fact that, “universities could contribute to the revitalization of national economies by assisting small and medium enterprises as well as by generating entirely new high-technology businesses.” (Stankiewicz, 1986: 3) Today, this focus on the university-SME (the U-SME) link has re-emerged amidst a new phase of policy activity designed to improve the basis for turning “science into business”.¹ Norway is one of the wider set of countries who are currently trying to define the new role of academic research in this sense. The question that has yet to be asked is how these efforts will effect the interaction between the country’s few large universities and its many small SMEs.

This report explores the changing relationship between academic research and SMEs as it is taking shape in Norway. It is designed to promote cross-country comparisons with Nordic neighbours in order to improve our understanding of the basis for policy initiatives, their substantial context, and their (potential) effect. This national report systematizes knowledge about commercialization of academic research and reviews existing formal and informal mechanisms for knowledge exchange between SMEs and universities. Particularly, it provides an overview of the current interaction between the university sector and the large population of Norwegian SMEs (the ‘U-SME relationship’), it describes the instrumental regulatory and institutional factors that shape the U-SME relationship in Norway, and it discusses relevant policy-challenges with an eye to further improving the relationship.

This report divides into five main sections, including the current introductory section. Section 2 presents baseline information about the industrial structure and innovation activities in Norway as they involve the university sector and the SME sector. This presentation provides comparable information that conditions the current state of U-SME relationship in Norway. The third section goes on to provide a digest of the changing policy-framework and institutional support structures in Norway that have particular relevance to the U-SME relationship. This Public R&D section surveys the major instrumental regulatory and institutional factors that shape the U-SME relationship, and reviews an array of relevant policy-initiatives in terms of their place in the wider innovation system. Section four then takes stock of the current degree and extent of the relationship between academic research and small and middle-sized enterprises in the country. We collect existing empirical evidence about academy-industry links before presenting four case-studies in order to identify current concerns and problems in the U-SME relationship. On the basis of current state of academy-industry interaction, the final section concludes by reviewing policy initiatives and discussing initiatives which might improve the interaction between university sector and SMEs.

2 Industry Structure and Innovation Activities in Norway

A defining characteristic of the Norwegian research environment is that, in international terms, a disproportionate proportion of research is publicly financed. The Norwegian university sector, which consists of a few large institutions, is responsible for a greater share of research than the international average. The situation of the Norwegian private sector is diametrically opposed. The private sector is characterized by a large proportion of very small firms who, on average, report innovation activities considerably below the Nordic average. Several of the salient features of formal R&D activities in the Norwegian case are listed in Box 1.

¹ In Benchmarking of Science-Industry links, the OECD listed “Promoting the participation of smaller firms” as one of six important policy concerns. (OECD, 2002: 10)

Box 1. Formal R&D in Norway: Expenditure and Employment

- The absolute level of R&D expenditure is modest in Norway: 1.7% of GDP or a NOK 4,554 per capita. This is below the OECD average, and the lowest in the Nordic area
- The proportion of publicly-funded R&D is the highest in the Nordic area, at 43% of total R&D expenditures. By implication, the private-sector R&D is the lowest at 47% (1999) which is similar to the Netherlands and Great Britain.
- The academic sector² accounts for 29% of total R&D expenditure, with the four universities alone accounting for 23% (1999) and 23% of total R&D employment. (1999) This places Norway among the top OECD countries;
- In this perspective, the R&D activity of industry and mining is roughly equivalent to that of the four universities.
- The Publicly sponsored research (universities, colleges, research institutes) accounted for only a fifth of R&D services bought (4,4 BNOK)
- The Norwegian industrial sector is characterized by low and relatively stagnate levels of R&D expenditure per capita. (NOK 2,000 (1990 kroner) in 1999)
- R&D expenditure is relatively evenly spread in Norway across R&D intensive sectors. The absence of R&D intensive world leaders in Norway (areas such as cars, aeronautics, communications) affects the R&D bottom line. (ANBERD 2000)

An important dimension to highlight in our context is that most Norwegian companies have relatively small R&D budgets, while the few universities have large ones. The institute sector, which is large in Norway, is in between. Table 1 illustrates how annual R&D expenditure breaks down between the private, the institute, and the academic sectors.

Table 1: Number of entities conducting R&D in Norway by how much they spent on R&D in 1999: private, institute, and academic sector.

	Industrial sector ³	Institute sector	University Sector		
R&D expenditure: MNOK		Research institutes ⁴	Universities	Schools of higher learning etc	PublicUniversity colleges
< 10	1 261	42	-	5	6
10-49	161	49	-	5	17
50-99	28	13	-	2	3
100-499	21	9	1	2	-
500-999	3	1	1	-	-
> 1 000	-	-	2	-	-
Total	1 474	114	4	14	26

Source: NIFU & Statistics Norway

2.1 General policy environment

The combined fact of high levels of publicly funded research to a small number of large public institutions and low-levels of formal R&D among a large number of small firms, has presented the Norwegian policymaker with something of a quandary. In sum, this situation has left him (and her) faced with a headline level of R&D which, at 1.7% of GDP (1999), is by an uncomfortable margin the lowest in the Nordic area. Indeed, the level of formal R&D is below the OECD average: getting it above that level has (again) become the holy-grail of the country's formative innovation policy.

In our context, this has led two policy questions to be (re)asked in Norway. The first is how to promote greater returns from public investments in academic research, while not undermining the

² This role and the level of R&D are monitored by the UoH survey and institute surveys. (NIFU)

³ Estimated number of entities (scaled sample for smallest size-classes)

⁴ Excluding museums and hospitals.

traditional values and role of academia. This relates to the policy objective, which is very current in Norway, of promoting greater commercialization of academic research. This objective has now been linked to efforts (new and old) to promote the diffusion of academic research through commercial channels. This is currently evolving as a multi-level effort to improve the conditions for the *commercialization of academic research* in Norway. The general objective is to increase the rate and degree of exploitation of the science base, thus improving the basis for economic growth. This particular policy area is not new in Norway. However, it has entered a defining stage of development. One element (Proposition 40) is a set of changes that effectively expands the societal responsibilities of universities and colleges to include promoting the practical application of research methods and results, not least in industry.⁵ This change is complemented by more instrumental legislation⁶ which recently went into effect. The implementation of Proposition no. 67 substantially changes the basis for commercializing academic research in Norway. The measure effectively removes the ‘professor’s privilege’ from the legal corpus, thus placing responsibility for commercialization of academic research on the universities. It explicitly follows developments in other countries (e.g. Denmark, Germany). The combined change in regulatory framework has served to bring Norway to a critical stage in its policy re-evaluation of the commercialization of academic research.

The second basic policy question is related. It asks how to promote innovation-activity in the country’s large population of small firms. This complicated question is linked to a more general and long-standing concern about industrial renewal in Norway, which is associated with recurrent concern about the post-oil economy. This is also a policy-area that has a relatively established tradition in Norway (and elsewhere), going back to the 1980s. It works from the premise that the Norwegian private sector is dominated by firms that are, taken as a whole, smaller, more traditional, and less innovative than competing firm-populations. As with the policy area dealing with the commercialization of academic research, the focus on SMEs has recently become a policy priority in Norway. This prioritization has readdressed many of the policy instruments that in effect bring SMEs and university research together in Norway. The current process to consolidate the support structure for innovation⁷ addresses some of these. The overview above indicates that, whereas public investment in university sector research is high, the level of innovative activity in Norwegian industry is moderate. Based on this characterization, policy instruments have tended to focus for example on ‘growth sectors’, but also on improving the circumstances of small companies more generally by encouraging links with academic research.⁸

Thus, interaction between the university sector and the SME-sector increasingly takes place at the intersection of central and highly active policy-areas in Norway. This is occurring just as the country is currently framing an ‘integrated innovation policy’,⁹ entailing a consolidation of diverse policy measures and instruments across ministries. This process impacts and substantially involves these two threads of policy. The changing policy environment in Norway highlights the importance of the new role of academic research in Norway and its implication for SMEs. A primary observation is therefore that the relationship between academic research and SMEs

⁵ Proposition 40: Ot prp. Nr 40 (2001-2002): § 2 nr. 4. <<Institusjonene har ansvar for å formidle kunnskap om virksomheten og for å utbre forståelse for og anvendelse av vitenskapens metoder og resultater, både i offentlig forvaltning, kulturliv og næringsliv.>>

⁶ Proposition No. 67 to the Odelsting (2001–2002). Amendment to increase the commercial exploitation of inventions: This amendment changes the ‘professor’s privilege’ (lærerunntaket) of Act No. 21 of 17 April 1970 relating to the right to inventions made by employees.

⁷ See the recent White Paper: St.prp nr 51 (2002-2003) Virkemidler for et innovativt og nyskapende næringsliv. (28.03.03)

⁸ Note that the competitiveness of SMEs is the subject of a recent ministerial Action Plan for SMEs. It is furthermore the focus of the MOBI program (and its antecedents).

⁹ The so-called “helhetlig innovasjonspolitik”. This work is scheduled to result in a Parliamentary White Paper (Stortingsmelding) in Autumn 2003.

combines two important, but not entirely integrated focus areas of Norway's formative innovation policy.

2.2 Norwegian SMEs and the economy

Table 1, above, illustrates the point that the level of innovative activity in Norwegian industry is moderate. The intensity of innovative activity in general—and formal R&D activity in particular—is influenced by basic features of Norway's industrial demography including its large proportion of small firms and the dominance of services and traditional sectors.

Box 2. Industrial demographics: how many SMEs

Firm-Size: The private sector (130,000 active enterprises) is dominated by small and middle-sized enterprises (96% of the population) with a high proportion of very small firms;
 Industrial-distribution: A large majority of Norwegian enterprises operate in the Services sector (including Wholesale and Retail), while less than 10% are found in Manufacturing. Public administration, defence, and other services such as health and education (but not R&D services) account for a further 10% of Norwegian enterprises.

Table 2. Norwegian enterprises with salaried employees (1998)¹⁰

	# enterprises	% total
MICRO (1-4)	81461	63,2
SMALL (5-49)	33959	26,3
MEDIUM (50-99)	8464	6,5
LARGE (100+)	3718	2,9
UNKNOWN	1290	1
TOTAL	128892	100

Source: Iversen (2001)

So, whereas there are four universities in Norway, there are over 120,000 SMEs in the country. It is obviously impossible to guess how many existing SMEs are potential partners for academic research in Norway. However, it is reasonable to suppose that (i.) the scope for improving the SME-Academic relationship is high but that (ii.) the majority of existing SMEs in Norway are not currently receptive to collaboration with universities. In these cases, the scope for increased partnerships with academic research or research institutes is limited or at best latent.

There are several aspects about individual small and middle-sized enterprises that help shape their potential to link with academic research. The industrial activity in which the SME is engaged in, its life-phase, its propensity to innovate, and, more obliquely, its propensity to patent are all indicative of the potential scope for increased partnerships with academic research. These aspects are briefly considered here.

A breakdown of the Norwegian enterprises according to general industrial activity¹¹ indicates that a large majority of Norwegian enterprises operate in the Services sector (including Wholesale and Retail). Most of these are small firms. Less than 10% of all Norwegian enterprise is found in manufacturing, where larger firms are more predominant. Public administration, defence, and other services such as health and education (but not R&D services) account for a further 10% of Norwegian enterprises.

¹⁰ 1% could not be associated with size-classes. The definition is based on enterprises (foretak) with 100 employees or more. In addition, smaller enterprises are considered large if they have 99 M NOK in annual turnover (an average of 1 million/employee, include 15 establishments, and area registered holding companies (NACE 74150) with at least 30 employees.

¹¹ The enterprise's principal product or service is used to assign an industrial activity. By NACE. Source: AA database. Iversen, 2001.

Box 3. Innovation activity in industry

- Under 50% of Norwegian firms report innovative activity (the lowest reported in the Nordic area)
- Expenditures reported for broader 'innovative activity' (CIS2) are also relatively low in a Nordic and a European perspective. Norwegian expenditures totalled 2.7% of industrial turnover
- Expenditures are highly industry dependent: with Cellulose, business-services, and chemicals all over 5% of turnover (1997)¹²
- Expenditures are highly-size dependent: SMEs estimated at 1.5% of turnover, the largest enterprises (over 500 employees) reporting over 3.5%.

The industrial sector is characterized by low (in Nordic terms) and (as of 1999) relatively stagnate levels of R&D expenditure per capita. This fact is partly accounted for by the industrial structure in Norway. R&D expenditure is relatively evenly spread across R&D intensive sectors. It should also be appreciated that the absence of R&D intensive world leaders in Norway (ie. Very large MNCs in areas such as cars, aeronautics, communications) affects the R&D bottom line.

A follow up question is where new industries will come from. In Norway, it has long been the expressed hope that this renewal will come from academic research that is spun out into the economy in the form of start-ups. Another indicator of academic partnering is therefore the turnover or renewal rate in Norwegian industrial sector. In Norway the turnover rate is relatively high. The registration of companies with tax authorities suggests that as many as 1 out of 10 Norwegian companies (with employment) die every year, while a slightly larger number of companies are established. This large turnover indicates a renewal process where there is potential to improve the role of academic research.

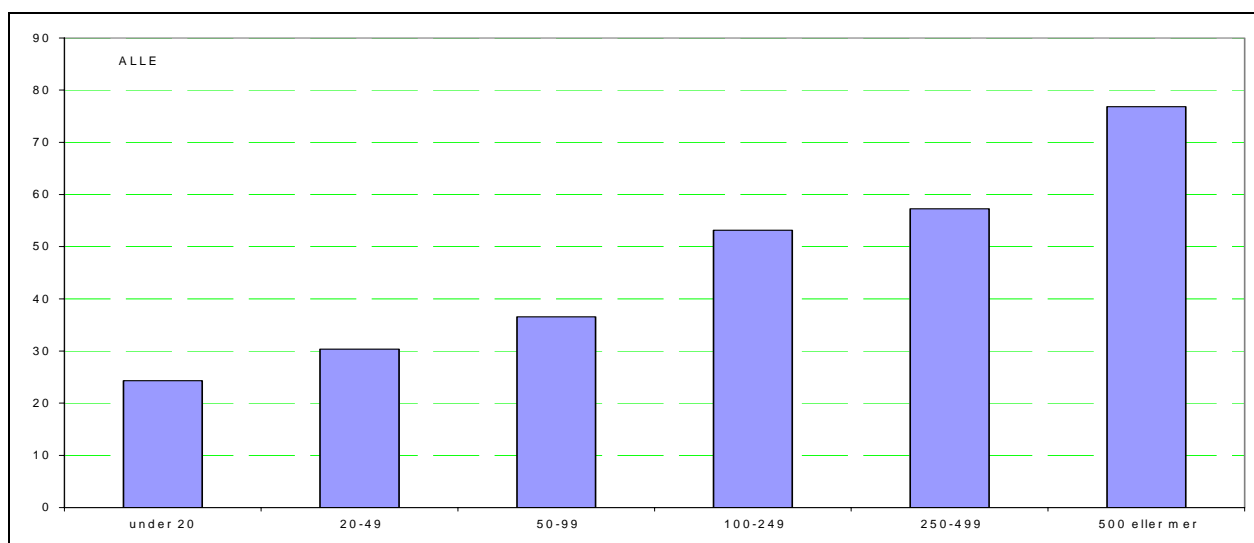
SMEs and R&D Activity

The question of how enterprises innovate is central to their current and potential scope for links with academic research. The results from the pan-European Community Innovation Survey (CIS) demonstrate differences in "innovativeness" among Norwegian firms based on size and industry. The survey suggests some peculiarities about Norwegian enterprises as a population. It also confirms the expectation that the largest firms display a markedly higher propensity to innovate than the smaller.

On average, roughly 80% of the large manufacturing firms in the European Economic Area report that they introduced innovations during the period. Figure 1 indicates that the Norwegian average is slightly below this: 75% of large Norwegian firms registered new or improved products in the period. This is similar to Sweden and Finland for example, and many other European countries. (Eurostat: 24) Another general tendency which Norway follows is that the propensity to innovate falls by size-class. According to the stratified sample of the smallest size-classes, (from 9-20 employees) less than one in three SMEs are innovative.

¹² Cf Braadland et al. Step-report R-01: 2001.

Figure 1: Proportion of Norwegian enterprises reporting innovation activity by size, 1997: Percent.



Source: Braadland et al, 2001.

This impression is consistent with other observations. Based on an earlier Community Innovation Survey (1992), Isaksen & Smith (1997) found that, “the proportion of innovating firms in a size class rises with firm size. Among the firms with less than 10 employees, only 16% engaged in innovation activity, as opposed to 72% for firms with more than 100 employees. This suggests that the scope for increasing activity in SMEs may be large.” (Isaksen & Smith, 1997)

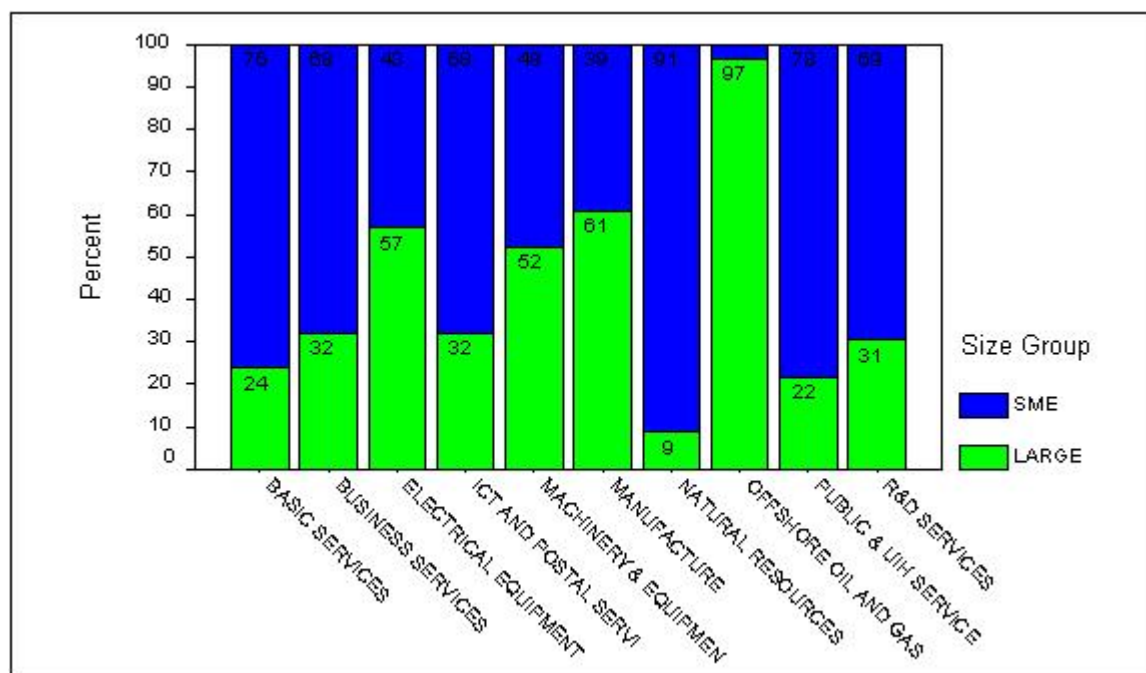
SMEs and patenting

Domestic patent data provides further indication of the formal R&D activities of Norwegian firms in general and SMEs in particular. In general, “innovative” Norwegian firms apply for patents less often than those in any other European country, save Portugal (CIS2). Although this indication is crude (it does not take into consideration industry-effects, etc for the individual countries), it is broadly consistent with anecdotal evidence.

Recent analysis supports the impression that SMEs are considerably less involved in patenting than are larger firms. In relative terms, large Norwegian enterprises apply on average for domestic patents 40 times more often than micro enterprises; 20 times more often than small; and eight times as often as medium-sized enterprises. (Iversen, 2001) In absolute terms, however, roughly the same number of patents is applied for by domestic SMEs (2,571 during the 1990s) as by large domestic companies (2,681).

Figure 2 shows how the product area affects the relative tendency to patent among SMEs. It indicates that SMEs in fields such as basic services and natural resources accounted for disproportionately more applications than larger companies. Note that small entities were also active in R&D services and university sector: especially through research institutes.

Figure 2. Applications by applicant's industry and size-group (n=4,312)



Source: Iversen (2001)

In general, it should also be noted that domestic patenting has risen strongly during the 1990s (VT, 2001). The strongest growth (unadjusted) has in fact been in SME-applications. Encouraging the rise of propensity to utilize the patent system among SMEs is a policy goal. At the end of the decade, policy measures were introduced to reduce the cost of applications especially for small and medium-sized companies.

2.3 Basic Dimensions of academic research

In this context public research organizations play a dominant and changing role in the Norwegian innovation system. There are two peculiarities about this role in terms of how it factors in to university-industry relations in Norway. The first concerns the large sector of specialized research institutes (114) that forms a middle-ground between the public and the private sectors. This sector of diversified research institutes has during the past 50 years or so played important roles in partnerships with SMEs (often facilitated by other policy initiatives). They now constitute an important intermediate space for the commercialization of academic research. However, the institute sector does not form a formal fixture of the academic sector¹³, with the consequence that they can adopt their own rules for the ownership of research results.

Box 4. The public research sector

- Academic research is strongly public, with only isolated examples of relevant privately funded activity (for ex. BI)
- The university sector is concentrated around four public universities
- The population of college consist of a further 6 university-colleges and 26 regional colleges
- In 1999, 9,000 permanent researchers were registered in the Norwegian university sector,¹⁴ 24% of which are professors. (NIFU, 2002)
- The institute sector makes an important element of the Norwegian research environment. The sector is large and relatively decentralized in Norway, with 128 institutes of different descriptions receiving public support and 114 reporting R&D.

¹³ Cf. Law of 12 May, 1995, number 22 concerning Universities and colleges.

¹⁴ Vitenskapelige og faglige personalet. Note that these include salaried PhD students.

The second observation concerns the university sector. The academic sector falls into four general categories: universities (4), public university colleges (26), schools of higher learning (6) and private university colleges (21).¹⁵ The four (current) universities¹⁶ form the centerpiece of the academic system, both in terms of research and teaching.¹⁷ The university sector is peculiar in that it concentrates large R&D expenditure among a small set of large institutions. The combined R&D expenditure and employment of the four state universities alone account for 23% of the country's total, which is roughly equal to industry and mining together.

The university sector is also overwhelmingly public, and the public universities and colleges having a common-organ, the Norwegian council for higher education (Universitets- og høyskolerådet). Again, the majority of research activity today is concentrated into a small minority of the 57 institutions, with only a few current exceptions among private colleges. However, the university sector continues to experience a period of reshuffling and consolidation, a tendency also found in the institute sector. During the mid-1990s, over 90 regional colleges were consolidated into the current 26 state 'høyskoler'. Whereas the state universities are all, to different degrees, research-performing public institutions, this is not the case for the colleges. Many are principally teaching centers and currently perform little research. According to the R&D survey (NIFU/SSB) six of these perform less than 10 million NOK of 'research', while only three report R&D expenditures in excess of 50 million NOK. There is a further set of six schools of higher learning.¹⁸ At least two of these actively collaborate with the private sector on R&D projects: one actively is associated with a research park.

In this process, an instrumental change in our context is that the mandate for academic institutions has recently been adapted. Proposition 40: (2001-2002): § 2 nr. 4 effectively extends the mandate for academic institutions to include a dissemination of scientific methods and results to the wider society including public administration and, more to the point, the business sector. In the changing situation, all entities are focusing harder on building up their research capabilities and reputations, not least through public support initiatives. Perhaps the best indication of existing or nascent research capabilities is that sixteen academic institutions currently have formal liaisons with FORNY, the publicly-financed program designed to facilitate the commercialization of research activities.

3 Public R&D System Structure

In the interest of cross-country comparison, certain structural aspects of the Norwegian innovation system should be highlighted. The organizational structure of what can be called the innovation infrastructure of Norway is depicted in the policy-centered organisational map of the Norwegian system of innovation, found in the annex. With reference to this figure, six functions that take place within the frame of the innovation infrastructure can be distinguished. These include policy formulation and coordination, the instrumental support structure (of R&D), and the performance of R&D (the university sector, the institute sector, and the private sector generally). Whereas the latter was presented in section 2, the first two aspects will be reviewed in this section as they reflect on the U-SME relationship.

¹⁵ The NSD translation.

¹⁶ These universities are the Norwegian University of Science and Technology (Trondheim), the University of Bergen, University of Oslo, and the University of Tromsø.

¹⁷ The University of Oslo is the largest, and its growth is indicative of the changing university sector. It has 32,000 students and 4,500 employees spread in eight divisions. (2000) The volume of PhD students has more than quintupled since 1990, to over 1500. The number of fellowships has tripled.

¹⁸ "Vitenskapelige høyskoler": These include the Agricultural University of Norway, Norwegian College of Veterinary Medicine, Norwegian College of Physical Education and Sport, Norwegian School of Economics and Business Administration (private), Norwegian State Academy of Music, and the Oslo College of Architecture.

3.1 Policy formulation and coordination: regulatory factors shaping U-SME interaction

The principal elements of the policy framework that bear on the university-industry relations are rooted in the Ministry of Trade and Industry (NHD) and the Ministry of Education and Research (UFD). These ministries, and their affiliated agencies, reflect either side of the U-SME relationship. The Ministry of Local Government and Regional Development (KRD) also plays a supporting role in our context since the U-SME relationship has an important regional dimension in Norway. The regional dimension is important as both the university-colleges and the SME sector are well represented in the districts: promoting dynamics among them is therefore seen as important to regional development.

The NHD is responsible for SME policy. In fact, a titular objective of the Ministry of Industry and Trade¹⁹ is to improve the lot of SMEs. In 2001, this activity resulted in an Action Plan for Small Companies²⁰ with the explicit goal of stimulating research, competence-building, and innovation collaboration in small firms. (viz. Action Plan, 4.2) More instrumentally, it is completely or significantly responsible for several central agencies, including major responsibility for the Research Council, the Industrial and Regional Development Fund (SND) the National Advisory Office for Inventors (SVO), the Trade Council, and the Patent Office. Moreover, NHD is also the center of technology policy in the country and a lead actor in the drive towards an integrated innovation policy. It has sponsored several select-committees to develop relevant policy-initiatives, including the Hervik-Committee.

The Ministry of Education and Research (UFD) represents the academic research side of the equation. The UFD holds responsibility for the university sector. The university sector is still in the midst of a process of transformation and consolidation.²¹ In this process, the legal status of institutions of higher learning is currently under review.²² In addition to general responsibility for the university sector, UFD contributes substantial funding to the Norwegian Research Council, and is currently active in contributing to shape Norway's integrated innovation policy. More to the point in the present context, UFD has had active responsibility both in the proposition to extend to extend the role of universities to promote the application of their research to wider society— especially industry²³; and the proposition changing the title/ownership to university research results²⁴. During the late 1990s, UFD sponsored a set of instrumental select-committees on commercialization of academic research issues (principally Bernt²⁵ and Ringnes²⁶ Committees) which ultimately led to the new legislation.²⁷

¹⁹ “The prime responsibility of the Ministry of Trade and Industry is to create a proper framework for Norwegian industry, the business community and the SMEs, to be innovative and competitive within the global knowledge economy.”

²⁰ See <http://odin.dep.no/nhd/norsk/publ/handlingsplaner/024071-990013/index-dok000-b-f-a.html>

²¹ This process started in the mid-1990s when 98 regional colleges were consolidated into 26 at present: some of which eventually hope to join the four current universities.

²² Ryssdal Select committee (December 2002) forthcoming in September 2003: this Greenbook will propose ways to harmonize the legal status of private and public institutions of higher learning. Implications for the way the state can influence/control these institutions. Discussion of the legal status of these institutions, with ramifications for the autonomy of the institutions involved

²³ Amendment of the University law (UFD- Ot.prp. 40(2001-2002)

²⁴ Amendment to Employment law (UFD - Ot.prp. nr. 67 (2001-2002)

²⁵ Bernt-utvalget (NOU 2001: From Insight to Industry: commercialization of research results from universities and colleges (“Fra innsikt til industri: kommersialisering av forskningsresultater ved universiteter og høyskoler”).

²⁶ “IPR-Committee”, on specific legal considerations of changing IP title at universities.

²⁷ See St. meld. nr. 39 (1998 -99) Forsking ved et tidsskille. See also Mjøs-utvalgets innstilling, NOU 2000: 14 Frihet med ansvar, Om høyere utdanning og forskning i Norge; St.meld. nr. 27 (2000-2001) Gjør din plikt - Krev din rett, Kvalitetsreform av høyere utdanning, and St.meld. nr. 35 (2001-2002) Kvalitetsreformen Om rekruttering til undervisnings- og forskerstillingen i universitets- og høyskolesektoren.

Major issues and directions in the policy-discussion

The White-Paper (UFD - Ot.prp. nr. 67 (2001-2002)) sums up many of the issues that have been raised in recent discussions about commercializing academic research in Norway.²⁸ This discussion has featured such topics as the changing boundaries between public and private knowledge, as well as the emergence of hybrid knowledge-based networks that source and exploit knowledge in entirely novel ways. The discussion has often explicitly been taken from international sources, in which references to adaptations in the US have been prominent but not exclusive (on Bayh-Dole, cf. Mowery et al.). There has been a notable recognition of the applicability of the experience of other Nordic countries.

The focus is however geared to national policy considerations. The discussion notes that public investments in research and education are high (see below) and takes the position that the research results of the country's academic institutions hold unrealized potential for application in industry. It makes the industrial transformation argument, saying that increasing the application of academic research can help develop the sustainable activities that can help reduce dependency on oil. In this context, the policy intention is to improve the conditions for knowledge/research-based industry, and to strengthen knowledge transfer.²⁹

The legal amendment hopes to increase commercial utilization of academy-based inventions. An important point is that it intends to do so while maintaining the academy's traditional goals, namely free-research and higher education. In fact, its intention is to strengthen the traditional goal of universities in spreading research results to society. To do so, the amendment substantially readdresses the role of academic research. It widens the interpretation of the university sector's obligation to disseminate research results³⁰ to include commercialization as a channel for such dissemination. In order to do this the amendment changes the right to industrial application/commercialization of 'inventions' formally from the researcher to the university sector institution.

The amendment is designed to confront the researcher with a clearer choice whether an invention should be patented as well published (or in addition to publication: see case 3). This intention is based on the perceived need to increase knowledge transfer between academy and industry, and thus provide society as a whole with more of the returns from the activities of universities and colleges. In this context, the White-Paper points out that this is not only a job for the researchers themselves, nor only for their faculties or universities. It is also a job for industry. This is also an important implication: the amendment places responsibility on Norwegian companies to utilize and further develop new knowledge from the university sector. It emphasizes that the active participation of the institutions in the commercialization is important, as is the adaptation of the legal and regulatory framework to facilitate this.

Several currents of the previous policy discussion³¹ are reflected to varying degrees in the new regulation. These include that:

- commercialization should be seen as part of the university's obligation to spread knowledge

²⁸ These discussions have included theoretical and policy discussions, and ranged from public documents, research reports, letters to the editor and conference activity. It became especially active from about the mid-1990s. See references for important components of this discussion.

²⁹ The White Paper cites that only about a fifth of the 4.4. BNOK of R&D services involved public research organization.

³⁰ Universitets og høyskolelov: §2.

³¹ Most notably: St. meld. nr 39 (1998-99) Forskning ved et tidsskille. (The Research White Paper),

- academic institutions should be positive to commercialization
- academic institutions ought to have a professional apparatus to promote commercialization: There is a need for intra mural support structures to promote better commercial application of patentable inventions.
- The researcher and the institution should have a right to share equitably in potential profits arising from commercialization³²
- The researcher should maintain the right to publish
- Commercialization should not undermine the long-term goals of the university
- The research and the wider research community decide what to research and how, and how the results should be presented.
- Any “added value” from commercialization should not be used to finance other aspects of the institution’s activities would be seen as principally suspicious.
- And, that other arrangements can be made on a bilateral basis between institution and researcher.

The change introduces new obligations on the researcher and the university sector institution. In the new environment, researchers are obligated to orient the university about results with potential industrial application. (‘notification obligation’) An obligation has been created at university sector institutions for active engagement in commercialization. The changing regime raises new questions and challenges. These include:

- The question of the right to publish, and who has responsibility in cases where more than one researcher is involved.
- The need to develop strategies whereby the researcher is able/encouraged to participate in commercializing (‘working’) the invention.
- How to introduce the obligation to notify on researchers who are not principally aware of, nor sensitized to what is patentable etc.
- The importance of introducing necessity that it act as the researcher’s partner not opponent
- The need to better understand the empirical effect of the changing regime.

3.2 The support-structure: Institutional factors shaping the U-SME link

The operative agents and agencies at the level beneath the ministries are instrumental in our context. Over time, the support structure has developed a set of institutions, programs and services that are designed to promote greater societal benefits (especially economical) from academic research. The support structure basically combines funding with advice. It includes the public and semi-public agencies, research parks and incubators, venture capitalists, etc. The functional division of labor of this support-structure can be broken down into financing and advisory agencies and their programs, the organization of research parks and incubators, as well as important basic agencies like the Norwegian Patent Office.

Public Financing and advisory agencies

The financing and advisory agencies immediately beneath the ministries are centerpieces of the Norwegian System of Innovation. The two main national bodies, which are designed to fill complementary roles, are the Research Council (NFR) and the Industrial and Regional Development Fund (SND). These are major institutions that provide funding and advisory services for start-ups, existing enterprises as well as university and institutionally-based research. They are central to the public-efforts to support new knowledge in Norway, and their networks

³² The provision of a ‘reasonable compensation’ (in the Arbeidstakeroppfinnelsesloven i lov av 17.april 1970 nr.21: § 7) has been interpreted to mean a 3 way split of equal amounts to the researcher, his institute and the university. (with reference to the University of Copenhagen)

shoot through the rest of the system. Both NFR and SND target SMEs in their research programs. Direct policy measures that involve the U-SME relationship are rooted in these two agencies. They (co)sponsor the two pillars of the policy-initiatives directed at academic research and SMEs: namely MOBI and FORNY. (see the policy-instruments section below)

The Research Council is a central funding agency both for university and private-sector research. Although its role in promoting the generation of new knowledge may be considerable, its direct role in the IP-system is much less pronounced. The number of patents reported on research funded by the Industry and Energy section of NFR grew rapidly in 2000. The raw applications jumped 120% from a cumulative total of 92 in the period till 1999, to 201 in 2000. Through its programs, the Research Council emphasizes the commercialization of research results. It is a cosponsor and the coordinator of the FORNY program (with SND), which is the spearhead of Norway's efforts to promote the commercialization of academic research.

The Industrial and Regional Development Fund (SND), which is undergoing a reorientation today, is the mainstay of Norwegian public funding for industrial development. It was established in 1993 on the basis of several previous funds, including the Small-Firm fund (Småbedriftsfondet). The SND offers enterprises and independent agents an array of instruments, which, in sum, combine funding and advisory services. Support is offered on a general basis both to entrepreneurs involved in starting up a new enterprise or to those developing an existence enterprise. Proposals that involve innovation, competence building, environment, and internationalization are especially welcomed. This role is supplemented by the Industrial Development Corporation. (SIVA) In 2001 SND's Entrepreneurship Center reported that, of SND's 16,000 users nationally, 90% are small and medium-sized enterprises. In general, about a tenth of the small firms themselves have integrated patenting into their business strategies. SND provides advice to applicants on intellectual property rights and hosts a set of relevant instruments.³³

There is also a set of much smaller organizations with more specific mandates and lesser public funding. Several of the agencies are spread throughout the country, especially in the larger cities. For example, SND has regional offices and is developing a local presence in the districts as well (Fylker). Here we can highlight the National Advisory Office for Inventors (SVO). National Advisory Office for Inventors offers a range of services, from the preliminary evaluation of the inventor's idea, to market surveys; from help in navigating the public support system, to help in locating partners. It receives on the order of 1000 applications per year, of which roughly half are considered more closely. Between 100 and 150 of these projects are then pursued. This means that its role is in many cases primarily advisory rather than financial. Only a small percentage of these (under 5%) can be traced directly to the university sector.

Publicly funded Investment Companies

A current tendency in the Norwegian national system is the attempt to marry public and private capital to promote start-ups or fledgling enterprises. These cater specifically to knowledge-based companies at early phase, when IP strategy is most important. The START-Fund (<http://www.startfondet.no/about/>) is the result of a relatively recent joint initiative between public and private interests. The Fund is a registered company (ASA) that provides risk-capital and advisory services to start-up companies. The Fund's capital-base is relatively large (compare that of SVO) at NOK 320 million, half of which is financed by private investors and half through guaranteed loans from the SND. Today it has 18 shareholders. Like many venture companies, it targets companies in rapidly changing areas with international growth potential, especially biotech

³³ See section 3.2: these include the OFU/IFU-ordningen, Start-up with new technology (ENT), NT, FRAM, BIT, Kultur og næring, Regional omstilling. It is also a co-sponsor of the FORNY program.

and ICT start-ups. However, its focus group is somewhat wider than that, and it opens for a, “wide variety of profitable, competence-based companies capable of creating value in Norway.”³⁴ Argentum is fund for risk-tolerant investment company co-owned by SIVA and SND. Its public endowment is of the order of 2.45 Billion NOK. This investment fund will be independent, and more than 50% of its stock will be privately held. Its intention is to provide longer-term financing for innovative companies. The new company is apparently not directed at startups, although it is not immediately clear how it will in practice complement existing range of (semi-) public activity designed at financing and advising innovative activity in the private sector.

Research Parks and affiliated incubators

The Corporation for Industrial Growth (SIVA) is a state-owned, independently operated innovation hub with a long and varied history. The 60 innovation centers that SIVA is involved in are designed to bring together commercial, financial, and R&D. These include the build up of 12 research parks from the mid 1980s until today. (<http://www.fin.no>) Norwegian research parks offer a range of services offer seed-capital, research facilities, and advisory services, especially concerning licensing. They are partially publicly supported especially to promote the commercialization of university-based research. The FORNY Program, administered by the Research Council, funds eight research parks in different parts of the country.

Norwegian Patent Office (NPO)

In Norway, the Norwegian Patent Office (NPO) is in many cases the first point of contact between the SMEs and the IP-system. The NPO is an agency under the Ministry of Trade and Industry with responsibility for patents, design, and trademarks/collective rights. It administers the application and grant processes for these rights, and it is responsible for their publication as well. In order to encourage smaller enterprises to patent the Ministry reduced of application fees in 2000.³⁵ This measure stipulates a 20% reduction in the application fee (to NOK 800) for enterprises of 20 employees or less, including independent applicants.³⁶ In addition, this applicant group will be exempt from the examination fee (NOK 2000) that was recently implemented. The examination-fee will affect medium-sized companies, but will be refunded in all cases should the application be withdrawn.

A changing environment

The innovation infrastructure is currently undergoing a series of important changes that will have significant consequences for the way U-SME relationships are promoted. The move towards an “Integrated Innovation Policy” already mentioned involves several of the ministries and their agencies, principally the Ministry of Industry and Trade (NHD)³⁷ There are several agencies that are instrumental to the commercialization of academic research that are involved in this process of consolidation: these include the Research Council (NRC), the Industrial and Regional Development Fund (SND), National Advisory Office for Inventors (SVO), and the Trade Council.³⁸ According to recent reports, the latter three agencies are to be merged into a single innovation and internationalization entity that will “make it easier for entrepreneurs.” (DN, 28.03.03: Gjør det lettere for gründere)

³⁴ see <http://www.startfondet.no/english/>

³⁵ kgl.res. 7 april 2000 for endring av forskrift vedrørende avgifter for Patetstyret

³⁶ The majority of applicants, see below. Note that the fee-schedule for patent applications has been considerably lower than, say, the Danish. In the new system, the combination of the application and the examination fee will, for large enterprises rise to NOK, which is the on par with the Danish. The combined fee for small and independent applicants will at the same time sink to NOK 800.

³⁷ Cf. <http://odin.dep.no/nhd/norsk/p30000694/index-b-n-a.html> for a status report.

³⁸ Note the Trade Council’s activity related to the commercialization of academic research.

3.3. Policy initiatives to stimulate commercialization of research results

In Norway, an array of policy instruments affects SME-university interactions more or less directly. The intention, the effect, and the sponsorship of these mechanisms—and their associated infrastructure—are quite diverse. This section takes stock of the mechanisms that most deeply, as well as most directly affect SME-university interaction. Three levels of the policy architecture are distinguished: general structural measures that make up the substantial foundation for U-SME interaction, the two specific initiatives that constitute the pillars to promote increased U-SME cooperation. These complement the formative mechanisms in the institutions themselves, which constitute one of the main areas for current policy concern.

Structural measures to adapt academic research to commercial needs: Foundations

Several broad aspects of the Norwegian Innovation system effectively lay the foundation for academy-industry relationships. Three general elements of the Norwegian architecture presented in the institutional-factors section (2.2), are emphasized here.

A principal corner-stone of the U-I relationship is Norway's particularly large institute sector. The Norwegian institute sector³⁹ is very broad and diverse, with over 100 institutions reporting R&D activity. Beginning in the post-war era, the build-up of this unique institute-sector can be seen as a policy-measure designed to promote and guide industrial-renewal by linking to the activities of public research organizations to traditional enterprises.⁴⁰ Today, public research organizations are increasingly developing its own technology-transfer activities (cf. SINVENT AS, 215 MNOK in turnover) and/or utilizing the support structure offices (FORNY)

A second corner-stone is the changing public funding-environment. One dimension, already emphasized, is the current primacy of the two principal funding agencies: the Research Council (NFR) and the SND. These central funding agencies together provide the basis for the two central pillars for supporting SME-academy interaction in Norway. (MOBI and FORNY: see below) Another dimension to highlight here involves the changes in the funding environment over the years which have brought academic and private-sector research together both as collaborators but also as competitors. This includes direct and indirect encouragement to collaborate (and compete) with industry research. This also involves explicit encouragement for Norwegian participants to participate in EU Framework projects, where innovation among SMEs is emphasized.

A third measure that provides the basis for U-SME collaboration is the build up of research parks, incubators, and business parks. This build up began during the mid-1980s under the auspices of SIVA (Corporation for Industrial Growth). The research parks (and aligned incubators) are located near central public research organizations. Norwegian research parks offer a range of services, including in some cases seed-capital, research facilities, and advisory services, especially concerning licensing. They are partially public supported especially to promote the commercialization of university-based research. SIVA is involved in 40 business parks. 12 of

³⁹ A total of 128 institutes of different descriptions receive public support. According to the R&D Survey (above), 114 conducted formal R&D. Eight institutes are research laboratories or agencies are operated and fully funded by the government. The majority are research organizations that receive a significant share of their total funding from public sources. Many of the others are small stand alone entities, although several are large even in European comparisons. Two of the large entities have several affiliated organizations which might be companies with majority control residing with the parent organizations. Many increasingly have significant private funding and look upon themselves as free-agents (not 'public').

⁴⁰ Sintef is an early, and very large example. It was built up to promote links with the private sector early in the post war technocratic environment. The original premise can be characterized by a technology push policy, where large existing companies were targeted for renewal. It originally had and continues to have expressed links with NTH (now NTNU).

which are ‘research parks’, with partial FORNY funding. Proximity, supported by conditions for localization, are designed to promote U-SME relations.

Specific strategic initiatives of the U-SME relationship: Pillars

In terms of specific initiatives, there are two major bridge-heads for the relationship between university research and SMEs: MOBI (proposed budget for 2003, 26 MNOK) and FORNY (proposed budget for 2003, 15 MNOK). Focus on SMEs has traditionally been trained on improving receptiveness to new technologies. There is a continuing legacy to promote links between SMEs and competencies in public research organizations. (cf. Bridge, Teft, Bunt) These are being continued in the comprehensive MOBI program. More recently, the policy focus has turned towards crystallizing new companies and/or promoting licensing from public research organizations. An extensive set of research parks/incubators have been set up during the 1990s. Since the mid-1990s, the focus has moved more expressly to the commercialization of public-supported research. The FORNY program, which is a joint venture between the two central support-agencies in Norway, has developed a regional net of technology transfer offices within existing research parks.

The MOBI (“Mobilizing R&D related innovation”) program explicitly targets SMEs and involves initiatives to promote collaboration with R&D centers, not least universities and regional colleges. MOBI was originally known as BRIDGE (BRO), “Bridging the gap between Industry and Research”. The change of name from BRIDGE to MOBI signals a changing orientation for this program, although it maintains its SME focus, its regional presence (TEFT attaches), and its attempt to coordinate different initiatives in the innovation system. The MOBI program has long been the mainstay for the relationship between university research and SMEs. This program has a long tradition, tracing beyond BRIDGE (1998-2001) to policy initiatives from the 1980s that focused on the absorptive capabilities of small firms.⁴¹

MOBI’s current portfolio includes measures to promote technology transfer between research-institutes and SMEs (TEFT), measures to promote mobility between (regional) colleges and SMEs, as well as more general measures to improve the position of colleges in regional clusters:

- TEFT: “Technology-transfer from research-institutes to SMEs (Teknologiformidling fra forskningsinstitutter til små og mellomstore bedrifter)⁴²
- College-based initiatives with commercial target: (Næringsrettet Høgskolesatsing – nHS) Cooperation between SMEs and state colleges
- SME-College (SMB-H) – to strengthen state colleges and their contribution to regional innovation (see also SME Competence)
- Regional Innovation Regionale Innovasjonspiloter: a joint venture between NRC and SND. Instruments contribute to building regional innovation-systems and clusters.
- The publication of SMB-revyen. (since 1993) about cases of SMEs who have received support.

The focal point of Norway’s commercialization of academic research activity efforts is the FORNY Program (FORskningsbasert NYskaping: “Research-Based innovation and start-ups”). FORNY (=Renew) represents a cooperative effort between SND and NFR. It was originally part

⁴¹ MOBI’s legacy reaches back to the 1980s (cf. TEKNOVE), when KRD (at the time Kommunaldepartementet) initiated links between the research system and regional SMEs. Regional research foundations and competence systems were set up. Programs in the late 1980s included SMB-T, Idesøk, Verkstedprogrammet i Nord-Norge, SMB-U, NT-programmet, and BUNT osv. This involved public support initiatives designed to provide firms with advisory services and to improve their knowledge capacities.

⁴² For an assessment of TEFT, see Remøe (1998).

of the BRIDGE umbrella of measures and it links relevant commercialization efforts (funding and advice) to activities found in existing regional research parks.

FORNY was established (1995⁴³) with the objective of stimulating public research organizations (the university sector as well as institute sector) to greater value-creation in Norway in the form of start-ups/spin-offs and licensing arrangements with industry, irrespective of company-size. The FORNY program promotes (and assists) the generation of new ideas in university sector institutions, it helps the research explore the marketability of the idea, and it assists during commercialization through its technology transfer offices.

The program was originally intended to become self-financing already in its fifth year. This intention turned out to be unrealistic⁴⁴, as previous experiences in other countries would suggest. It provides resources to promote technology transfer advisory functions at public research organizations (infrastrukturmidler) in general as well as providing financial support to the commercialization of individual ideas from the university sector. (incentivmidler: NOK 200.000) In its second iteration, FORNY II (2002-2009) has been strengthened. Since the regulatory changes, it has become the signal-bearer for increased commercialization from the university sector. The FORNY budget has been increased for fiscal 2003 including funds earmarked to aid universities in improving organizations for the new law. The current FORNY program has subsumed the program of Industrial development from Medical Research (2002) and has generally increased attention to biotechnological research. It is currently planning to expand operations to supporting the commercialization of R&D from public and private companies.

Other initiatives that target relevant issues: Buttresses

FORNY and MOBI therefore are intended to come at the U-SME relationship from the two ends: FORNY in funding the establishment of spin-offs or start-ups based on academic research and MOBI on existing SMEs. In addition, these funding are designed to complement a list of other public financing instruments supporting different phases of newly established or establishing companies, not least that of the seed-capital/risk capital funds. (cf. above)

A set of other instruments also provide significant support to improving U-SME collaboration. In the SND:

- New bonus support for entrepreneurs targeting public research organizations (PROs) in the areas of Marine Biotechnology and biochemical engineering. (linked to FORNY) (total 1 MNOK)
- Innovation and technology-program in Northern Norway (Nyskappings- og Teknologiprogrammet i Nord-Norge: NT-programmet) 'to contribute to increased innovation in new and existing technology companies in Northern Norway.' (24 MNOK in 2003) Including fellowships to link University sector researcher to SMEs.
- Public Research and Development Contracts (OFU) and Industry Research and Development Contracts (IFU) support R&D collaboration with public sector and private sector entities respectively.
- VINN is a private consulting and contract R & D institute supported by SND that offers services in the fields of technology, competence and information for industry and the public sector.
- InnoMed: National Center for innovation support and industrial development in the Health Sciences.⁴⁵ This regional network is based in large public research organizations (Sintef

⁴³ Initiated by NFR and SND, its original funding (95million) came from NFR, SND, KAD, NHD.

⁴⁴ In 1997, royalties were at about 3 MNOK. See Hervik et al.

⁴⁵ Nasjonalt senter for innovasjonsbistand og næringsutvikling i helsesektoren

Unimed, Medinnova, Norut Medisin og Helse). It is designed to focus and coordinate research in order to adapt solutions for the (public) procurement of health sector. It provides testing services, facilitates contact, and acts as a coordinating device to the public financing of relevant projects (from SND, Eksportråd, NRC, SVO).

- Medinnova SF (est. 1986) to coordinate U-I collaborations involving the national hospital, Rikshospitalet. It presents itself (<http://www.medinnova.no/norsk.htm>) as bridge-builder between research and commercialization of healthcare technologies, and offers a range of services under the headings of technology transfer (Assessment of market and commercial potential, Intellectual property rights, Product development, Partnering, Management of licensing deals, Formation of companies, Business plan development), research collaboration (“Medinnova promotes and administers all kinds of research collaboration like clinical research, laboratory research and animal experiments”), funding administration, and networking and links.
- SIMULA Research Laboratory (est 2001): Adapting ‘basic research’ in information and communication technologies to business ideas. Pledges of public funding totalling 250 MNOK for a five-year period. One of its areas of activities is an organizational model (EFFEKT) for the commercialization among public research organizations.
- The Business at School Initiatives (Næringsliv i Skolen) involving the confederation of companies (NHO), universities and public and private sponsors. This is an umbrella for a variety of initiatives including Gründerskolen ("Gründerskolen", a nationally recognized course in entrepreneurship (10 credits), Young Leadership (Ungt Entreprenørskap), and Venture Cup, a competition in designing a business-plan.

4 Case studies and existing academy-industry link indicators

This section addresses the difficulty in collecting reliable information about the current degree and extent of the relationship between academic research and small and middle-sized enterprises in Norway. We collect existing empirical evidence about academy-industry links. Then four case-studies are surveyed in order to identify current concerns and problems in the U-SME relationship

4.1 Existing empirical evidence

The ability to identify university-industry interaction, for example through patent data, has until now been severely limited. In fact, the virtual invisibility of academic patents in the patent record is one of the byproducts of the teacher’s exception clause. In cases where inventors have been entitled to all rights from their research, their contribution to commercializable results remains an unknown.

Evidence from Patent Data

Given this situation, Table 5 attempts to identify academic patents by using information in the names and addresses of applicants in domestic Norwegian patents during the 1990s. This gives a preliminary (=incomplete) sketch of patenting activity at some research parks (the research park is listed as an applicant) and (more incomplete) of universities.⁴⁶ This first look indicates a lower bound of 129 patents, suggesting that at least 1% of Norwegian patents involve the university sector and/or companies at research parks. The major lesson is that reliable information is lacking about current and past academic patenting and that it should be improved in light of the changing regulatory environment.

⁴⁶ The patenting of other public research organizations are indicated here, and can be verified using records kept by NIFU.

Table 5: Norwegian patent applications (1990s) by type of applicant (N=12,852)

APPLICANT IDENTIFIERS	Total
BANKS	2
COMPANIES	3658
CO-OPS ETC	35
CORPORATIONS	2067
GOVERNMENT	7
INDIVIDUAL	6692
INSTITUTES AND FOUNDATIONS	207
IP PROFESSIONALS	34
PUBLIC CORPORATIONS	21
RESEARCH PARKS	89
UNIVERSITIES	40
Grand Total	12852

Source: SINTEF-STEP

Evidence from Research Parks

Table 6 provides an additional indication of the interface between university research and new firms, by enumerating firms located at established research parks in 2000. The firms are all SMEs, although not all are necessarily research oriented let alone products of nearby academic research institutions. However, it is fair assumption that a majority are research oriented and benefit specifically from proximity to university research environments.⁴⁷

Table 6: Number of active companies in 7 research parks, 2000. (N=236)

Research Park	Total
OSLO RESEARCH PARK LTD	55
TROMSØ RESEARCH PARK LTD	19
BIOPARKEN LTD	19
BERGEN HIGH-TECHNOLOGY CENTER, (SARSIA INNOVATION AS)	18
LEIF ERIKSSON NYFOTEK LTD, TRONDHEIM	26
ROGALAND SCIENCE PARK, ROGALAND	47
CAMPUS KJELLER LTD	15
TRONDHEIM INNOVATION CENTRE LTD. (TECHNOSTALLEN AS)	37
Grand Total	236

Source: SINTEF/Thomas Halvorsen

The activity reflected by research parks is high, a fact that comes through in the OECD survey below where the number of spin-offs is uncommonly high. Another indication of research park activity (which is also a reflection of colleges trying to establish themselves as university candidates) is that they continue to multiply: Today, there are twelve research parks, including Lillehammer Knowledge Park Ltd., Sørlandets Teknologisenter Ltd., IT Fornebu, Research Park, Narvik.

Evidence from the FORNY Program

The instrumental FORNY program, which is one of two policy-instrumental pillars promoting U-SME relations in Norway, also provides valuable insight into the current extent and depth of the link. The FORNY offices are located in the research parks, so that their reports can be read in light of the above. In its first manifestation, FORNY reported a total budget of 178 MNOK for the period 1995-2000. For the same period the program reports involvement in approximately 1,500

⁴⁷ For a survey of the economic viability of firms, see Halvorsen, 2001.

business ideas. Of these, 232 were reported to have been commercialized: about 130 through spinoffs/startups and over 100 license-arrangements.⁴⁸ This would tend to indicate, assuming that start-ups do locate at the research parks, which between approximately half of the tenants at the research parks represent a founding link with universities.

One relevant example is Leif Eiriksson Nyfotek (LEN), which caters to the environment surrounding the Technical University and SINTEF in Trondheim. It promotes licensing of the ideas from universities and institutes in Middle Norway. In addition, it claims (2000, interview) to have spun off roughly 40 companies, of which seven involved patents.

Evidence from a recent OECD survey

The picture of U-SME interaction in Norway has been significantly improved by a survey recently conducted as a part of the OECD study on *The Strategic Use of Intellectual Property By Public Research Organisations in OECD Countries*⁴⁹. The survey covered a total of 34 offices involved in some form of commercialization of results from public research organizations.⁵⁰

This study confirms that technology transfer and IP management remain relatively informal in Norway. Few of the offices had more than one full time employee, suggesting that (as of 2001) a total of 38 man-years (i.e. fulltime equivalents) are devoted to technology transfer activities in Norway. In most cases technology transfer is not a formalized role (consisting of an office or division) of Norwegian public research organizations. Only one in five respondents reported being dedicated to the technology transfer from/to his host public research organization. Universities and colleges, including university hospitals, figure prominently as the home of research in question.

Much of the technology transfer activity in Norway is involved in research agreements with firms. Only a little over half of the technology transfer offices apply for patents. In most reported cases the institution retains some ownership claims, while in half the reported cases so does the researcher. In about a forty percent of the cases the funder and/or the government is said to hold rights. The respondents represent different size-classes of R&D activity as measured by expenditure.

In terms of patenting and licensing at Norwegian Public research organizations, one third of the actors report having active patent portfolios. These portfolios range in size from 1 to 34 patents in all, yielding a total of 114 patents reported to be in force. Twenty-eight patents were granted (mostly in Norway) in the previous year, while ten respondents reported applying for a total of 43 patents in that same year.

Table 7. PRO patent applications in 2001: technical orientation (N=43)

recent applications	Number	%
Health/pharmaceuticals	5	11,6
Food/Agro industry	7	16,3
IT, electronics, instruments	6	14,0
Production technology, new materials	10	23,3
Energy, environment, transportation	14	32,6

⁴⁸ FORNY's objectives for 2002, include identifying 300 research-based commercial ideas, 50 licenses or start-ups. FORNY estimates that this would generate 400 MNOK in the form of turn-over, R&D expenditure, and sale of startups or licenses.

⁴⁹ DSTI/STP(2002)42/Rev1

⁵⁰ That is: research performing universities, research laboratories and other research organisations that receive a significant share of their total funding from public sources.

Fishing technology	1	2,3
Total	43	100,0

Source: Iversen (2002)

Licensing activity was modest. Twenty-two licenses were granted in the previous year (2001) Mostly on the basis of some sort of exclusivity. The important aspect to note in our context is that most licensing activity involved “SMEs”.⁵¹ Fourteen were licensed to this size-class while 8 licenses were granted to larger firms. Licensees were both foreign and domestic.

A considerable number of spin-offs and start-ups were reported to be generated by a small number of respondents. Six respondents report the generation of a total of 39 spin-offs and 28 start-ups were reported by 11 respondents. (these may overlap) This result is comparatively high in the OECD survey. Since both Public research organizations and technology transfer offices involved in more than one PRO were both questioned, some of these might be double-counts.

4.2 Four illustrative cases

Four cases were chosen to illustrate different aspects of the SME-university sector relationship in Norway, and the involvement of the support structure. The four cases are taken from four different regional and academic environments. Three of the cases are associated with universities (Oslo, Trondheim, Bergen) while the other came out of a degree project from one of the university-colleges. The initial and the continual involvement of the academic institution(s) vary as to level and intensity. In addition to a degree project in which the advisor is co-submitter of the patent, (case 2) the cases include situations in which the founder no longer works in the academic institution but maintains active links to universities via a scientific board (case 1), in which the professor has reduced his work-load at the university to lead the company while recruiting actively from the university, (case 3) and in which different professors have maintained their post while working at the company.(case 4)

CASE 1: A start-up based on degree-project at science-college

Basics: Case 1 illustrates an attempt by a graduate student to commercialize on the basis of a degree-project at a science college. The company is developing a method to remove predators from shellfish sea-farms involving an environmentally-friendly coating. The company was established 2000 upon completion of degree at the Agricultural University of Norway. (south of Oslo) The graduate is the only employee. This company is presently located at the regional incubator/research park (the Aas BioScience Park Ltd) associated with the college. It is working towards a functional prototype.

Link with the university sector: The basic idea for Company1 represents a continuation of thesis-work in engineering. This is a case where the graduate and his advisor are co-applicants on the company’s single patent (2002). The advisor continues to contribute to the partnership, although at arm’s length. The start-up is currently located at the college’s incubator, but intends to move closer to potential collaborators and/or customers. The incubator offers some advisory functions.

Patenting and the importance of the support-structure: Company one also represents a case of a commercialization that, for different reasons, has not utilized the main channel for public support. Instead, it has been referred through the National Advisory Office for Inventors, which has provided Inventor-Fellowship support and covered patent-costs. It is currently aiming to develop the idea through a partnership contract (Industry Research and Development Contract (IFU) from SND). It is negotiating an agreement with a sea-farm and intends to move out of the research park incubator, which is not close enough to market. The decision to patent was made on the basis of advice and earmarked funds.

⁵¹ although the size-class was defined at less than 500 employees.

CASE 2: SME with international presence and strategy

Basics: Company2 is an antibody therapeutic company that was founded in 1996-7 by a Norwegian molecular biologist in conjunction with a German academic team. Its area of specialization is methods to screen for and target human antibodies. It currently employs 25 “scientists and business professionals” and has a growing range of product-services.

Link with the university sector: This small firm grew up in the incubator of a science park (Oslo Research Park, adjacent to the University of Oslo and the Norwegian National Hospital) where it is still centred: it has utilized the Park’s IP office for certain licensing purposes. Its research, its market strategy and its presence are however international. It maintains active contact with university environments both domestic and foreign. It collaborates nationally with public research organizations, and has (had) an international strategy and presence. Contacts with national academic research have been maintained principally through its international three-member scientific advisory board.⁵² Recently, the formal links represented by this board have been loosened in favour of more ad hoc relationships.

IPR issues: An active intellectual property strategy is central to the firm’s strategy, and it has actively sought to acquire access to markets and complimentary technologies through acquisitions as well as through partnerships with other biopharmaceutical companies and research institutions. According to reports, Company2 leveraged its business idea on the fact that a competitor did not patent in Norway (Norway was a ‘loophole’ because it was outside the EPC). It has an active international strategy in which IPRs are primary: at this stage IP is seen in terms of acquisition or partnering with outside knowledge bases. The company has a number of active patent-families internationally and is relatively neutral to potential changes in patent regulation. (cf. in terms of the Biotech Directive or in terms of Norway’s formal relationship to the EPO)

Links with the support-structure: Company2 has been supported by the Norwegian support system. It is located in a science park (Oslo Research Park, adjacent to the University of Oslo and the Norwegian National Hospital), on whose board the founding CEO now sits. The company’s co-founder and chairman is actively involved in advocacy and other roles with the support-structure, including prominent positions at the Norwegian Bioindustry Association, the Oslo Research Park, and member of the Research Board for Medicine and Health at the Norwegian Research Council. Company2 notes a need to adjust the support-structure in order to cater to the special needs of life-science research. In the company’s view, there are special reasons to dedicate increased resources to research and development activities in this field that are geared to the longer time-horizons implied by this activity.

CASE 3: Spin-off from contract research: New technology in existing applications

Basics: Case 3 originated from project work in NTNU environment in Trondheim in the early 1990s. It was formally established as a company in 1996 and reported its first commercial sale in 2000. There are 11 employees. This company effectively grew out of contract-research for an SME (1994) to produce a light generator. Today the company addresses the ‘low tech’ field of electrical generators by ‘high tech’ means, in order to address several specific needs such as deep water power generation. Company3 works on ‘smart’ integrated solution involving motors, electronics and electronic control. One product is a propulsion system for wheel-chairs.

Link with the university sector: Company3 effectively came out of project-work at the Norwegian University of Technology and Science (NTNU) Department of Electrical Power Engineering. Several of the active participants, including a founding member, maintain positions at the university as professors. Others have been recruited from different areas of the university. And

⁵² This board included prominent university researchers from Norway, Germany, and Australia.

this link is maintained through a framework agreement. The company also was aided by the contributions of a retired professor. And benefited from support from parts of the SINTEF system. (Depts. Production Engineering and Materials Technology) It has also pursued a policy of involve students in its work.

Links with the support-structure: The nearly ten year old company is currently located outside the research park in Trondheim. including program, NFR It was co-owned by NYFOTEK, a Trondheim research park. A notable aspect of Company3's development is the support from the faculty at the university itself, which reportedly acted as a midwife and incubator unit for the company. It does not appear to patent.

CASE 4: Spin-off in Bergen

Basics: Case 4 involves a firm that in 1996 spun out of marine-biology research in Bergen. The technology allows for the testing of environmental pollution using biochemical markers. It represents a case where both the local environment (the university and formative support structure) together with a range of public support structures have actively contributed. It is located in the regional science park, but maintains a wide platform for international collaboration. It currently has 16 employees, including the founder who has reduced his position at the university in order to direct the company. Different arrangements have been made to connect it with its immediate academic environment.

Link with the university sector: The company involves many recruits from the university. PhD fellows have also been linked to the work of the firm. The lead figure has reduced his position at the university in order to direct the company. Different arrangements have been made to connect it with its immediate academic environment. The company involves many recruits from the university. The company involves many recruits from the university. It collaborates widely internationally, including with international universities. Professor, Institute for Molecular Biology, University of Bergen (working 20% at university): 10 scientists, most from UIB, also UIO.

Links with the support-structure: Extensive. It is located in the High-Technology Centre (HIB), a Science Park in Bergen, Norway. Financial support: KAPBIO Program (NFR) financing (50%), including matching funds on an IPO; FORNY funding, Start Fund (first project to be funded: 3 MNOK, SND (IFU), EU Framework Programme. OTHER SUPPORT: Advisory (eg. patent), lab access, pliancy for professorship from HIB and university. (access to labs)

IPR Issues: Both patenting and publication are emphasized, as is the need to find the resources for both. A lack of IPR culture among academicians is noted, and the valuable contribution from the technology transfer office (Forinnova) praised in this respect. Active patenting, help from Forinnova (including taking over another patent: monitoring role)

5 Concluding Policy Discussion

The policy-objective to improve the interaction between university research and SMEs proceeds from the recognition that several factors have actualized it. One important factor is the changing funding environment (cf. NOU 2001:11) that has increasingly brought SMEs and academic researchers both into collaboration—and competition with one another.⁵³ In light of this development, it has become more important to promote interaction between academic and small firm research while avoiding direct competition that can have negative effects in the economy as a whole. This concern for symbiosis over competition/crowding-out is one important aspect which

⁵³ Developments on the funding side of research is one of a set of factors (viz Bayh-Dole Act in the US, 1980) that originally led to a more and more urgent questioning of how to deal with research results from private and public institutions on an equitable footing.

has been brought forward in the changing environment, and which makes clear the potential for increasing interaction bears with it the potential for increased competition as well as increased cooperation.

Another claim that has been raised is that the changing nature of certain research fields is making commercialization a more suitable way to disseminate research results than more traditional means (see emphasis in White-Paper). Publication is for example considered an insufficient vehicle to spread ideas whose value is best developed by trying out different practical applications: in such cases, generally associated with life-science and information technology, the incentive that commercialization represents to study such applications can be a more apt carrier for new ideas. At the same time, it should be recognized in that commercialization is an avenue that is much more resource-intensive than the traditional channels of dissemination.

In this environment, the interaction between university research and SMEs entails a growing need to facilitate a mutually attractive division of labor between the parties. In it, it is important that both parties have something to contribute and that both receive commensurate benefit. This benefit need not be monetary. The type of division of labor that is most suitable may vary from case to case. There are many forms for U-SME interaction, implying that policy measures must take into consideration very different needs.

In general, interaction can take on several forms, including the following:

- Classical scenario: Ongoing academic research can lead to results with commercial potential: this potential can be realized through contractual (e.g. licensing) relationships with existing SMEs or it can lead to a new company (spin-off or start-up). This entails ways to identify the ideas with commercial potential and ways to link the idea with other types of entrepreneurial expertise such as funding, patent strategy etc.
- Publicly-funded joint-research: Collaborations between university and SMEs (for example in a grant situation) can lead to results with commercial potential. In this scenario, the partnering SME will generally spearhead the commercialization process with the continued participation of university environments. This entails mechanisms that allow for university researchers not only to participate in the conception of the idea, but also in its follow-up. (See the case studies for different arrangements)
- Contract-research and shared results: An SME can itself fund university research in order to address a concrete problem. This contract research may lead to a solution which has wider commercial potential. Mechanisms to deal with this eventuality will tend to be contract-based, along the same lines as above.
- Mobility. Researchers in one context can (on sabbatical etc) come to work in the other, producing results that have commercial application. Mechanisms to deal with this eventuality will also tend to be contract-based, where there may be an incentive to arrive at such results.

5.1 Concluding observations of the Norwegian case

Against this background, this report demonstrated that the state of U-SME links has been associated with two threads of Norwegian policy. The first thread caters to small and middle-sized enterprises and goes back to the 1980s. The second policy thread involves the commercialization of academic research, whose modern history starts in the middle 1990s, but which extends back to earlier phases of Norwegian industrial policy. The report identified a set of current policy initiatives along this border.

Two policy instruments in particular were highlighted as the pillars of Norwegian policy to improve university-SME interaction. The MOBI-program and the FORNY program were shown as historically linked and, by intention, complementary. It was observed that MOBI's precursor

(BRIDGE) represented an ongoing attempt to consolidate university-industry links specifically directed at new and existing SMEs. This tradition, which originally attempted to widen the field from that of R&D to other innovation activities, has since narrowed its focus to the link with existing SMEs, especially in the regions. At the same time, FORNY has been moved outside the MOBI framework (still as a collaborator) in order to focus on new establishments. In its second phase, FORNY has grown into a larger and more visible instrument to stimulate the commercialization of public research. It is currently working with the university sector to build up in-house competences for commercialization in line with White Paper recommendations and the new obligations for the university sector. Somewhat out of role, FORNY is also opening for commercialization of research from other sources than public research. (cf. 2002-2007 Plan) In general, Norwegian support instruments can be said to provide a wide range of functions that affect the U-SME relationship. This review suggests that many of the relevant concerns in promoting U-SME collaboration are in place in the Norwegian support structure. Primarily the focus is on funding mixed with advisory function in the Norwegian case, for different types of collaborations at different phases in development. There is an expressed intention that there is an apparent diversity of instruments for financing start-ups, pre-start-ups, growing companies, and existing companies actively interested in collaborating with the university sector. In addition, there are initiatives that address the need for locations near university centers, as well as the germination of initiatives to stimulate entrepreneurship, etc.

The review however has not provided the basis to say how well (=effective and efficient) the individual initiatives work, or how well they work together. Nor does it provide an adequate basis to draw conclusions on how well the support addresses the needs and concerns of those currently involved in U-SME interaction. The four case-stories are by and large positive about the role of the support structure, although complaints were heard (from experience or not) specifically about the high cost of borrowing from the funds, of the high costs of some research parks, and of a certain short-termism in the support-structure.

5.2 Policy challenges

As the report has demonstrated, Norway is now embarking on the next stage of how the innovation system can better facilitate fruitful and equitable partnerships between academic and industrial research. So far, Norway has focused on the question of making more out of the (disproportionately) large public investment in university sector research. It is now addressing how the institutional set-up can gear itself to the considerable challenge to commercialize academic research. At the same time, the country has set out to form an “integral innovation policy”. In this work, policy should (continue to) link the question explicitly to assisting the country’s large population of small and medium-sized companies.

By and large, the current policy concerns have been explicated in the Norwegian policy discussion in the run-up to the recent amendment.⁵⁴ As the report has shown, these concerns have tended to revolve around the instrumental change in the question of title to IP results. This question is central to the university-industry relationship in general and, by extension, to the potential for improving relations with SMEs. The central policy-measure was the one that prevailed⁵⁵ in the proposition 67, namely to reassign title to IP from research from the level of the individual researcher to the level of the academic institution.

⁵⁴ Notably in the White Paper (Ot Prop 67), and in different green-papers, principally the Bernt Select Committee Green Paper but also others, including the Ringnes Select Committee. Note that there has not been unanimity in the work of the committees.

⁵⁵ This occurred in substantial opposition to the majority position of the Bernt Green Paper.

The newly released OECD report on Turning Science into Business (see section 4) notes (OECD 2003) however that this question of formalizing title is not in itself sufficient to improving conditions for commercializing academic research: it may not even be necessary. It does however provide a set of benefits, including (i.) that it provides greater legal certainty for involved parties, (ii.) that it lowers transaction costs for partners/better bargaining position, and (iii.) that it fosters more formal and efficient channels for knowledge and technology transfer. These benefits may be useful in intensifying cooperation between university research and SMEs.

However, this potential effect is neither automatic nor does it come without considerable pitfalls. The dangers recognized in the in the White Paper (and in the green-papers) revolve around the threat that this change could pose to academic independence, or what is termed 'free research' in the Norwegian documentation. A set of potential risks are warned against in the OECD report. These included the risk that commercialization efforts might limit access to publicly funded research results, affect the cost and efficiency of research, reorient research towards more lucrative fields, and lead to conflicts of interests (OECD, 2003: 10). The report notes that several OECD countries have begin to see backlash against commercialization activity, which call for safeguards against such risks.

This is a major challenge and it remains a major concern of many academic researchers in Norway. The implication is that the perception that this delicate balance is not being maintained would tend to undermine the legitimacy of commercialization efforts at the university among researchers, and thereby counteract efforts to encourage the spread of entrepreneurialism among relevant populations of researchers.

5.3 Considering policy measures

In general, the aim of good SME-academic link policy is to improve the conditions for—and the quality of the way academic research is commercialized and the role SMEs have in that commercialization. The primary goal is an intensification of university-SME collaboration, where this implies both a greater extent for cooperation (including investigating new areas of research and commercialization) but also an improvement of the quality of this cooperation.

This principle implies a set of things that public policy instruments can encourage and a set of things they can help discourage. In general, policy-initiatives should encourage the balanced build-up of research as well as entrepreneurship skills in both the SME and the university sector; they can promote modes to identify/attract collaborators of two parties; and they can create incentives/pressures for university researchers to identify and collaborate with the main users of their research in equitable ways. The continual improvement of the U-SME link will depend on a set of more particular conditions, such as the development of a diversified support structure for the commercialization of academic research; the availability of funding and advisory functions at different phases of the U-SME collaboration, the suitable build up of activities/expertise within the research institutions themselves, and a significant degree of coordination between intra-mural and inter-mural transfer activities (i.e. within university sector institutions and between them and support-structure initiatives).

These are areas where policy can have a role. An important aspect of its role is however to avoid attendant pitfalls, such as overselling the profit motives to academic researchers, imposing unrealistic time expectations for germinating U-SME collaborations, or promoting the growth of ineffectual bureaucracies. Such potential pitfalls entail sustained attention from the regulatory framework.

In general, the changing regime in Norway raises a set of new questions and challenges. These include:

- The need to develop the requisite human, institutional and regulatory resources for greater commercialization of academic research and better linkages with SMEs
- The importance that the changing technology transfer function involves the researchers as a partner not an opponent
- The question of the right to publish, and who has responsibility in cases where more than one researcher is involved.
- The need to develop strategies whereby the researcher is able/encouraged to participate in commercializing the invention.
- How to introduce the obligation to notify on researchers who are not principally aware of, nor sensitized to what is patentable
- How to deal with research results which might benefit by commercialization but which are not patentable
- The need to better understand the empirical effect of the changing regime.

Such issues need to be actively followed up. In this connection, several areas are set forth below which can help address policy concerns in the Norwegian case. These are structured with reference to four categories of recommendations the OECD recently elaborated on the strategic use of intellectual property by public research organizations. (OECD, 2003)

General

1. Make national policies on the U-SME relationship more coherent

The challenge in Norway is to implement the new legal conditions coherently across the university sector, other public research organizations, and the funding agencies. This entails ongoing attention to improve the complementarities in support-structure efforts, for example between programs in NFR, SND, SIVA, and the Norwegian Patent Office. Moreover, it entails a major competence-building exercise at several levels:

- To promote awareness and expertise about commercialization strategies in SMEs and in the university sector (not necessarily related to patenting alone)
- To promote participation among academicians that can shape the changing practice
- To encourage entrepreneurship among researchers and among SMEs.
- Integrate a regime for intellectual property policies among the university sector, other public research organizations, and the funding agencies
- And a general need to address the attitudes of both university professors but also SMEs to knowledge strategies that provide for the necessary balance between dissemination and control of new ideas.

A strategy one-sidedly extolling patenting is problematic here for several reasons. A more varied approach should be used, stressing different strategic channels which concentrates on different contractual arrangements.(with or without patenting) Here concerns about how to safeguard public research missions must be followed up.

Government and Universities

2. Encourage development and implementation of policies at institutional level

A major challenge is to promote the further development of the support structure while linking it to formative efforts in university sector institutions. This requires coordination in the support structure, while maintaining a degree of diversity among technology transfer activities. The challenge is to build up technology transfer mechanisms within university sector institutions that will promote the dissemination of research results through commercialization, in line with the intention of the law. In doing so there is a need to gear this new institutional set-up with existing technology-transfer activities, notably those built up under the FORNY program.

In general, this transition means that technology transfer activities which involve university sector research are being revamped. In this process, special attention should be paid not only to how to promote spin-off companies where this is called for. Also, attention should be directed towards how to partner with existing small and medium-sized enterprise, not least in traditional sectors. Here, explicit links with the MOBI program should be considered.

A more general point during this process is that the design of the university TT-organizations should strive towards guidelines that are simple, flexible, but as uniform as possible from institution to institution. Flexibility is important in order to provide for the heterogeneous needs of technology-transfer in different disciplines. A common set of guidelines is important because it would benefit both potential commercial partners, who would not need to learn different rules in order to partner with different university sector institutions, and it would promote a larger pool of technology transfer expertise at universities.

Special issues to consider in terms of common-guidelines include:

1. clear conflict of interest rules,
2. common contractual arrangements that address the question of when and under what conditions exclusive licenses are called for,
3. common contractual arrangements that include enforceable requirements to work clauses;
4. common monitoring and enforcement provisions.

3. Enhance IP management capacity at public research organizations

There is a general need to increase IP management competences in Norway, among SMEs, among certain areas of the support structure, and among policymakers. (Iversen, 2001) In light of current development, there is a need to raise sensitivity and increase knowledge and experience with the IP management issues in the university sector: IP management is becoming central to research management in the university sector. Increasing expertise does not mean simply increasing the number of patent applications. Patenting should not be treated simply as an alternative to publication or as success-criteria, but should be based on an informed decision on how best to proceed with commercialization. One suggestion already under consideration is to introduce courses (or course material, even on an elective basis) in intellectual property rights into the curriculum (Iversen, 2001) of higher level courses in business-educations, (not least those oriented towards entrepreneurship) and potentially in science and technology studies. This would address the need for awareness and relevance both among tomorrow's professors and tomorrow's small business leaders.

4. Improve data collection and share good practices

The need for better monitoring practices of relevant activity, including, the “need for timely and accurate information on the nature and extent of research collaboration between universities and industry, and on how it varies across discipline, type of university, sector, firm-ownership and time” (Calvert & Patel, 2002). The monitoring function is in fact formally called for by the change in laws concerning in Norway (e.g. on the effect of the change in laws). Areas to follow include, institutional strategies, collaborative research models, intellectual property rights, consulting activity, spin-off firms, and training and personnel links.

REFERENCES

- Arbo, Peter (2000) Framtidig organisering av det fou-rettete virkemiddelapparatet: hvem skal ha ansvaret for hva?
- Arora et al; Faulkner & Senker (1995) Knowledge Frontiers: Public Sector Research and Industrial Innovation in Biotechnology, Engineering Ceramics, and Parallel Computing)
- Braadland, Nås, Pedersen, Sandven, Ørstavik (2001): Innovation in Norwegian commerce and industry: A new overview. STEP report R-01
- Calvert, Jane and Pari Patel (2002). University-Industry Research Collaborations in the UK. SPRU report
- Dagens Næringsliv (daily newspaper), Gjør det lettere for gründere. 28 mars 2003.03.28
- Gambardella, Alfonso. (1995) Science and Innovation: The U.S. Pharmaceutical Industry During the 1980s (New York: Cambridge University Press, 1995)
- Halvorsen, Thomas. (2001) Science park policy –nurturing environment or artificial life support? A quantitative impact analysis of the economic effects Norwegian science parks have on their tenant firms. Political Science Thesis, NTNU.
- Hervik, Arild, Maja Arnestad & Bill Wickstead. (1997) Evaluering av FORNY-Programmet: Tilrådinger og endringsforslag. Møreforskning rapport nr 9703.
- Iversen, Eric (2002) Norwegian SMEs and the IPR-system: Exploration and Analysis. The STEP-Group. A study carried out for the World Intellectual Property Organization (WIPO). To be published by WIPO (forthcoming).
- Iversen, Eric and Aris Kaloudis (1999) Basic and Applied Modes of Organized Research: the Changing Positions of Patenting and Publishing. STEP-Group Report R06-1999.
- Jacobsson, Staffan (2002). Universities and industrial transformation June 2002. SPRU Paper No. 81
- Jensen, R., M. Thursby. (1998) Proofs and prototypes for sale: The tale of university licensing. Amer. Econom. Rev. 98(1) 240-259.
- Nationen (daily newspaper). For dyre gründer-lån. 1.10.03.
- Packer, K. and A. Webster (1996) 'Patenting culture in science: Reinventing the wheel of scientific credibility', Science, Technology and Human Values, vol. 21 no. 4 pp 427-53
- Rappert, Brian and Andrew Webster (1997). "Regimes of Ordering: The Commercialisation of Intellectual Property in Industrial-Academic Collaboration" Technology Analysis and Strategic Management 9(2).
- Remøe, Svend Otto (1998). "Forskningsbasert nyskaping: Erfaringer fra FORNY programmet" Hamar: Prokontra AS.

Remøe, Svend Otto (1999). TEFT: Diffusing technology from research institutes to SMEs. Step-working paper. Working Paper A-03-1999. <http://www.step.no/wp.asp>

Remøe, Svend Otto. (1999) Rushing to REGINN: The evolution of a semi-institutional approach. Working Paper A-02-1999. <http://www.step.no/wp.asp>

Rolfsen, Monica. (1994) Evaluering av FRAM-Programmet: Delrapport A Analyse av programmets målsetning. Sintef

Simula Research Laboratory (2002) Effect: en model for forskningsbasert nyskaping! Simula report 2002.

Smeby, Jens-Christian (2002): Forskningsvilkår ved universiteter og vitenskapelige høyskoler. (NIFU)

Stankiewicz, Rikard. (1986) Academics and entrepreneurs: developing university-industry relations. 1986. Frances Pinter (London)

Waagø, Sigmund, Einar Rasmussen, Thomas Kvaal, Magnus Gulbrandsen, Eilif Trondsen. (2001) The role for the university in economic development: an analysis of six European universities of science and technology. NTNU, GREI.

Webster, A. (1999) 'Knowledge Translations: Beyond the Public/Private Divide?', Journal of Education Through Partnership 3, 2: 7-22.

Government Documents:

Act on Employers Right to Commercialise Inventions Made by Employees, 1970

Greenpaper: NOU 2000: 14 Frihet med ansvar, Om høgre utdanning og forskning i Norge; Lov av 12 mai 1995 nr. 22 om universiteter og høyskoler.

Lov om patenter LOV 1967-12-15 nr 09

NFR (2003) The Strategic Platform for the BRIDGE-programme: 25 May, 1998.

NFR(2002). Programplan for innovasjonsprogrammet "Kommersialisering av FoU-resultater" - FORNY (2002-2009)

OECD (2002) "Benchmarking of Science-Industry links". Oecd, Paris.

OECD (2003) Turning Science into Business: Patenting and Licensing at Public Research Organizations. Oecd, Paris.

Research White-Paper: Stortingsmelding nr. 39 (1998-99) Forskning ved et tidsskille (forskningsmeldingen): Research at the dawn of a new era

UFD (2003) Reglement om forvaltning av eksternt finansiert virksomhet ved universiteter og høyskoler og om disse institusjonenes samarbeid med andre rettssubjekt.

Universitetsrådet 31. januar 2000 Immaterialrettsutvalget, (Ringnes-utvalget)

White-Paper: St.meld. nr. 27 (2000-2001) Gjør din plikt - Krev din rett, Kvalitetsreform av høyere utdanning,

White-Paper: St.meld. nr. 35 (2001-2002) Kvalitetsreformen Om rekruttering til undervisnings- og forskerstillinger i universitets- og høyskolesektoren.

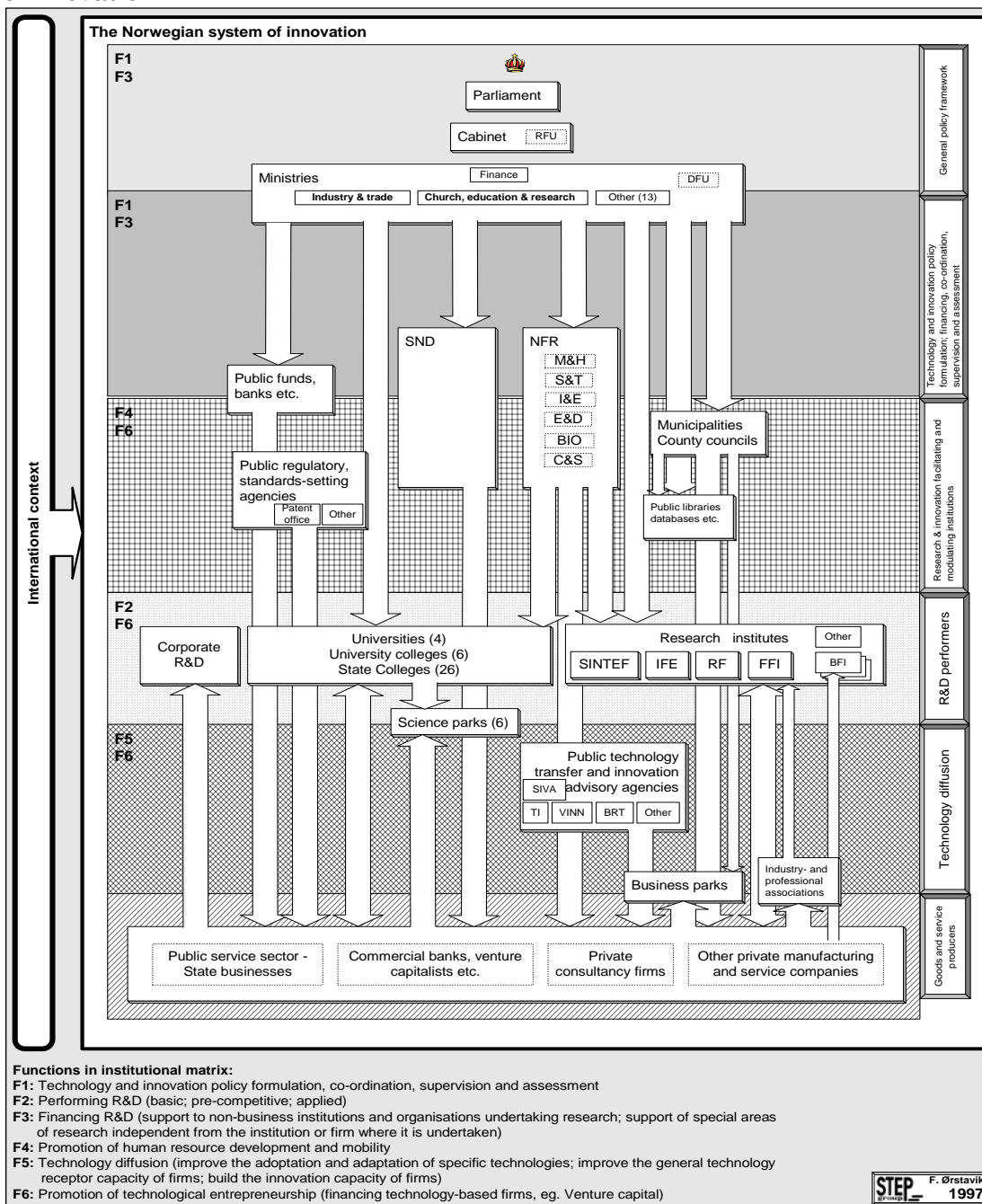
White-Paper: Stortingsmelding nr. 36 (1998-99) Om prinsipper for dimensjonering av høgre utdanning.

Whitepaper: Ot prop 67: Bill to increase the commercial exploitation of inventions Proposition No. 67 to the Odelsting (2001–2002) relating to the Act relating to amendments to Act No. 21 of 17 April 1970 relating to the right to inventions made by employees:
<http://odin.dep.no/ufd/engelsk/publ/stmeld/045041-050002/index-dok000-b-n-a.html>

Whitepaper: Ot.prp. nr. 40 (2001-2002) Om lov om endringer i lov 12. mai 1995 nr. 22 om universiteter og høyskoler og lov 2. juli 1999 nr. 64 om helsepersonell.
<http://www.dep.no/ufd/norsk/publ/otprp/045001-050002/index-dok000-b-n-a.html>

6 Annex

Figure: A policy-centered organisational map of the Norwegian system of innovation



Source: Ørstavik. Step-Working Paper 1/98.