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Innovation policies for SME's in Norway: Analytical framework and policy options

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Abstract

1. This report presents a perspective on the role of Small and Medium-Sized Enterprises (SMEs) in the Norwegian economy, and on the future role of SME-oriented innovation policy. It overviews the general position of SMEs in the industrial structure, reviews their innovation performance, discusses the development and use of skills and technological competence in such firms, analyses the role of SMEs in industrial clusters, and describes public policy initiatives directed towards SMEs. Finally, it discusses some options for future policy actions.

2. SMEs play an important role in the output and employment pattern of the Norwegian economy. They are particularly important in such large industrial sectors as food processing, timber products, and mechanical engineering, and in service activities such as graphics production and business services. Many of these sectors are regarded as ‘traditional’, low-tech or medium-tech activities. However, many such sectors, or segments within such sectors, are growing rapidly, and the share of employment in SMEs has been growing over time. In terms of innovation, SMEs have significant proportions of their sales deriving from new products, across all sectors, with the share of new products in sales in innovative SMEs being generally higher than in larger firms. But innovation activities are very unevenly distributed among the SME population, and the SME sector is characterised by high turnover in the labour market, and by high turnover in the population of firms.

3. The use of skilled and highly-qualified employees is growing among SMEs, but there is considerable variation between sectors and regions, and growth rates of such employment are lower than in larger firms. The report argues that access to technological and management competence is an increasingly important issue for SMEs, since even the ‘traditional’ sectors of the economy are characterised by intensive use of complex and advanced technologies. The ability to identify, access and use such technologies is critical to the innovation performance and long-term survival of SMEs. The report argues that the science and technology infrastructure in Norway plays a key role in developing, maintaining and diffusing such technologies.

4. The report contains detailed analysis of ‘specialised production areas’ in Norway. It defines such areas as clusters of firms within the same sector in the same locality or region, and shows that such clusters frequently perform better than their industry nationally: they grow faster (or decline slower), and employment grows faster within them. ‘SME clusters’ are particularly important in timber products, textiles, mechanical engineering, and parts of the chemical sector. The report argues that such clusters can form an important target group for policy in years ahead.

5. There exists a wide set of public policies aimed at innovation support, in which SMEs participate significantly. These policies cover not simply R&D support, but technology transfer, financing, consulting advice, and so on. The report argues that there is a need for greater co-ordination and flexibility among the services on offer to SMEs.

6. The report discusses two major policy options. The first addresses the fact that innovation processes in SMEs are complex in relation to firm-level resources. Firms may face problems with respect to finance, training, business strategy, marketing and so on. Given that firms may lack internal capabilities and require outside support across the spectrum of innovation activities, the policy challenge is to develop programmes which can respond across the whole range of potential innovation problems. The second option is to address the infrastructural needs of specialise production areas, by targeting specific clusters. Given the

complexity of their technology bases, and the role of the infrastructure in supporting technology creation and use within them, there may be scope for a more effective targeted infrastructure policy.

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Chapter one: Small firms in the Norwegian economy[1]

Introduction

In this chapter we provide a general overview of the role of small firms in the Norwegian economy, discussing in particular the future place of SMEs in research and innovation policy in Norway. This discussion is empirical: it is based on a range of statistical sources and seeks to develop an approach which is well-founded in the empirical realities. The key suggestion which emerges from this data exploration is that the industries in which Norway performs relatively little R&D are the large, 'traditional' sectors, and it is in these sectors that SMEs play a particularly important role. We argue that many of these sectors are growing, or contain significantly growing product groups, and are moreover highly innovative.

The chapter reviews available data concerning size distributions of firms, employment patterns, turnover (survival rates and turbulence); here the point is that both employment and the firms population as a whole are highly turbulent. Firms survival rates are low, and there is a high level of employment turnover. We argue that survival depends ultimately on competitiveness resting in turn on innovation performance, and this leads us to look at innovation inputs and outputs. We show that small firms, across all industries, can be and are innovative, but that innovative investment is high relative to turnover. In later chapters we explore the employment of highly qualified personnel, and geographical clustering and its effects.

1.1: Why should SMEs be a target for policy?

Most arguments in support of innovation policies for SMEs focus on the role of SMEs in creating innovations and employment, and on the obstacles which they face in doing so. Dodgson and Rothwell have set out some of the strengths and weaknesses of small firms in innovation in the following table, which summarises

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[1] With the exception of Tables 1.1 and 1.3, all tables and figures used in this chapter are drawn from STEP Group datasets, and/or books, reports or articles by members of the STEP Group.
Tables 1.2, 1.4, 1.5, and 1.6 are drawn from Arne Isaksen and Olav Spilling**, Regional utvikling og små bedrifter** (Regional development and small firms), Høyskoleforlaget: Kristiansand, 1996
Tables 1.3 and Figures 1.1 and 1.2 are calculated from Statistics Norway, Industrial Statistics, various years.
Table 1.6 and Figures 1.3 and 1.4 are calculated and/or drawn from the CIS survey Norway, and CIS data for Austria, Denmark, the Netherlands and Germany.
Table 1.9 is drawn from Arne Isaksen "Towards Increased Specialization. The Quantitative Importance of New Industrial Spaces in Norway, 1970-1990", **STEP/KAD Note 4/95**.

also many of the arguments which are used in policy support and even the design of programmes.[2]

Table 1.1: Advantages and disadvantages of small and large firms in innovation. Statements in brackets represent areas of potential disadvantage.

	Small firms	Large firms
Marketing	Ability to react quickly to keep abreast of fast changing market requirements. (Market start-up abroad can be prohibitively costly).	Comprehensive distribution and servicing facilities. High degree of market power with existing products.
Management	Lack of bureaucracy. Dynamic entrepreneurial react quickly to take advantage of new opportunities and are willing to accept risk. (Often lack management specialists, e.g. business strategist, marketing managers, financial managers).	Professional managers able to control complex organisations and establish corporate strategies. (Can suffer an excess of bureaucracy. Often controlled by accountants, who can be risk-averse. Managers can become mere ‘administrators’ who lack dynamism with respect to new long term opportunities).
Internal communication	Efficient and informal internal communication networks. Affords a fast response to internal problem solving: provides ability to reorganise rapidly to adapt to change in the external environment	(Internal communications often cumbersome; this can lead to slow reaction to external threats and opportunities).
Qualified technical manpower	(Often lack suitable qualified technical specialists. Often unable to support a formal R&D effort on an appreciable scale).	Ability to attract highly skilled technical specialists. Can support the establishment of a large R&D laboratory.
External communications	(Often lack the time or resources to identify and use important external sources of scientific and technological expertise).	Able to ‘plug-in’ to external sources of scientific and technological expertise. Can afford library and information services. Can subcontract R&D to specialist centres. Can buy crucial technological information and technology.
Finance	(Can experience great difficulty in attracting capital, especially risk capital. Innovation can represent a disproportionately large financial risk. Inability to spread risk over a portfolio of projects).	Ability to borrow on capital market. Ability to spread risk over a portfolio of projects. Better able to fund diversification into new markets.
Economies of scale and the system approach (scope)	(In some areas economies of scale form substantial entry barriers to small firms. Inability to offer integrated product lines or systems).	Ability to gain scale economies in R&D production and marketing. Ability to offer a range of complimentary products. Ability to bid for large turnkey projects.
Growth	(Can experience difficulty in acquiring external capital necessary for rapid growth. Entrepreneurial managers sometimes unable to cope with increasingly complex organisations).	Ability to finance expansion of production base. Ability to fund growth via diversification and acquisition.
Legal	(Lack of ability in coping with the patent system. Can not afford time or costs involved in patent litigation).	Access to legal specialists. Can afford to litigate to defend patent infringement.
Government regulation	(Often cannot cope with complex regulations. Unit cost of compliance for small firms often high).	Ability to fund legal services to cope with complex regulatory requirements. Can spread regulatory costs. Able to fund R&D necessary for compliance.

[2] Source: M. Dodgson & R. Rothwell, “Financing Early-stage Innovation in Small Firms (Flexible and Broad-ranging Support Packages)”, in **Enterprise, Innovation and 1992: Innovation Support Services in Europe**. TII, 1989, pp.58-60

This overview summarises most of the problems which SMEs are believed to face, and it would certainly be possible to classify many policy initiatives according to the ways in which they seek to ease the relevant problems. However these are of course described at a very general level. The argument of this report is that we can identify a range of SME-related issues which are quite specific to the Norwegian industrial and innovation system. The following chapters attempt to set out some of the primary issues involved in the Norwegian situation.

Before turning to an analysis of the industrial system in Norway, we argue that there is a basic case for focusing R&D policy in particular on firms with less than 100 employees, particularly in what are usually referred to as 'low tech' industries. At the present time, R&D performance in Norway is distributed very unevenly: more than 50% of industrial R&D is carried out by the ten largest R&D-performing firms. These firms also tend to receive a disproportionate share of R&D support from the research policy system. Given that these firms are usually quite strongly R&D intensive, it is hard to see that it is either desirable or feasible to raise their already high levels of research. If we are to succeed in raising R&D in Norway, then we must look outside these firms. If we look also at *industries*, we see that where Norway is relatively low - in comparative terms - is in so-called 'low tech' industries such as food products, timber products etc., and in 'medium tech' industries such as machinery. These industries are relatively low in R&D, but they generate most of the output and employment in Norwegian manufacturing.

To give one example of this, consider the 'graphics' industry. This industry, which covers publishing, and production and reproduction of recorded media, is the third largest single branch in terms of employment in Norway, and accounts for just over ten percent of value-added in Norwegian industry. It is the largest branch in terms of numbers of enterprises: nearly 17% of all industrial firms are in this branch; in the Oslo region ca 46% of all firms are in the branch. It is a very low R&D branch, with less than 0.5% of total industrial R&D, yet it is a field of rapid technological change (especially via the introduction of IT into pre-print processes). But it is an 'SME branch': 87% of the firms have less than 20 employees, and the majority of firms have less than 5 employees. This is a field of growth, and increasing internationalisation, where technological performance is very important, where the potential for the use of R&D results appears to be increasing. From a policy point of view it appears to be important to consider the future of such low-R&D but high-SME growth industries.

The low relative performance in such industries means that there is presumably some scope for raising R&D to OECD average levels, in contrast to industries such as IT where Norway is well above the OECD average.

The important role of small firms in the graphics industry is in fact common across the large, low-R&D industries of Norway. If we look at *firms*, we should note that most employment and output in Norwegian low-tech and medium-tech industries is in SMEs (meaning firms with less than 100 employees). These points are analysed in more detail below. We argue that such industries are innovative, and moreover that many product groups within them are growing. We believe that it is reasonable to conclude from this material that policies aimed at raising R&D in Norwegian industry should be focused primarily on *SMEs in low and medium tech industries*.

1.2: SMEs in the Norwegian industrial structure

The Norwegian economy, and particularly the manufacturing sector, has traditionally had two distinguishing features: a predominance of industries engaged in processing of Norway's abundant raw materials, and a predominance of small firms. However since the late 1970s a new and in many ways dominating feature has emerged, namely the oil economy. This has led to significant structural change in the economy, mainly because an appreciating exchange rate has led to the decline of a number of labour-intensive industries, and hence to changes in the regional distribution of industry.

It has been widely recognised since the beginning of the oil economy that the only viable long-term adjustment to oil must involve raising the technological level of the non-oil economy. Non-protected labour-intensive manufactures would face serious problems in Norway, and there has indeed been a sharp and continuing fall in manufacturing employment, especially in industries such as furniture, shoes and clothing. Given that large Norwegian firms were usually concentrated in stable or stagnant industries, this meant a need to promote and/or support the creation of new firms and measures for the support of the technological bases of such firms have been a long-standing feature of the Norwegian policy scene.

However this does not necessarily imply, in the Norwegian context, support for SMEs or so-called 'New Technology-Based Firms' (NTBFs). There has been persistent debate as to how this objective of technological advance should be reached: should it involve the active promotion of such high-tech sectors as IT, or should it involve the technological improvement of low-tech but high-employment sectors such as food products? This dilemma has formed an important framework for policy debate principally because the numbers of firms, and the levels of employment, are significantly higher in low-tech industries in Norway than in high-tech industries. Table 1.2, on the following page, shows the general situation for all industries. Firms with less than 100 employees made up more than 99% of companies, and approximately 72% of employment in all Norwegian industry.

Table 1.2: Size structures for enterprises in main industries 1990

	All industries		**Oil extraction, mining and quarrying**	**Manufacturing**	**Construction**	**Wholesale and retail trade, restaurants and hotels**	**Transport**	**Financing, insurance, real estate and business services**	**Community social and personal services**
Companies		**%**	**comp/%**	**comp/%**	**comp/%**	**comp/%**	**comp/%**	**comp/%**	**comp/%**
Number of companies			863	23 416	40 676	76 802	25 625	25 886	16 333
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
0-4	176 440	84.2	75.3	70.6	89.0	81.5	91.5	87.6	87.9
5-9	17 448	8.3	10.5	10.3	5.5	11.2	4.2	7.1	7.5
10-19	8697	4.1	5.8	7.9	3.3	4.7	2.1	3.0	3.2
20-99	6015	2.9	4.9	8.9	2.0	2.5	1.7	2.0	1.3
100-499	905	0.4	2.2	2.0	0.3	0.2	0.3	0.2	0.2
500-999	73	0.0	0.7	0.2	0.0	0.0	0.0	0.0	0.0
1000-	23	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0
Employment		**%**	**man years/%**	**man years/%**	**man years/%**	**man years/%**	**man years/%**	**man years/%**	**man years/%**
Number of man-years	866 656		19 028	283 717	113 668	254 794	77 454	78 281	39 714
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
0-4	160 909	18.6	3.6	5.6	21.3	25.5	26.3	27.1	34.3
5-9	112 785	13.0	3.2	5.6	13.0	21.6	9.0	14.9	19.5
10-19	114 942	13.3	3.7	8.8	15.7	18.4	9.2	13.2	17.4
20-99	231 597	26.7	8.6	31.4	26.2	25.6	24.2	25.6	17.9
100-499	166 653	19.2	19.9	32.1	18.8	8.0	21.3	11.6	10.8
500-999	47 242	5.5	22.1	10.1	2.0	0.8	7.0	5.9	0.0
1000-	32 528	3.8	38.9	6.3	3.0	0.0	3.0	1.8	0.0

This position with respect to resource-based and low-tech industry can be seen in Table 1.3 on the following pages. These tables break down employment and numbers of firms - by size class - according the familiar OECD classification of high-tech, medium-tech and low-tech industries.

These tables shows just how dependent the Norwegian manufacturing sector is on what are usually regarded as low-tech activities, and on the role of small firms within these industries. With the exception of machinery - which in Norway has a close connection to maritime activities - the high-tech sectors are extremely small. ISIC 3825, probably the most R&D-intensive sector outside pharmaceuticals, has an absolute total of 1100 employees, less than 300 of whom are in small (<100 employees) firms. Pharmaceuticals has about 2200 employees, with about a third in SMEs. Food products, on the other hand, has nearly 44,000 employees, of whom 80% work in small firms. Timber products has nearly 14000 employees, again with about 80% in small firms.

Unless there is radical structural change in years ahead, these figures imply that the general evolution of industrial output and employment in Norway in years ahead will depend heavily on performance in these industries. Contrary to much of the ‘conventional wisdom’, we shall show below that these industries are often highly innovative, in the sense of developing and marketing new products, and moreover that within these industries many product segments are rapidly growing. Finally, we shall show that ‘clusters’ within these industries are performing well in terms of output and employment.

Table 1.3: Firms and Employment in High-Technology, Medium-Technology and Low-Technology Industries in Norway, 1992 (OECD Definition)

TIER 1.B: 1992		NUMBER OF FIRMS								EMPLOYMENT							
High Technology Industries		TOTAL	<5	5-9	10-19	20-49	50-99	100-199	200+	TOTAL	<5	5-9	10-19	20-49	50-99	100-99	200+
3522	Drugs & Medicine	24	4	3	3	3	5	5	1	2265	10	22	45	154	526	822	686
3825	Office & computing equip.	26	11	7	3	1	2	-	2	1100	23	50	38	24	156	-	809
383 (excl.3832)	Electrical machines (excl. comm.)	282	106	44	39	47	18	23	5	8872	258	318	589	1616	1221	3379	1491
3832	Radio, TV & Comm. Equipment	134	59	12	19	19	13	4	8	5369	129	86	284	592	986	537	2755
385	Technical, Scientific, Photo & Office Instruments	89	31	20	13	16	6	1	2	2008	69	176	159	447	434	110	613
3851	Technical & Sci. instruments	82	28	20	12	15	4	1	2	1809	62	176	143	422	283	110	613
TIER 2: 1992		NUMBER OF FIRMS								EMPLOYMENT							
Medium Technology Industries		TOTAL	<5	5-9	10-19	20-49	50-99	100-199	200+	TOTAL	<5	5-9	10-19	20-49	50-99	100-199	200+
351 +352 (excl.3522)	Chemicals excl. drugs	155	46	22	21	26	18	9	13	3367	104	108	176	582	822	427	1148
382 (excl.3825)	Non-electrical machinery	978	488	159	116	95	62	22	36	36210	1251	1133	1658	3163	4800	3242	20963
3821	Engines & turbines	4	-	-	-	-	3	1	-	431	5	-	-	-	240	186	-
390	Other manufacturing	314	199	43	29	28	10	2	3	3918	456	299	388	944	703	282	846
TIER 3: 1992		NUMBER OF FIRMS								EMPLOYMENT							
Low Technology Industries		TOTAL	<5	5-9	10-19	20-49	50-99	100-199	200+	TOTAL	<5	5-9	10-19	20-49	50-99	100-199	200+
311/2	Food, Beverages & Tobacco	1878	713	277	350	342	119	55	22	43987	1762	2058	5007	10902	8609	7289	8360
3114	Fish Products	468	153	69	87	105	39	13	2	9957	351	483	1218	3217	2495	1689	504
321	Textiles	329	156	45	44	56	17	10	1	5716	333	318	656	1725	1049	1375	260
331	Timber Products	1015	497	186	165	111	39	16	1	1366	1229	1300	2327	3722	2520	2191	377
3311	Building Materials	799	354	161	134	97	36	16	1	12163	927	1135	1906	3290	2337	2191	377
341	Pulp & Paper	111	21	6	14	20	18	18	14	10772	70	65	215	671	1427	2503	5821

1.3: Employment in SMEs

Before turning to growth and innovation performance, it should be emphasised that SMEs are important in the Norwegian employment pattern. In most sectors, with the notable exception of oil, the share of employment in SMEs has been either stable or growing over time, as Table 1.4 shows:

Table 1.4: Shares of employment by size and main industrial sector 1975 – 90

Year	Total employment	Shares of employment by size of companies (%) Small (0-19)	Medium (20-99)	Large (100-)
Oil extraction, mining and quarrying				
1975	10 066	23.1	15.3	61.6
1980	15 585	13.1	13.2	73.7
1985	16 486	12.1	13.4	74.6
1990	19 028	10.5	8.6	80.9
Manufacturing				
1975	382 092	17.3	27.9	54.8
1980	365 555	17.1	29.1	53.8
1985	333 843	18.6	31.0	50.4
1990	283 717	20.1	31.4	48.6
Construction				
1975	107 061	47.6	27.1	25.3
1980	112 475	50.2	25.5	24.4
1985	122 977	52.1	25.9	22.0
1990	113 668	50.0	26.2	23.8
Wholesale and retail trade, restaurants and hotels				
1975	262 873	64.8	25.8	9.3
1980	261 890	65.1	25.8	9.1
1985	288 966	64.1	26.8	9.1
1990	254 794	65.5	25.6	8.9
Transport				
1975	87 941	41.2	21.4	37.5
1980	96 818	38.2	21.7	40.1
1985	91 834	42.8	23.7	33.5
1990	77 454	44.5	24.2	31.3
Financing, insurance, real estate and business services				
1975	35 476	55.7	28.1	16.1
1980	50 108	51.4	26.5	22.1
1985	72 822	51.9	25.4	22.7
1990	78 281	55.2	25.6	19.3
Community, social and personal services				
1975	42 255	53.2	23.0	23.8
1980	40 676	59.7	23.9	16.4
1985	45 436	65.0	23.5	11.5
1990	39 714	71.2	17.9	10.8
All manufacturing				
1975	927 764	39.7	26.3	34.1
1980	943 107	40.1	26.4	33.5
1985	972 364	43.2	27.3	29.5
1990	866 656	44.8	26.7	28.4

However employment in SMEs is characterised by substantial turbulence, with turbulence increasing over time, as Table 1.5 shows. This is based on plant-level data, measuring job creation (net increases in growing plants) and job destruction (net decreases in plants which are contracting in size). The total turnover (job creation + job destruction as a proportion of total output) is high across all firm size categories, but is particularly high in firms with less than 20 employees, where almost 60% of jobs are either created or destroyed over a five year period. This is not, therefore, in any sense a static labour market.

Table 1.5: Employment changes in Norway 1980-1985 and 1985-1990, by size class of firms

		Size categories			
	Total	**0-19**	**20-99**	**100-499**	**500+**
1980-1985					
Employment in 1980	943.1	378.3	248.7	199.7	116.4
Expansions	166.0	106.1	33.4	20.3	6.3
Contractions	139.8	50.0	34.6	28.3	26.8
Close downs	125.6	65.6	29.7	20.7	9.7
Net changes before establ.	-99.4	-9.5	-30.9	-28.7	-30.3
In % of employment in 1980	-10.5	-2.5	-12.4	-14.4	-26.0
Establishments	129.1				
Net changes	29.7				
Total gross changes excluding establishing	431.5	221.7	97.7	69.3	42.8
In % of employment in 1980	45.8	58.6	39.3	34.7	36.8
Total gross changes including establishment	560.6				
In % of employment 1980	59.4				
1985-1990					
Employment in 1985	972.4	420.1	265.8	189.2	97.2
Expansions	140.2	97.0	23.7	14.1	5.4
Contractions	183.8	85.3	44.4	33.3	20.7
Close downs	161.0	84.4	43.7	23.1	9.8
Net changes before establ.	-204.6	-72.7	-64.4	-42.3	-25.1
In % of employment in 1985	-21.0	-7.4	-24.3	-22.3	-25.8
Establishments	98.7				
Net changes	-105.9				
Total gross changes excluding establishing	484.9	266.6	111.8	70.4	36.0
In % of employment in 1985	49.9	63.5	42.1	37.2	37.0
Total gross changes including establishment	583.6				
In % of employment 1985	60.0				

Employment figures in 1000 man years, total of changes in the periods. The periods goes from the 1.January for the given years.

1.4: Turnover: the life and death of companies

Corresponding to turnover in employment is turnover of firms. A key problem facing SMEs is stability. SMEs in Norwegian manufacturing are characterised by extremely high turnover rates: over the decade 1980-1990, nearly half of all companies in the size class 1-9 employees closed down, and there were new firms created equivalent to nearly 65% of the original population. It can be seen that survival rates increased with the sizes of firms: the general point being to confirm the view that risks associated with new small firms are high. Table 1.6 shows the general dimensions of this in Norway, looking not only at survival rates over three five-year time periods.

Table 1.6: Development of company population in Norway, 1975-1990: survival rates

	1975-1980		1980-1985		1985-1990	
		Survival rate/		Survival rate/		Survival rate/
Size	Companies	share of new companies	Companies	share of new companies	Companies	share of new companies
Secondary industries						
Not report.	5 773	0.56	7 468	0.54	8 795	0.58
0	4 125	0.52	6 786	0.47	9 719	0.60
1-9	31 319	0.76	35 607	0.74	37 373	0.78
10-19	3 210	0.88	3 121	0.84	3 251	0.82
20-99	3 287	0.90	3 310	0.86	3 367	0.83
100-499	753	0.92	752	0.88	673	0.90
500+	101	0.96	97	0.91	89	0.91
Total comp. Inn	48 568	0.73	57 141	0.70	63 267	0.73
New comp.	21 665	0.45	23 792	0.42	18 870	0.30
Total		1.18		1.11		1.03
Tertiary industries						
Not report.	12 390	0.59	12 428	0.56	20 324	0.52
0	14 414	0.69	18 051	0.66	25 513	0.67
1-9	64 912	0.77	68 258	0.77	77 271	0.76
10-19	4 658	0.92	4 719	0.89	5 379	0.83
20-99	2 714	0.92	2 827	0.90	3 227	0.84
100-499	268	0.95	287	0.93	304	0.86
500+	21	0.95	24	0.92	23	0.87
Total comp. Inn	99 377	0.75	106 594	0.73	132 041	0.71
New comp.	29 509	0.30	49 688	0.47	44 780	0.34
Total		1.05		1.20		1.05

The columns for companies gives the number of companies by the start of the period as well as number of companies that has entered during the period. The survival rate gives the share of survived companies relative to number of companies that existed by the start of the period. Share of new companies is measured relative to the total number of companies at the start of the period.

1.5: Growth in the ‘low-tech’ and ‘medium-tech’ sectors

It is not the case that low or medium-technology industries, in which SMEs are concentrated, are necessarily low-growth industries. On the following pages we show growth data calculated from SSB’s Industrial Statistics at a highly disaggregated level. Here we are looking not at large industries but at a finer classification, close to the level of product groups. For any product group, output tends to fluctuate cyclically, which means that ‘raw’ growth rates of output - which are represented here - tend to be affected by the phase of the business cycle, which may differ between industries. This means that growth rates between industries will vary according to the time period chosen. Here we show growth for two time periods, simply listing the ten fastest growing product groups within the relevant time-period.

The key point which emerges is that the 'top ten' product groups are, broadly speaking, made up of low and medium-tech product groups.

Figure 1.1: Top 10 product groups, annual growth in Value Added, 1984-91

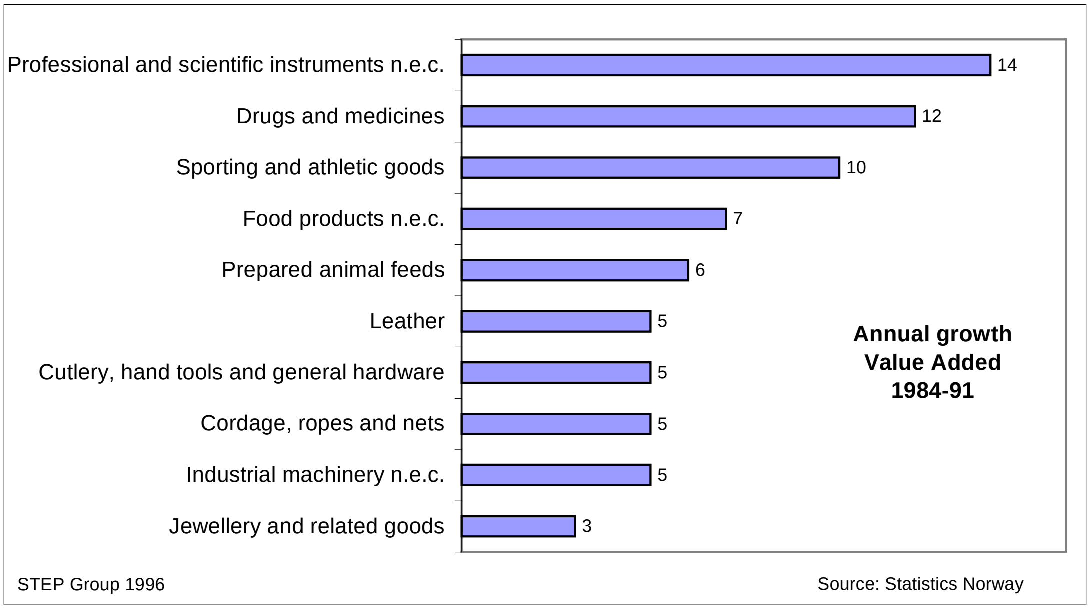
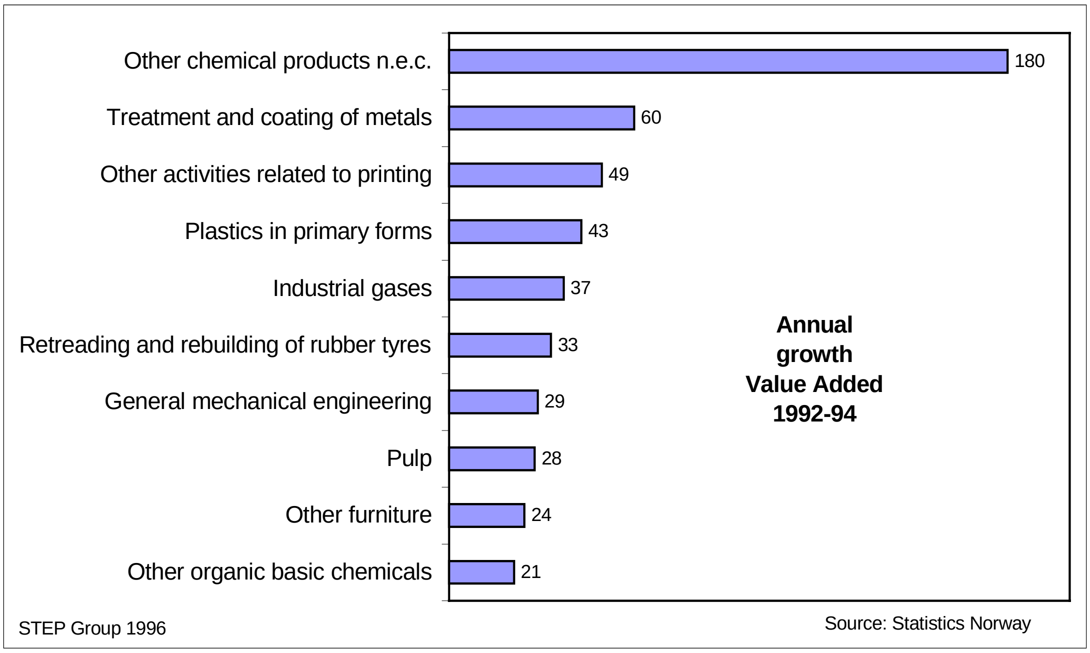


Figure 1.2: Top 10 product groups, annual growth Value Added 1992-94



1.6: Innovation outputs by SMEs

Table 1.7, on the following page, shows the proportions of sales deriving from new products for various size classes of firms, comparing Norway with three other countries: Denmark, Austria, the Netherlands and Germany. The data on which this table is based is drawn from the CIS survey, scaled up to national totals. Norway compares favourably with all of the other countries, but it is more important to note the spread of innovation activity (in terms of new product sales) across industries. Note also that, among firms which have new products in their sales mix, Norwegian SMEs generate higher proportions of turnover from innovative products than larger firms.

Table 1.7: Shares of products 'new to the firm' in 1992 sales of those firms which have products new to the firm, by industry and size classes (number of employees)

Industry	NACE	N	NL	DK	IE	[2]A	G
Mining, oil and gas extraction, energy and water supply	10-14, 40-41	25	22	na	na	[1]23	36
Food and beverages, tobacco	15, 16	45	32	48	na	20	34
Textiles, wearing apparel	17-18	33	39	[1]47	na	49	43
Wood and wood prods, pulp and paper, publishing and printing	20-22	22	27	24	na	30	30
Petroleum refining, chemicals, rubber and plastic prods	23-25	27	31	27	na	32	51
Other non-metallic mineral prods	26	24	28	[1]23	na	28	31
Basic metals	27	10	15	[1]27	na	20	33
Fabricated metal prods excl machinery and equipment	28	44	28	29	na	25	42
Machinery for prod and use of mechanical power, machine tools	29.1, 29.4	[1]40	29	[1]32	na	[1]33	37
General purpose machinery, weapons and ammunition	29.2, 29.6	[1]44	46	31	na	[1]42	49
Agricultural and forestry machinery, other special purpose machinery, domestic appliances	29.3, 29.5, 29.7	64	43	34	na	34	58
Office machinery and computers, radio, tele and communication	30, 32	56	47	37	na	[1]46	77
Electrical machinery and apparatus	31	52	43	29	na	41	46
Medical, precision and optical instruments	33	56	42	38	na	[1]49	51
Motor vehicles, aircraft and spacecraft	34, 35.3	[1]31	46	[1]38	na	[1]43	60
Other transport equipment (excl air and space)	35 excl 35.3	46	36	[1]40	na	[1]10	36
Furniture, other manufacturing	36	[1]46	39	[1]41	na	50	66
Size classes							
10-19		46	29	na	na	22	57
20-49		35	33	35	na	29	48
50-99		36	34	31	na	35	46
100-199		40	36	36	na	35	40
200-499		37	34	30	na	38	42
>=500		26	36	28	na	37	45

[1] Less reliable because of low number of observations
[2] Figures relate to innovative products introduced during the last **five** years

1.7: SMEs and innovation inputs

What problems do SMEs face in terms of investing in innovation? Our analysis here uses the Norwegian Innovation Survey which is described STEP Report 4/94 (*Innovasjon og ny teknologi i norsk industri: en oversikt*). It contains data on the following topics, as well as general data on the output, employment and exports of the firm:

- expenditure on activities related to the innovation of new products (R&D, training, design, market exploration, equipment acquisition and tooling-up etc.).
- outputs of incrementally and radically changed products, and sales flowing from these products
- sources of information relevant to innovation
- R&D performance and technological collaboration
- perceptions of obstacles to innovation, and factors promoting innovation

The Norwegian Innovation Survey therefore contains firm-level data innovation processes across a wide range of industries, and all relevant firm-sizes in Norway. The innovation dataset has already been used in a preliminary project for the SMB programme. That project showed a number of interesting results with respect to small firms. The most important of these are as follows:

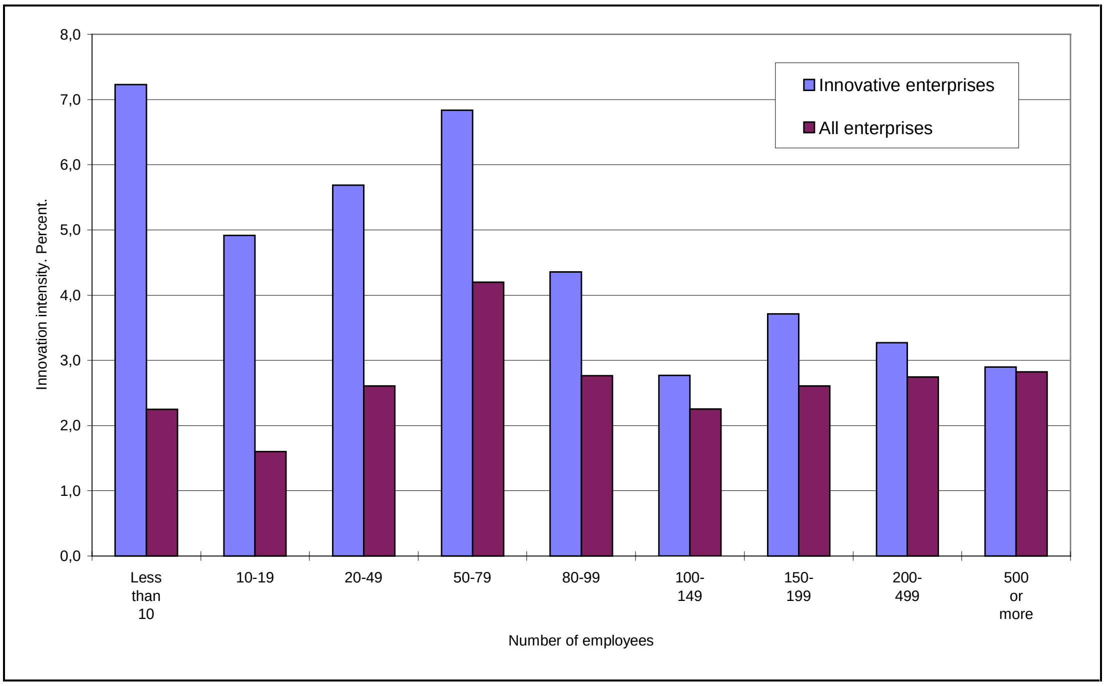
1) The proportion of innovating firms in a size class rises with firm size. Among the firms with less than 10 employees, only 16% engaged in innovation activity, as opposed to 72% for firms with more than 100 employees. This suggests that the scope for increasing activity in SMEs may be large.

Table 1.8: Innovating and non-innovating firms by size class. percent.

	Innovation survey		
Number of employees	Innovators	Non-innovators	N
Under 10	16	84	238
10-49	30	70	368
50-99	56	44	135
100 or more	72	28	245
Total	40	60	100 %
N	400	586	986

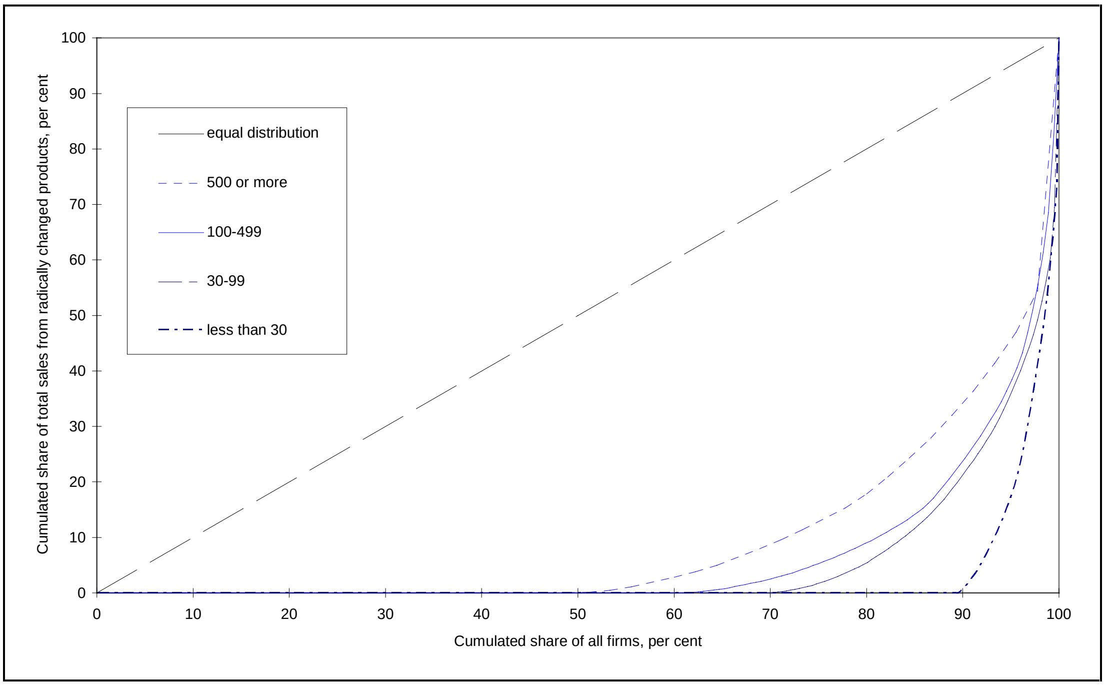
2) Figure 1.3 shows that when small firms innovate, they must spend much higher proportions of their total sales on innovation-related activities than large firms; this suggests that if an innovation fails, the result is much more serious for small firms than for large firms.

Figure 1.3: Innovation expenditures, as proportion of sales, by size of firm. Percent.



3) Within the small-firm class, innovation activity is distributed very unevenly, as Figure 1.4 shows. Less than 10% of the small firms account for the majority of new product sales, and the majority of innovation expenditures. Again, this suggests considerable scope for extending innovation and research performance.

Figure 1.4: Distribution of innovation expenditures by size class.



1.8: Geographical clustering and its impact

Finally, we can ask whether SMEs really matter in terms of growth of output in the low-tech industries we have discussed above. This issue discussed in detail in Chapter 3 below. It is approached in the following way. We define a 'cluster' as a group of ten or more SMEs within a region, all in the same sector, and all with vertical links to other producers. A wide range of such clusters can be identified in Norway. The most important of the clusters are in the low-tech sectors of the economy, and two important results emerged from the analysis. The first was that in absolute terms most of these clusters of SMEs increased their levels of output and employment, even where their industry was declining nationally. Where clusters declined, they declined less than the national average. The second result, following from the first, was that clusters of SMEs increased their shares of Norwegian output in these industries. Finally it is important to note that the industries in which SME clusters performed particularly well were also the industries in which Norway has a relatively strong advantage in international trade. We measured this using the 'revealed comparative advantage' (RCA) indicator, which shows exports in the relevant branch as a share of Norway's total exports, divided by total OECD exports in the branch as a share of total OECD exports. An indicator of more than 1 indicates that Norway has an advantage. The industries shown here are the only industries in which Norway has an RCA of more than one.

Table 1.9: Effects of geographical clustering

			SHARE OF ALL JOBS IN THE SECTORS TO BE FOUND IN THE CLUSTERS	
Industrial sector	**REVEALED COMPARATIVE ADVANTAGE**	**THE NUMBER OF INDUSTRIAL CLUSTERS IN 1990**	**1970**	**1990**
Ships	**8.57**	**12**	**31.6**	**60.6**
Petroleum refining	**4.55**	**3**	**48.4**	**78.4**
Basic metals	**3.91**	**30**	**74.0**	**78.4**
Pulp, paper	**2.03**	**8**	**55.9**	**74.4**
Wood prod.	**1.37**	**9**	**25.2**	**34.9**
Furniture	**1.37**	**5**	**22.8**	**34.1**
Food (i. e. fish)	**1.35**	**14**	**55.1**	**65.6**

What emerges from this research is that small firm clusters are particularly important in these industries, in the sense that their shares of industry output and employment (see the last two columns) have grown significantly between 1970 and 1990.

Conclusion

This empirical overview has argued that any policy which seeks to support SMEs as a mechanism for innovation and growth must take account of the fact that the Norwegian industrial economy is heavily based on low and medium-tech industries, in which SMEs account for significant proportions of employment and output. This chapter has argued that such industries are not low-growth sectors, nor are they low innovation sectors. They innovate, grow and are sectors of successful trade specialization. In the following chapters we demonstrate that these sectors are also knowledge and competence-intensive, and that there are high-performing regional 'clusters' within them.

Chapter two: SMEs and innovative competence

Introduction

It is increasingly argued that the development of innovation policies for small and medium-sized enterprises should concern the type of competences SMEs need in order to innovate. For example, the recent Government Commission on Small Firms (*Småbedriftsutvalg)* analysis of policy instruments in relation to SMEs states that "the development of competence is of growing importance as a competitive factor and… the development of competence in small firms will be a central challenge in coming years"[3]. This chapter seeks to analyse existing levels of competence as well as competence needs among SMEs. The main problem is to establish what type of competence is required to increase the innovative capacity and ability of SMEs.

Our approach to this problem is three-pronged. Firstly, we present a brief discussion - based on current perceptions in the literature of this area - of competence factors generally considered to be important to innovative activity in firms. We examine both the formal training of the education system and experience-based, tacit knowledge. This discussion will form the basis for a categorisation of competence.

Secondly, this chapter presents an empirical analysis based on data from the Statistical Central Office (SSB) Employee-Employer register (the 'AA' register). The aim of this analysis is to chart the formal education qualifications of SME employees as compared to employees of larger companies, as well as to examine the development of SME employees' qualifications over time. We examine SMEs according to size, sector and geographic area. This should provide us with a rough indication of the innovation possibilities of different groups of SMEs, based on formal competence alone. The analysis provides the basis for assessing which types of formal competence SMEs possess and which types of competence in particular appear to be lacking in relation to carrying out innovative activity.

Finally, we present more qualitative material on competence needs in SMEs. This information has been gathered from a number of different studies of SMEs, as well as from evaluations of policy instruments aimed at SMEs and from informants with particular knowledge and insight into the situation of small firms. On the basis of this information we discuss the strengths and weaknesses of SMEs in relation to carrying out innovation, the role of the science and technology infrastructure in SME knowledge bases, the abilities of SMEs in identifying their own competence needs, as well as the obstacles to learning and increasing competence in SMEs.

[3] E. Hervik, "Utvikling av en småbedriftspolitikk i Norge" in O. R. Spilling (ed.) **Perspektiver på næringsutvikling.** BI Yearbook 1997. Fagbokforlaget, Bergen 1996, p. 153.

2.1: What sort of competence is important to innovative activity?

In order to analyse the competence requirements of firms involved in innovative activity, it is essential that we have an understanding of how the innovation process takes place. One important feature of innovation processes is their *complexity*[4]. Firms which innovate have to integrate a wide variety of activities and thus require different types of competence throughout the innovation process.

Innovations often involve technical elements, in the form of new products with new technical components or through the use of new technology in the production process. It may be necessary to develop prototypes and make investments in production equipment. Thus firms have to bring in or develop technological competence; it may be necessary to carry out research internally or to bring in research results from elsewhere.

However, no innovation - not even a technological innovation - is a purely technical phenomenon. Innovation involves the inter-linkage of a range of different activities, such as marketing, company strategy, technological development and recruitment of personnel. Firms have to explore the market for new products and perhaps establish new relations with clients. They have to plan project finance, and innovation strategy has to be integrated with the long-term strategy of the firm. It may also be necessary to employ new personnel or to train existing staff. There may be a need for new suppliers as well as an integration of the firms' activities with those of the supplier.

Firms will thus require many different types of competence during innovation processes. We can split competence needs during innovation in to four main types:

1. Technical/technological knowledge
2. Strategic/business knowledge
3. Market knowledge
4. Internal organisational skills

This categorisation takes account of the fact that innovations can consist of new or altered products, production processes and marketing methods, as well as development of new organisational forms - both internally and between firms. What are the kinds of knowledge which firms must access or possess in these areas? Lundvall and Johnson are amongst those who have argued that the ability to learn is central to economic processes. But what is it that firms must learn and know about in order to innovate and survive? Lundvall and Johnson define relevant economic knowledge along four main dimensions:[5]

- 'know what' - by which they mean factual information about the technology concerned. As we shall see below, an important part of the learning-from-abroad process is simply access to information about what was happening. Learning that

[4] K. Smith, "New directions in research and technology policy: Identifying the key issues", **Step-report 1-94**. STEP-gruppen, Oslo 1994.

[5] B. Lundvall and B. Johnson, "The learning economy", **Journal of Industry Studies**, Vol. 1, No 2, 1994, pp.23-42.

there is something to access is of course a precondition for undertaking other learning processes to actually absorb and use it.

- 'know why' - by which they mean knowledge of basic scientific and technological principles for the solution of problems.

- 'know who', by which they mean specific and selective social knowledge - learning and knowing who the relevant people are for the solution of problems. In the context of human-embodied knowledge and interactive learning and interactive problem solving, access to key personnel is potentially a key resource in Scandinavian inward technology acquisition.[6]

- 'know-how', by which they mean practical skills and capabilities; covering skills, and all aspects of production capabilities and marketing.

These types of learning and knowledge must cover at least three distinct areas: technological competences and capabilities, organisational capabilities, and management of links between different types of actors or institutions who are involved in the transfer process.

However, competence needs vary between different sectors and types of firm. Innovative activity is never uniform; firms innovate in very different ways. Firms have different needs for external competence during the innovation process, and experience different management and organisational demands. For example, some sectors and firms require substantial formal R&D competence. Other sectors may place greater emphasis on the development of prototypes, testing and trial production, and have greater need for skilled-workers.

Next, we can draw a general distinction between radical and incremental innovations. Radical innovations concern the development of entirely new products or production processes. Formal, higher-education level competence is often required, along with systematic research and development[7]. However, innovation more usually takes the form of smaller, incremental, changes, often in areas where firms already have the necessary expertise and experience. This type of innovation is usually developed within production itself by engineers, technicians or workers. There is generally a need for technical insight and competence at a skilled worker level, gained through formal training and/or long-term experience with a particular production and technology. Competence is needed here to be able to introduce frequent, small changes to products and processes, to find concrete solutions to production problems, as well as to find efficient ways to produce new products.

Firms thus have different competence needs, and require different levels of competence during the innovation process. There may be a need both for formal R&D competence and for skilled worker competence. Further, experience of R&D work, administration, marketing and production are also all important to innovative activity.

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[6] See especially E. von Hippel, **Sources of Innovation,** Oxford: OUP 1989.

[7] C. Freeman, "The 'National System of Innovation' in historical perspective", **Cambridge Journal of Economics**, 19, 1995, pp. 5-24.

In addition to formal competence, tacit knowledge has been identified in many studies as an important factor in innovation[8]. Tacit knowledge refers to the fact that we know more about a phenomenon than we are able to communicate through writing or speech. We may for example possess knowledge about *how* a specific technology functions, but not know exactly *why* it functions in the way that it does. This means that tacit knowledge is difficult to communicate. Such knowledge is possessed by people and is transmitted through informal learning at work and in the local community. “Important elements of tacit knowledge are collective rather than individual”[9]. This is knowledge that is learned through practice; by watching what others do and by trial and error.

Tacit knowledge is often seen as an opposite of formal, codified knowledge, despite the fact that there is no absolute distinction between the two. Formal knowledge is communicated through speech or writing. It is this kind of knowledge that is taught to pupils and students through lectures and books. Senker and Faulkner claim that tacit knowledge continues to play an important role in innovative activity, despite the growth of scientific knowledge and research and development activities[10]. This is because firms make use of - and create - both codified and tacit knowledge in their innovative activity. Technologies can be complex, and innovations may be developed through experimentation; a successful result can be obtained without a deep understanding of the reasons behind the successful outcome. Further, as mentioned, much innovation takes the form of smaller, gradual changes to products and processes within day-to-day activity. New solutions in production methods or products which function well are copied, without the actors necessarily having a fundamental understanding of how things work.

Firms thus develop knowledge about their products and production methods both as codified knowledge in the form of written manuals and instructions, and as tacit knowledge in the form of routines and successful ways of doing things. A lot of knowledge is therefore specific to certain products, production methods and firms, and knowledge is tied to specific individuals who have a certain type of experience within the firm. The importance of tacit knowledge for innovative activity means that an examination of formal competence within firms by no means provides us with a full picture of their innovative capacity. However, through statistical analysis of the competence of employees in SMEs, we are limited to looking at formal competence.

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[8] J. Senker and W. Faulkner, “Networks, tacit knowledge and innovation”, in R. Combs et al (eds.) **Technological Collaboration. The Dynamics of Cooperation in Industrial Innovation**, Edward Elgar, Cheltenham UK 1996, pp. 76-96.

[9] B-Å. Lundvall and B. Johnson, “The learning economy”, **Journal of History Studies**, 1, 1995, pp. 23-42.

[10] op cit.

2.2: Formal competence in SMEs

Against the background of data from the Employee-Employer register (the A-A register), we will now chart the formal competence of employees in (different types of) SMEs compared to large companies. Further, we will examine how employee competence developed in SMEs between 1986 and 1994.

Table 2.1 presents the share of employees according to the different size categories of firms[11]. The main pattern reveals that firms with fewer than 50 employees increased their share of employees between 1986 and 1994. That is to say, firms with fewer than 50 employees have as a group grown more rapidly than the average for all firms. In contrast, firms with more than 50 employees show a decline in share of employees. This is particularly true for the largest firms with more than 500 employees. The pattern that emerges from Table 2.1 is in agreement with other surveys and data sources, for instance Isaksen and Spilling (1996), and presented in Chapter One, where the source of data is the *Bedrifts- og foretaksregister* of SSB (Statistical Central Office). The smallest firms make up a growing section of the economy, but there are different explanations for this growth.

Table 2.1: Educational levels in different size categories of firms

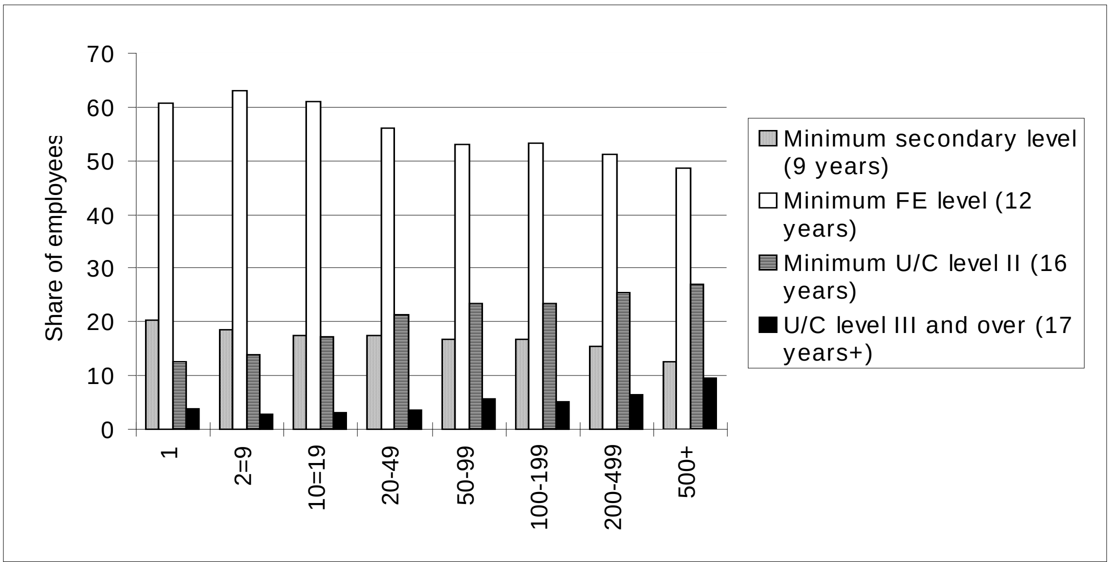
	1	2-9	10-19	20-49	50-99	100-199	200-499	500+	Total no. of employees
1986	2.3	15.7	11.0	17.2	13.7	12.0	11.5	16.5	1,664,243
1990	2.5	17.5	11.6	17.6	13.3	11.8	11.2	14.2	1,666,431
1994	2.5	17.8	11.9	17.6	13.3	11.6	11.8	13.5	1,710,233

When we examine education *levels* (no. of years in education), we find significant differences between the different size categories. Educational levels rise evenly with increasing firm size (Figure 2.1). For example, 17% of employees in size-categories 2-9 have university/college level education, whilst this is true of almost 37% of employees in firms with over 500 employees.

Figure 2.1 includes all types of education. Figure 2.2 shows shares of employees with qualifications within two areas that we can presume to have great importance for firms' innovative activity, namely a) administration, economics, social sciences and law, and b) manufacturing, handicrafts, sciences and technical studies. In the former area, shares are greatest for the small size categories, which is to say that small firms have relatively greater shares of employees with qualifications within administration etc. than large firms.

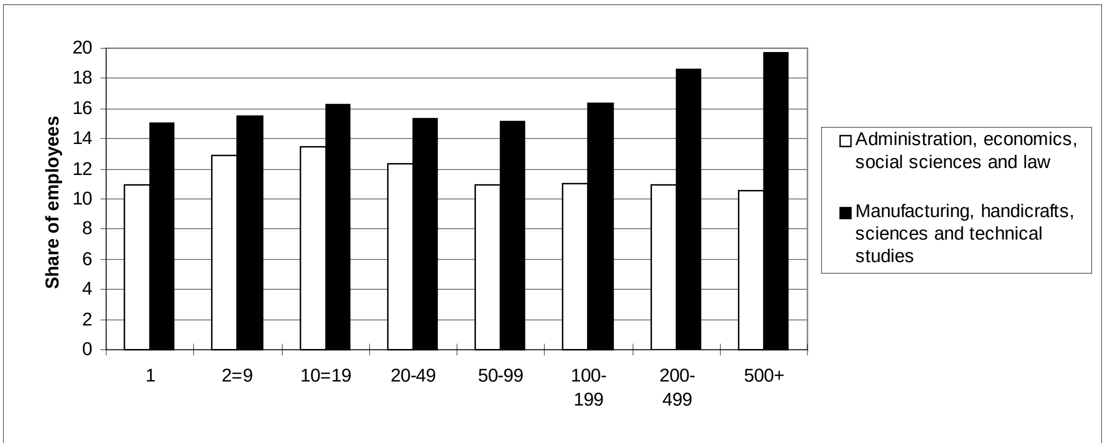
[11] In the first instance we are looking at SMEs in all industries as a whole, despite the fact that SMEs in for example *The European Observatory for SMEs* are limited to private sector firms excluding agriculture. Later in the chapter we examine SMEs within different industries.

Figure 2.1: Educational levels of employees in different firm size categories. 1994



However, this difference is due to the fact that smaller firms have a higher share of employees with qualifications in these areas from further education colleges (business school etc.). The share with qualifications within administration etc., at university/college level is slightly greater for larger firms, but the difference is not striking. This shows that smaller firms are well covered in terms of competence within administration, economics, etc., compared to larger firms.

Figure 2.2: Share of employees in two areas of education. 1994



The share of employees with qualifications in manufacturing, handicrafts, science and technical studies increases for firms of 100 employees and more but appears to be relatively substantial for the smallest categories also. However, here too we find significant differences in levels of education. The share of employees with further education level qualifications within manufacturing and handicraft etc. is as large for small firms as for larger ones. However, larger firms have a far greater share of employees with qualifications at university/college level (such as technicians, engineers and civil engineers) (Table 2.2.).

Table 2.2. Share of employees with qualifications in manufacturing, handicrafts, natural sciences and technical studies, by education level. 1994.

	1	2=9	10=19	20-49	50-99	100-199	200-499	500+
Minimum FE level (12 years)	10.7	11.9	12.1	10.8	9.7	10.3	10.7	10.8
Minimum U/C level II (16 years)	2.9	2.6	3.0	3.1	3.2	3.6	4.3	5.0
Minimum U/C level III (17 years +)	1.4	1.0	1.2	1.5	2.3	2.4	3.5	3.9
Total	15.0	15.5	16.3	15.4	15.2	16.3	18.5	19.7

Shifts in education levels

If we look at developments between 1986 and 1994, we find that levels of education have risen for all groups (Figure 2.3). However this rise, by percent, increases according to firm size, with the exception of the smallest size group. In size categories 2-9, the share of employees with university/college level education rose from 11% in 1986 to 17% in 1994, i.e. by 5%. In firms with more than 500 employees, the share of employees with this type of education rose by almost 10 percentage points, from 26.8% to 36.7%. Thus the distance between size groups in terms of education levels is increasing. Educational levels are rising for smaller firms, but they continue to lag behind larger firms.

These developments in education levels for the different size categories reflect a variety of firm-level processes. Firstly, changes in the make-up of personnel can lead to increases in education levels, as young employees generally have higher levels of education than older ones. However, there is also a significant change in the make-up of firms, both overall and within the different size-categories. For example, in Norwegian manufacturing 43% of firms that existed in 1980 had ceased to exist by 1990, whilst the same period saw the establishment of new firms that more than made up the number of those disappearing[12]. This shift was particularly strongly felt within the smaller size categories. At the same time, many firms also increase or decrease in size and therefore move between size-categories.

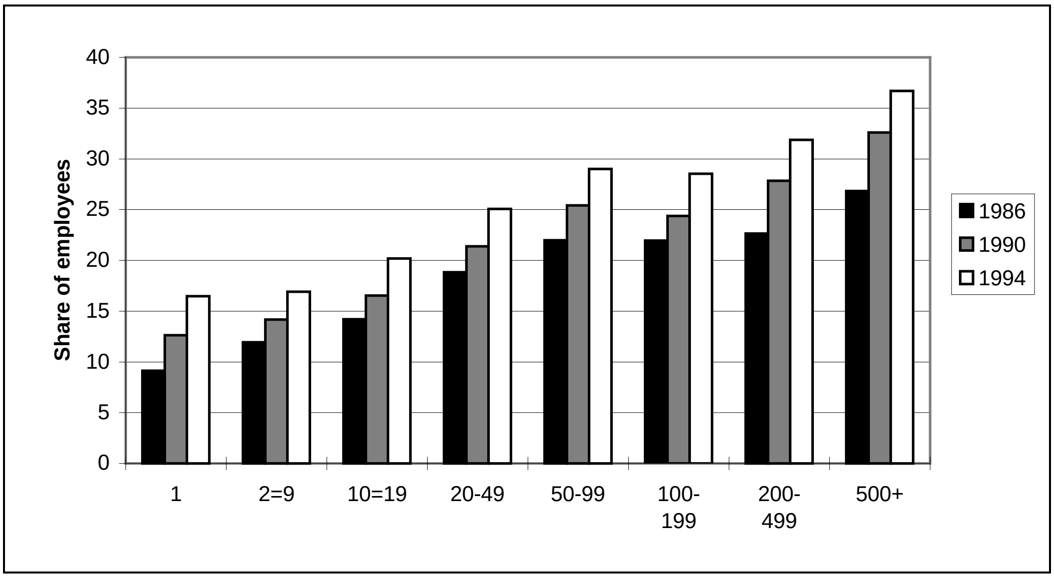
When we compare different size categories at different points in time, we are thus comparing different populations of firms. This type of change may help explain why the smallest size category, firms with one employee, displays a faster rise in education level between 1986 and 1996 than all other categories under 200 employees. There is a particularly high rate of firm turnover in this group, and there is probably a degree of establishment of new firms where the founder (who may be previously employed in a larger company) has higher education qualifications.

It is noticeable that although SMEs on the one hand are increasing their numbers of employees at a faster rate than larger firms, on the other hand, smaller firms show slower growth in numbers of employees with higher education. If we, for the sake of

[12] A. Isaksen and O. R. Spilling, **, Regional utvikling og små bedrifter** (Regional development and small firms), Høyskoleforlaget: Kristiansand, 1996, p. 136. See Chapter One above.

simplicity, allow the number of employees with higher education to be an indicator of firms' access to competence, then we must conclude that firms with least competence and least growth in competence grow fastest.

Figure 2.3: Share of employees with university/college level education according to firm size categories. 1986, 1990 and 1994



However, there are a number of factors which make this conclusion too simplistic. Firstly, there are numerous and connected causes behind the increased share of employees in SMEs. There are reasons behind this growth other than simply that SMEs grow quickly because they are more competitive than large firms. For instance, changes in business structure affect different sized firms differently[13]. The past twenty years has seen a steady decline in the number of manufacturing employees in Norway, whilst several service sectors have experienced massive growth. The manufacturing sector has a far greater proportion of large firms and lower proportion of small firms compared to the service sectors. This means that a large-firm sector (manufacturing) has fewer employees, whilst small-firm sectors (services) have increased. Structural change, with a relative shift in importance between manufacturing and services) thus leads to an increase in the importance of small firms in the economy as a whole.

Next, part of the growth in small firms may also originate in developments within large firms. One feature is that large firms to a larger degree concentrate on their core activities and sub-contract other activities to outside companies. This may lead to a loss of jobs within large firms and to growth in small firms, despite the fact that the large firms continue to control activities to the same extent as before. This type of development means that large firms are growth creators, by providing a basis for the establishment and expansion of small firms.

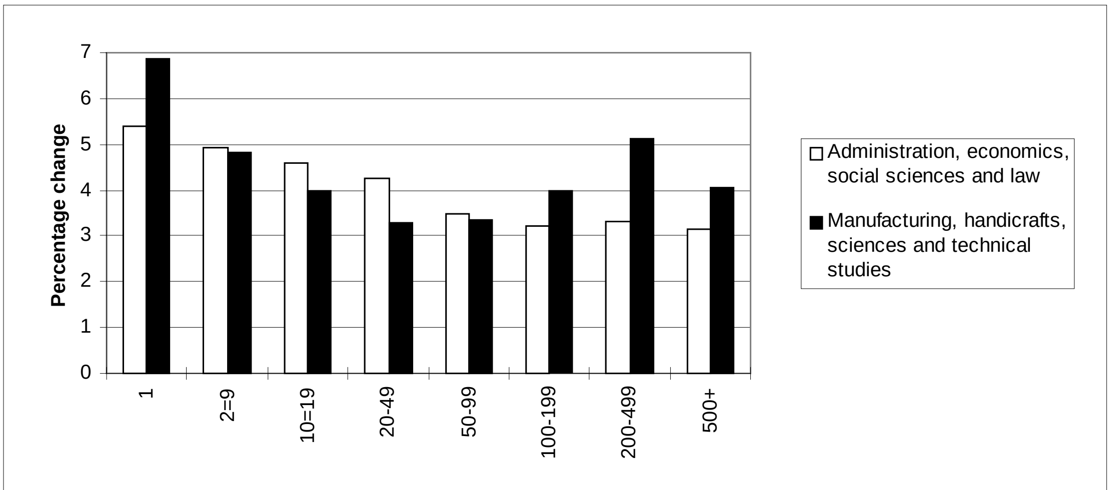
Another aspect which makes the statement that firms with least competence display the greatest growth too simplistic is the matter of how we define *competence*. So far

[13] cf. A. Isaksen and O. R. Spilling, ibid.

we have concentrated on education *levels*. We find that smaller firms as a whole have a relatively large share of employees with further education qualifications within trade, administration, economics, manufacturing and handicrafts. The importance of experience-based competence has not been considered. As noted above, this type of competence is considered to be very important to innovative activity, especially with respect to smaller, incremental innovations. Further, firms can also bring in competence from outside, for example through network co-operation. This is also an important element in innovative activity, in that innovation is fundamentally an interactive process.

If we concentrate on the two areas outlined above - administration, economics, social sciences and law on the one hand, and manufacturing, handicrafts, sciences and technical studies on the other - we find that the picture of low growth in formal competence in SMEs changes somewhat. The smallest firms show a greater rate of growth in the *share* of employees with qualifications in administration, economics etc. than the largest groups (Figure 2.4). If we look more closely at these figures, we find that growth amongst smaller firms is generally in the share of employees with further education and university/college levels I and II, incorporating in particular the "traditional" trade and administration studies at further education college and up to three years at university/college level. Large firms have relatively greater shares of growth from employees with more than three years at university/college level. Nevertheless, upgrading of competence in administration and economics seems to be a general feature for SMEs.

Figure 2.4: Changes in share of employees in two areas 1986-1994, according to firm size categories



Shares of employees educated within manufacturing, handicrafts, etc. have also increased for all size classes, and there are no systematic variations between classes. Growth is greatest for the smallest and largest firms. For the smallest firms, the greater part of this growth is accounted for by further-education level qualifications. In size class 10-19 employees, for example, almost 80% of the increase is due to further-education qualifications. For larger firms a greater share of the growth comes from university and college level. Approximately 40% of the increase among firms with 100-499 employees comes from this level. This means that all size classes of firms have strengthened their position at skilled worker level within manufacturing and handicraft areas in the period 1986-1994, whilst for large firms, a relatively greater share is accounted for by technicians and engineers.

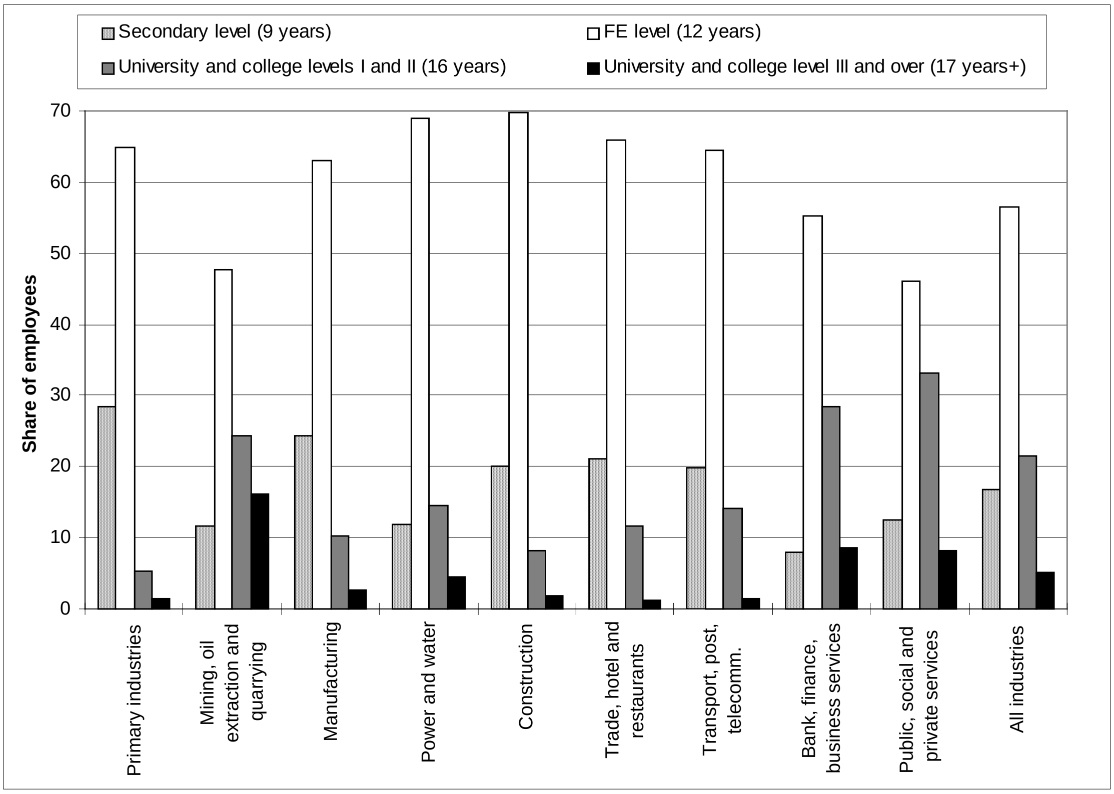
Education levels in different size classes and industries

We will now turn to look more closely at the distribution of education levels according to the main industries. We find significant differences between industries (cf. Figure 2.5). Three industries are notable for high shares of employees with university and college education. These are:

- Mining and oil. This is accounted for by the fact, noted in Chapter One, that the oil sector has a large number of employees with higher education, many with university/college level III or higher.
- Banking, finance, insurance, and business services. Here it is the business services sector, or consultancy sector, which in particular has a large number of highly educated employees.
- Public, social and private services. Here, “education, health and other social services” displays the highest education level.

Educational levels are lowest for primary industries and construction. In primary industries (agriculture, forestry, fishing and whaling), only 6.6% of employees have higher education qualifications, compared to 26.6% for all industries as a whole, and more than 40% in mining and oil as well as public, social and private services.

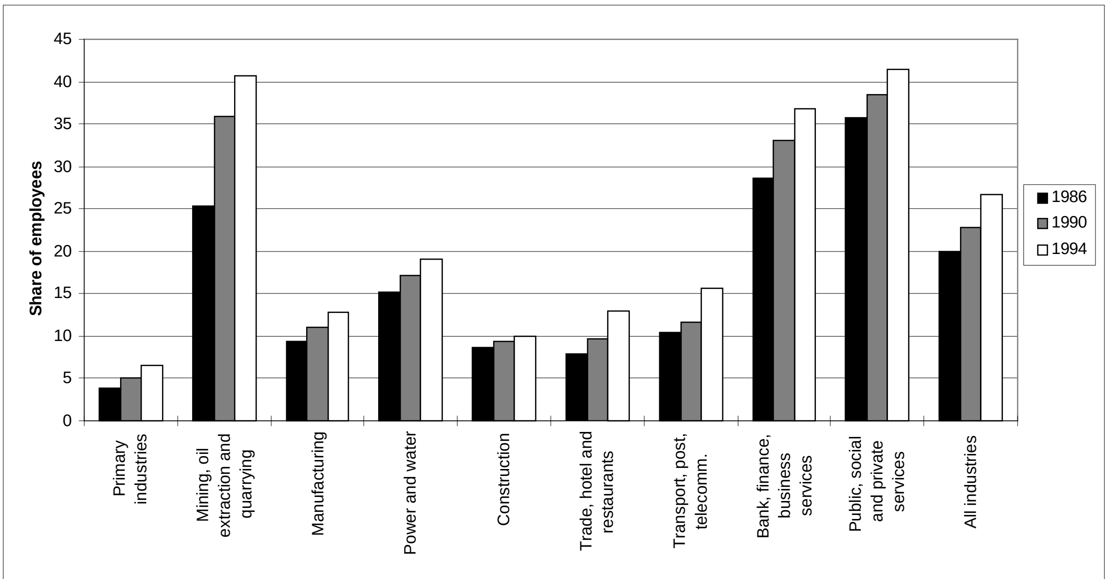
Figure 2.5: Employees according to qualifications, by main industries. 1994



Despite the fact that the fishing sector stands out as a sector with low education levels according to the indicators used here, Dietrichs and Smith characterise this as a "high-tech" sector[14]. It is characterised as high-tech on the grounds that the technology employed in large parts of the sector is closely tied to some of the most advanced areas of industrial technological change. Thus the fishing sector is an area where advanced technology is created, adopted and put into use. Norway - partly in conjunction with the oil sector - has built up substantial knowledge resources within high-tech sectors such as acoustics, optics, electronics and offshore technology generally. This is knowledge which is applied with great success in the fishing sector (particularly within whaling and aquaculture), and the industry is today at the technological vanguard in several areas. This process is dependent not simply on the industry's internal R&D, but on industry's ability and opportunities to create networks interfaced with the existing knowledge infrastructure. In other words, low formal education levels of actors in a sector do not mean that the sector fails to exploit substantial competences.

Education levels rose in all the main industries between 1986 and 1994 (Figure 2.6). Measured by percent the increase is greatest for mining and oil, as well as for banking, finance and business services - i.e., for two of the sectors with the highest initial education levels. Increases are lowest for the construction industry and for the primary industries. This means that recruitment of highly-educated personnel is unevenly distributed between industries; highly educated employees are first and foremost recruited to industries that already possess this type of workforce. Thus differences between industries are increasing.

Figure 2.6: Share of employees with university/college qualifications by main industries



14 E. Dietrichs and K. Smith, "Innovasjonssystemer i fiskeindustrien", in A. Isaksen (ed.), **Innovasjoner, næringsutvikling og regionalpolitikk** Høyskoleforlaget, Kristiansand, 1997.

What then is the distribution of highly educated employees according to firms' size classes within individual industries? As mentioned, the pattern for industry as whole is that the number of employees with higher education rises as firm size increases (cf. Figure 2.1). With a few exceptions, this pattern is true also for the industries taken individually. Primary industries have relatively low education levels for all size classes (Figure 2.7). In mining and oil there is a sharp increase for size classes 50 employees and more. Firms with fewer than 50 employees have an extremely low share of employees with higher education; this group of firms is likely to include a large number of mines and gravel companies. Larger firms are generally active in the oil sector, where education levels are relatively high.

In manufacturing, education levels increase for size categories 100 employees and more. In addition, the smallest size category (1 employee) also has a relatively large share of employees with higher education. However, there are no massive differences for large and small firms in manufacturing. In the four sectors power and water, construction, trade and hotel/restaurants, and transport, storage, post and telecommunications, education levels generally rise as firm size increases. The level decreases somewhat, however, for the largest firms in power and water and in construction.

In banking, finance, insurance and business services, education levels are even for all size categories. This industry includes numerous small consultancy firms with large shares of highly educated personnel. In public, social and private services, a sector largely consisting of public servants we also find a high education level which increases according to firm size.

Figure 2.7: Share of employees with university/college qualifications, by main industries and size categories. 1994

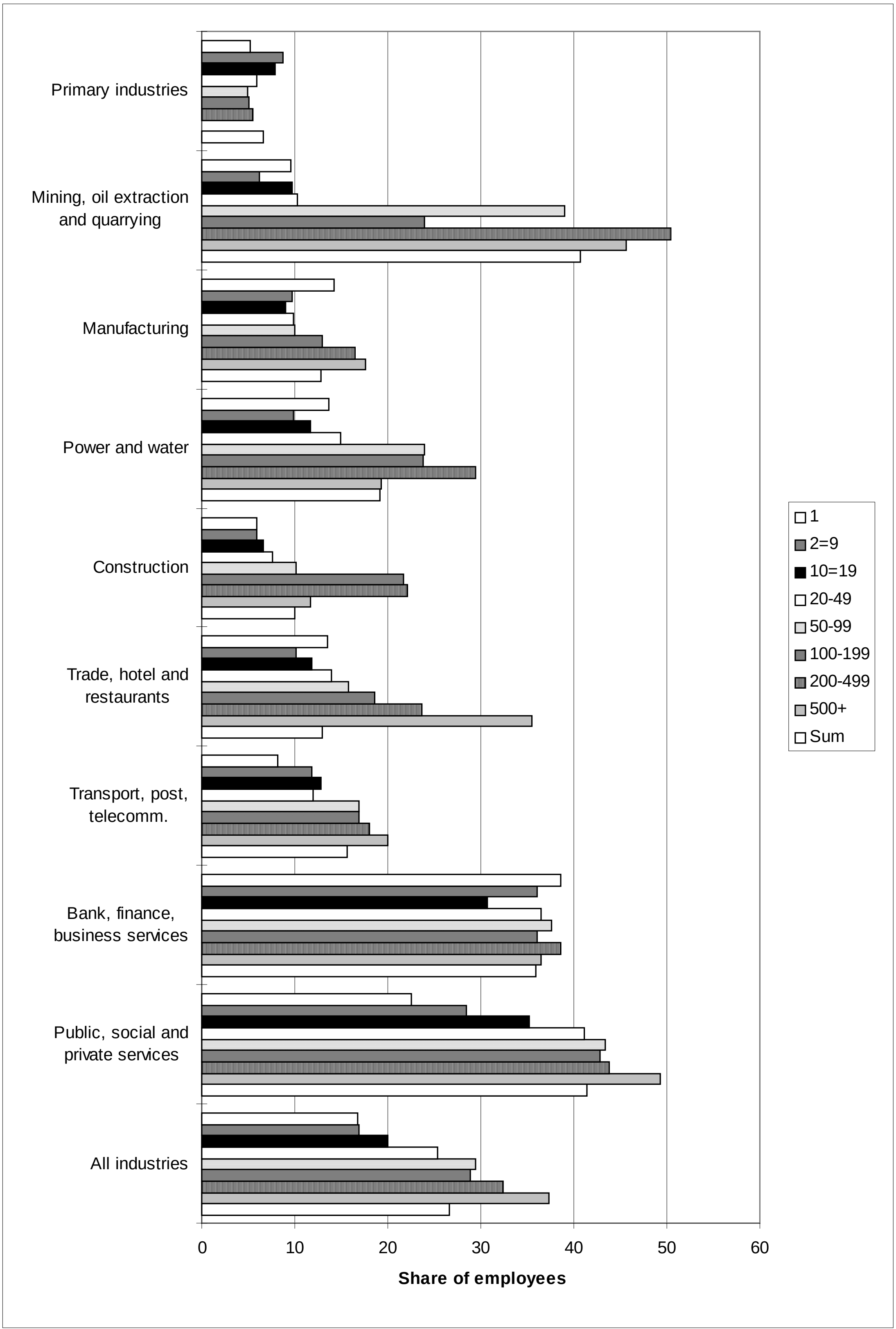


Figure 2.7 shows that the general pattern of smaller firms having lower education levels than larger firms is true for most industries. There are, however, significant

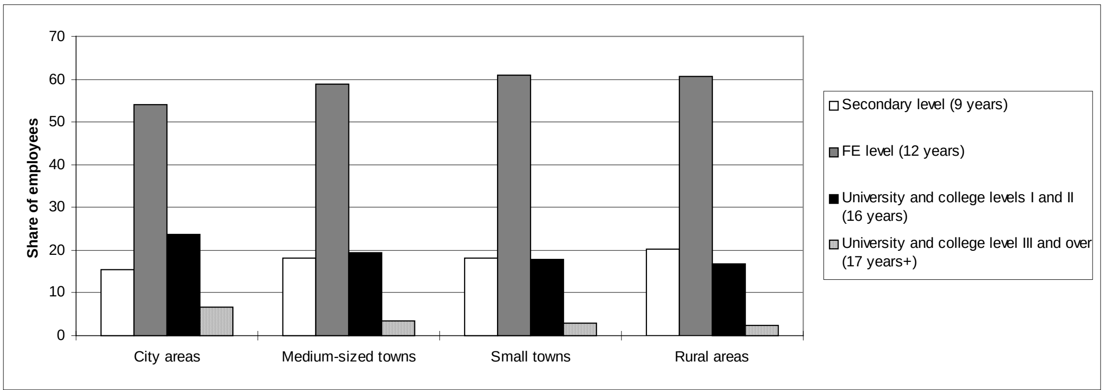
variations in education levels between SMEs in different industries. Most noticeable is the high education level of small firms in banking, finance and business services compared to small firms in construction.

Education levels in different regions

We will now finally turn to examine the variations in education levels in different geographic areas. In order to do so, we have chosen to divide Norway into four area types, based on the Central Statistical Office classification of municipalities according to degree of centrality (cf. Figure 2.8). This type of classification highlights the centre-periphery dimension[15].

Figure 2.8 displays significant differences in education levels between the four area types, and we can see a clear centre-periphery pattern. Education levels are highest in city areas, where around 30% of employees are educated to university/college level. In rural areas only 19% of employees are educated to this level.

Figure 2.8: Education levels in different area-types. 1994



The variations in education levels between area types reflects, amongst other things, differences in local business structures. City areas thus have a relatively large number of employees within the three industries with highest education levels, namely oil, banking finance and business services, as well as important parts of the public sector. Rural areas, on the other hand, have relatively large numbers of employees in primary industries, which have the lowest education levels.

The education level rose for all areas between 1986 and 1994 (Figure 2.9). the increase is greatest (in percentage terms) in city areas, and smallest in rural areas. Thus changes in education levels follow set patterns; increases in education level are

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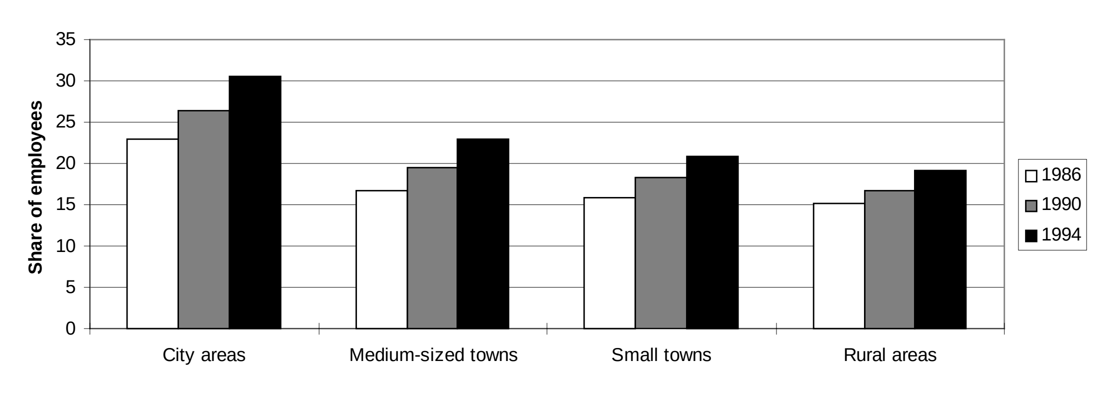
[15] The four area types are developed on the basis of SSB's 1990 classification of municipalities according to centrality. City areas are coded 3; these are built up areas with a dense settlement (level 3) plus municipalities lying within 75 minutes travelling distance (90 minutes for Oslo) to the centre of such a built up area. Six areas came under this code in 1990; Oslo, Kristiansand, Stavanger, Bergen, Trondheim and Tromsø. The medium-sized towns are made up of all towns with a density of 2 or areas within 60 minutes travelling time from the centre of such an area. Level 2 density areas usually have populations of between 15 000 and 50 000. Smaller towns come under centrality code 1. Level 1 density areas usually have a population of between 5 000 and 15 000. Finally, rural areas include municipalities with 0 code centrality; this is a residual which includes all those areas which do meet the requirements for centrality codes 1, 2 and 3.

greatest in those size categories, industries and geographic areas which have high levels to start with. Employees with high levels of education are recruited to firms, industries and areas that are already well supplied with such manpower.

Figure 2.9: Share of employees with university/college qualifications in different area-types. 1986, 1990 and 1994



What then of education levels in small and medium-sized firms in different area types? For SMEs also, education levels are clearly highest in city areas, and lowest in rural areas (Figure 2.10 and 2.11). For example, 30% of employees in medium sized firms in city areas are educated to university/college level, whilst this is true of only 20% in rural areas.

Competence and the Science and Technology Infrastructure

One of the key elements in the Norwegian innovation system is a large sector of universities, high schools and research institutes. What role does this sector play in the creation and distribution of technological competence with respect to innovation in Norway?

The roles of networks and regional clusters will be discussed in more detail in the following chapter, but here we present a concept of the knowledge base of an industry, with a detailed empirical example. Our argument is that this example is characteristic of many of the sectors of the Norwegian economy in which SMEs are important.

How can the knowledge base of an industry be understood and described? Clearly all firms operate with some kind of technological knowledge base. Here we distinguish between two areas of production-relevant knowledge, namely firm-specific knowledge, and sector or product-field specific knowledge.

At the firm level, the knowledge bases of particular firms are highly localised, and specific to very specialised product characteristics. We can distinguish between two cases. Firstly, there are firms with one or a few technologies which they understand well and which form the basis of their competitive position. Secondly, there are multi-technology firms, but here also the final product is usually technically very specific in terms of performance attributes and technical characteristics. The highly specific character of these knowledge bases is not simply technical: it is also social, concerning the way in which technical processes can be integrated with skills, production routines, use of equipment, explicit or tacit training, management systems and so on. In terms of the form of knowledge, the relevant technological knowledge base may - as we noted above - be informal and uncodified, taking the form of skills specific to individuals or to groups of co-operating individuals. The tacit and localised character of firm-level knowledge means that although individual firms may be highly competent in specific area, their competence has definite limits. This means, firstly, that they may easily run into problems in innovation which lie outside their area of competence, and secondly that their ability to carry out search processes relevant to problems can also be limited; this they must be able to access and use knowledge from outside the area of the firm when creating technologies.

Secondly there are knowledge-bases at the level of the industry or product-field. At this level, modern innovation analysis emphasises the fact that industries often share particular scientific and technological parameters; there are shared intellectual understandings concerning the technical functions, performance characteristics, use of materials and so on of products.

This notion tends also to underpin the important system concepts of “technological paradigm” or “technological regime”. This part of the industrial knowledge base is a body of knowledge and practice which shapes the performance of all firms in an industry. Of course this knowledge base does not exist in a vacuum. It is developed, maintained and disseminated by institutions of various kinds, and it requires resources (often on a large scale). Gregory Tassey has defined the combination of knowledge and institutional base as the "technology infrastructure", in the following way:

> The *technology infrastructure* consists of science, engineering and technological knowledge available to private industry. Such knowledge can be embodied in human, institutional or facility forms. More specifically, technology infrastructure includes generic technologies, infratechnologies, technical information, and research and test facilities, as well as less technically-explicit areas including information relevant for strategic planning and market development, forums for joint industry-government planning and collaboration, and assignment of intellectual property rights[16].

In other words some knowledge contributing to the competitiveness of the firm is also stored in its networks and external relations. An industry which is low-R&D can thus still be an intensive user of advanced technologies and high-level research-based knowledge. In the case of fishing, which we shall describe in more detail below, the industry interacts with other industries to buy advanced-technology inputs, and it uses advanced knowledge developed for other purposes (often by universities or research institutes) to solve problems within fishing. That is to say, there are inter-industry flows or ‘spillovers’ of advanced knowledge.

These flows take two forms, known as ‘embodied’ and ‘dis-embodied’ spillovers. Embodied flows involve knowledge which is built in to machinery and equipment.

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[16] G. Tassey, "The functions of technology infrastructure in a competitive economy", **Research Policy**, 20, 1991, p.347.

Dis-embodied flows involve the use of knowledge, transmitted through scientific and technical literature, consultancy, education systems, movement of personnel and so on.

The basis of embodied flows is the fact that most research-intensive industries (such as IT, or the advanced materials sector) develop innovative products which are used within other industries. Such products enter as capital or intermediate inputs into the production processes of other firms and industries: that is, as machines and equipment, or as components and materials. When this happens, performance improvements generated in one firm or industry therefore show up as productivity or quality improvements in another. A familiar example is computing, where large decreases in price-performance ratios have their major impact not on the computer industry itself but on computer-using industries (recent research has shown that this is having increasingly large economic impacts). The point here is that technological competition leads fairly directly to the inter-industry diffusion of technologies, and therefore to the inter-industry use of the knowledge which is "embodied" in these technologies. The receiving industry must of course develop the skills and competences to use these advanced knowledge-based technologies. Competitiveness within 'receiving' industries depends heavily on the ability to access and use such technologies.

Examples of embodied flows in Norwegian fishing include use of new materials and design concepts in ships, satellite communications, global positioning systems, safety systems, sonar technologies (potentially linked to winch, trawl and ship management systems), optical technologies for sorting fish, computer systems for real-time monitoring and weighing of catches, and so on. Within fish-farming, these high-technology inputs include pond technologies (based on advanced materials and incorporating complex design knowledges), computer imaging and pattern recognition technologies for monitoring (including 3D measurement systems), nutrition technologies (often based on biotechnology and genetic research), sonar, robotics (in feeding systems), and so on.

The disembodied flows and spillovers are also significant. Underlying these technologies are advanced research-based knowledges. Ship development and management relies on fluid mechanics, hydrodynamics, cybernetic systems, and so on. Sonar systems rely on complex acoustic research. Computer systems and the wide range of IT applications in fisheries rest on computer architectures, programming research and development, and ultimately on research in solid-state physics. Even fish ponds rest on wave analysis, CAD/CAM design systems, etc. Within fish-farming the fish themselves can be transgenic (resting ultimately on research in genetics and molecular biology), and feeding and health systems have complex biotechnology and pharmaceutical inputs. It is clear that a wide range of background knowledges, often developed in the university sector, flows into fishing: mathematical algorithms for optimal control, molecular biology, and a wide range of sub-disciplines in physics for example.

An empirical description of this kind of industrial knowledge base involves a 'map' of:

i) the key activities in the industry and key personnel performing these kinds of activities. What are the main technical components of production activity within the sector concerned?

ii) the key techniques - meaning capital inputs, equipment, instruments and production routines - being utilised to perform these activities.

iii) the knowledge bases - in terms of engineering and scientific knowledges - supporting these techniques. What are the codified knowledges with which the technical operations are designed, analysed, and produced?

iv) what are the organisational forms - in terms of companies, research institutes, universities and so on - through which these knowledges are produced and disseminated? Concretely, who develops the relevant knowledge inputs, and on what resource basis?

It is argued above that firms, within the same industries, share some similarities with regard to knowledge bases, i.e. they are familiar with certain kind of activities, procedures, personnel, suppliers, scientific principles etc. Our argument concerning SMEs in Norway is that the institute sector is crucial to the structure and operation of these knowledge bases-

Table 2.3 gives an overview, drawn from earlier STEP work, of the regime of an industry, in this case aquaculture

Table 2.3: Activities, technologies and networks in Norwegian aquaculture.[17]

Activity	Technology/Knowledge-area	Networks
Construction of Ponds, moorings, cranes, lifting-equipment boats	materials technology, wave analysis, hydrodynamics , surface technology, construction- and welding technology, Information technology, CAD, CAM,	Simrad Subsea AS, Sintef Norsk hydroteknisk laboratorium, Marintek, Havforskningsinstituttet, Fiskeriforskning
Monitoring	Sonars, information technology, computer imaging, electronics, advanced mathematical algorithms, acoustics, optics	Simrad, Lindem, Sintef
Health, laboratory services, vaccines, chemicals	nutrition technology, bio technology, electromicroscopy, gas technology, thermodynamics, marine biology, chemistry hydrodynamics	Norges Veterinnærhøgskole, Norconserv, Akvaforsk NLVF, Fiskeridirektoratets ernæringsinst., Inst. for næringsmiddelhygiene-NVH , Inst. for bioteknologi Sintef Norsk hydroteknisk lab., Havforsknings inst., Inst. for fiskeri- og marinbiologi, NINA, Fiskeriforskning, Vetrinærinst., Norbio AS, Inst. for fiskeri-og marinbiologi, Inst. for akvakultur NVH, Fellesavdeling for farmakologi og toksokologi NVH, Inst. for medisinsk biologi UNIT, Inst. for mikrob. og plantefysiologi UIB, Teknisk kjemi Sintef, Biologisk inst. UIO
Feed	process control, industrial processes, chemistry, marine biology, hydrodynamics, extrusion technology, monitoring technologies, information technology, nutrition technology	Akvaforsk NLVF, Fiskeridirektoratets ernæringsinst., Inst. for bioteknologi Sintef, Sintef Norsk hydroteknisk laboratorium, Havforsknings-instituttet, Sildeolje- og sildemelindustriens Forskningsinst., Fiskeriforskning, Fiskeridirektoratets ernæringsinst, Marintek AS, Norges Fiskerihøgskole
Feeding Machines	materials technology, information technology, telecommunication, electronics, cybernetics high pressured air technologies, robotics, welding technology	Fiskeriforskning, Akvaforsk NVL Ås

[17] This table is based on information from **NFFR's prosjektkataloger 1986-1993, Norsk Fiskeoppdrett, Havbruk** and interviews and visits at different plants.

Table 2.3: Activities, technologies and networks in Norwegian aquaculture. (continued)

Measurements and manipulation of colour and fat	nutrition technologies, biotechnology, spectro photometer, bio physics, computer tomograghy, NIT, NIR, NMR spechtrography, 3D measurements, visions and camera technology, marine biology	Norsconserv, Fiskeriforskning, Akvaforsk, institutt for bioteknologi Sintef
Measurements and manipulation of stress before slaughtering	high pressured liquids, chromography, magnetic resonance, biophysics, marine biology	Teknisk kjemi Sintef, Fiskeriforskning, Havforskningsinstituttet
Slaughtering, filleting	mechanical industry, mechanics, information technology, acoustics, optics	Fiskeriforskning
Sorting, counting and weighing of fish	mechanical industry, information technology, electronics, laser technology, mathematical algorithms, optics	Fiskeriforskning, Havforskningsinstituttet
Fish processing, refinement	mechanical industry, freezing technology, information technology, programmable logical systems, robotics, optics, acoustics	Fiskeriforskning, Havforskningsinstituttet
Conservation, cold storage	materials technology, refrigeration technology, gas technology, NMR spectroscopy, thermodynamics, transport theory, biology, electronics	Institutt for bioteknologi NTH, Institutt for kuldeteknikk NTH, Fiskeriforskning
Trading of fish	information technology, telecommunication, signal processing, electronics	Marintek, NORUT Fiskeriforskning
Transport and transport equipment	material technology, mechanical industry, welding technology, refrigeration technology, gas technology, telecommunication, signal processing, thermodynamics	Marintek

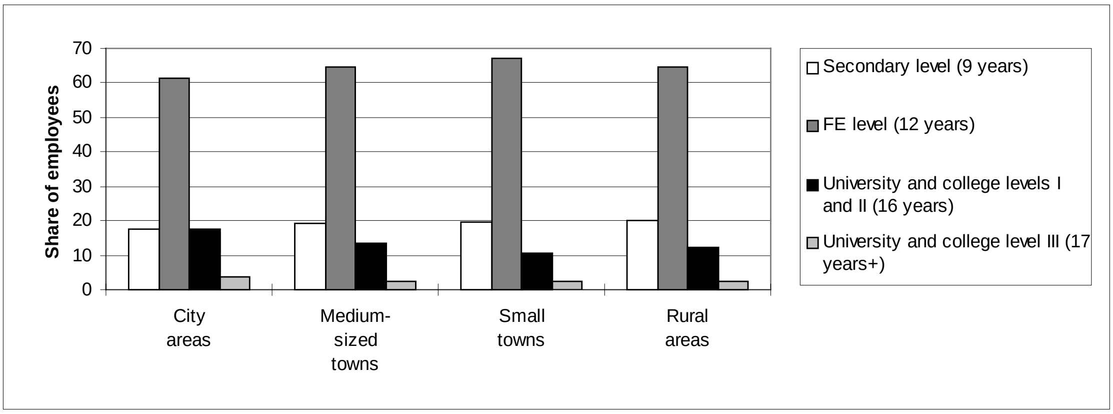
This 'map' demonstrates the main activities, technologies and networks which are familiar to most aquaculture firms in Norway. Two key points emerge. First, there exists a close linkage between the principal technologies of the Norwegian aquaculture sector and some of today's most advanced areas of industrial innovation.[18] Second, we see close networks and links to important research institutes and firms in Norway. This map illustrates that aquaculture is the subject of substantial knowledge spillovers from other institutes and industries mainly located in Norway: The sector to a very significant degree draws on the general knowledge infrastructure.

This is not the place for a full discussion or extension of this approach. However the processes which have been illustrated in the aquaculture sector can be shown to be characteristic of many if not most sectors of the Norwegian economy, and particularly of the low-R&D sectors in which SMEs are prominent. We conclude therefore that an understanding of the competence requirements of the SME sector must include an appraisal of the institute-sector infrastructure which plays such an important role in establishing and distributing high-grade technological knowledge.

2.3: Can SMEs identify their own competence needs?

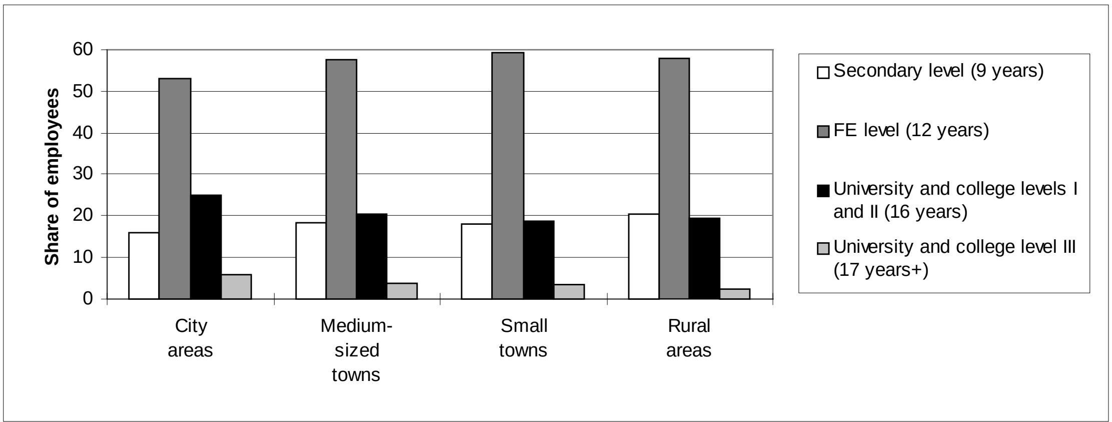
Whilst Chapter 2.2 presented a quantitative charting of the formal competence of SMEs on the basis of the Employee-Employer register, we will now turn to qualitative studies dealing with the competence needs of, and lack of competence in, SMEs. These studies supplement and illuminate the results of Chapter 2.2. The problem is tied to understanding the strengths and weaknesses of small and medium-sized firms when it comes to carrying out innovations, the degree to which (different kinds of) SMEs are able to identify their innovation competence needs, as well as the barriers to learning and development of competence in SMEs.

Figure 2.10: Education levels in small firms (0-19 employees) in different area-types. 1994



[18] This pattern of technology use is not reflected in the internal R&D of the industry itself, and the usual indicator of technology intensity (the R&D/Sales ratio) is a very unsuitable indicator of the real technological characteristics of the industry.

Figure 2.11: Education levels in medium-sized firms (20-99 employees) in different area-types. 1994



One problem that we encounter when trying to answer questions of this type is that SMEs make up an extremely heterogeneous group of firms, with a variety of existing competences as well as different competence needs[19]. In Section 2.2, small and medium sized firms were categorised according to size, industry and geographic location. We found that SMEs as a whole have lower levels of formal competence than large firms, but also that competence levels vary substantially between SMEs in different areas and industries.

We will now carry out a further classification of small and medium sized SMEs. In Norway, SMEs are generally considered to be firms with fewer than 100 employees. Further, SMEs are considered to be independent organisational units, thus excluding daughter companies, branch offices and so on[20]. This is an important limitation in the present context, as firms that are part of a larger company or concern are often able to access competence from their head office or other units within the concern. It may also be that strategic decision-making, marketing and product development may take place in a head office, whilst a branch company will mainly be concerned to maintain efficient production and will therefore be concerned with process and organisational innovations.

Suppliers who produce parts or components of a product will also generally meet quality and price demands of the customer which require them to be innovative. This can be seen, for example, in the electronics industry at Horten[21]. In Horten there are a number of independent companies, often large companies by Norwegian standards, that is to say companies with their own products for the final goods market, as well as recognised trademarks in international market niches. In addition there are a number of suppliers to these companies in the area, and the larger companies subcontract substantially within the local area. The suppliers are both subcontractors and companies with their own products. Many of them are medium sized companies.

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[19] Cf. O. R. Spilling, **SMB-typologi. Om klassifisering av små og mellomstore bedrifter**, Notat. Senter for Næringsutvikling og Entreprenørskap, Handelshøyskolen BI, Sandvika, 1996.

[20] O. R. Spilling (ed.), **SMB 1997 - fakta om små og mellomstore bedrifter i Norge**, Fagbokforlaget, Bergen 1997.

[21] The description of Horten electronics industry is based on the Norwegian contribution to the Nordic SME forum, sub-project no. 4 “Dynamiske verksamhetsmiljöer i Norden” for Nordisk Industrifond.

The most important activity for the subcontractors is electronics assembly, and they supply components and modules according to customer specifications. Suppliers with own products are found both in electronics and other industries, in particular mechanical engineering.

The trend in recent years has been to develop long-term, wide-ranging forms of co-operation between 'system companies' and suppliers. This can be seen in the early involvement of suppliers in the product development process of the system companies, in that suppliers bear greater responsibility for the development of components and modules which later form a part of the system companies products. Thus subcontractors can affect, for example, the design of components in circuit boards, which in turn contributes to more efficient and cheap production of circuit boards.

This type of supplier thus takes part in a network which requires them to innovate frequently. This section will therefore focus on independent firms with fewer than 100 employees; firms which also do not act as subcontractors with close working relations with customers on innovative activity. We are basically talking about small and medium sized final products firms, with their own products or services. This group comprises a significant number of firms - probably the majority of Norwegian SMEs - with a wide range of competence needs, sectors and markets. Of course, the heterogeneous nature of this group makes it impossible to generalise about the competence needs of this type of firm. It is therefore necessary to further divide this group according to competence needs and barriers to competence.

Spilling examines a range of criteria and methods of classification for small and medium sized firms[22]. An appropriate classification for the discussion in Section 2.3, and more generally when considering innovation policy on SMEs, could be as follows:

1. Non-innovative SMEs; Firms which have little or no innovative activity and which lack conscious innovation strategy. It is likely that the majority of SMEs fall into this category. Certainly more than fifty percent of SMEs (fewer than 80 employees) in Norwegian industry reported no costs associated with innovative activity in the period 1990-92, and less than 15% of turnover in the same period was accounted for by new or altered products. Less than a quarter of the firms had made changes to their products in this period[23].
2. Incrementally innovative SMEs; Firms which make changes to existing products and/or processes from a recognised need to innovate.
3. Radically innovative SMEs; Firms which develop entirely new products and/or processes.

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[22] O. R. Spilling, **SMB-typologi. Om klassifisering av små og mellomstore bedrifter**, Notat. Senter for Næringsutvikling og Entreprenørskap, Handelshøyskolen BI, Sandvika 1996.

[23] S. O. Nås et al, "Innovasjoner og ny teknologi i norsk industri: En oversikt", **STEP-report 4/94**, STEP-gruppen, Oslo 1994.

The NT Programme evaluation

The evaluation of the NT Programme tried, amongst other things, to chart firms' competence needs during development projects and the degree to which the programme managed to meet those needs. Personal interviews were carried out with 24 managers of firms that had received support from the programme and with case-handlers/executives in the NT secretariat. In addition, three separate surveys were carried out of a larger group of firms[24]. The NT Programme's clients fall into groups 2 and 3 above. The programme has managed to reach a group of innovative firms in Northern Norway, and the majority of the firms are small and medium sized.

The evaluation concluded that the "NT-firms" generally possessed a high degree of technological competence. In technological terms the majority of development projects were indeed successful, with firms managing to develop the new product or process in mind. Case-handlers/executives in the NT secretariat found their target group of firms often to be technologically "short-sighted", i.e. preoccupied with technological aspects of the project; the development of a new product or process. The policy task became one of broadening the firms' horizons, i.e. to explore other issues such as marketing and strategic aspects of the project.

This view concurs with the firms' own experiences of the NT Programme's contribution to the innovation process. The most important non-economic contributions made by the programme were advice and guidance on developing strategy, project management, working methods and market orientation. Technological assistance was not considered to be an important factor by the "NT firms".

The evaluation of the NT Programme thus suggests that innovative firms have competence needs first and foremost in areas such as strategic/business and market areas. Further, it seems that firms themselves have difficulty in identifying these needs, as they are preoccupied with technological problems and possibilities.

SME studies

A further example which throws light on the competence problems of (some) SMEs, is the development of the plastic boat industry in Arendal[25]. This region is undoubtedly the centre for the plastic leisure boat industry in Norway. In the mid-90s, approximately 25 boat-builders are found in the area, many of which are the largest and most well-known in Norway. All the firms, however, have fewer than 100 employees. In fact, with the exception of two firms, all have fewer than 30 employees. Approximately 15 subcontractors are also found in the region - firms which supply the industry with important products and services. These firms have traditionally had local founders and owners, and have generally been owned and operated by the same individual. In total, the boat-builders and subcontractors account for around 500 jobs.

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[24] A. Isaksen et al, "Evaluering av nyskapings- og teknologiprogrammet for Nord-Norge (NT-programmet", **STEP-report 1/96**, STEP-gruppen, Oslo 1996.

[25] This example is also based on the Norwegian contribution to the Nordic SME forum, sub-project no. 4 "Dynamiske verksamhetsmiljöer i Norden" for Nordisk Industrifond.

In the 1960s the Arendal boatyards experienced dramatic growth. The area had long traditions in building wooden boats which also proved useful to building in plastic. The area was a front runner in the casting of plastic boats and actually led developments in parts of European boat-building in the 60s and 70s. However at the end of the 1980s the plastic boat industry declined severely. The Norwegian market declined by more than half, and foreign markets also stagnated and declined. Many boatyards went bankrupt, and the Arendal industry suffered substantial job losses.

One of the strengths of the plastic boat industry in this area is the sizeable - mainly tacit - competence which has been built up, mainly in production techniques but also in market knowledge. Firstly, we find competence among the managers and owners of the boatyards, which are often family businesses. The boatyard workforce often have substantial experience in the industry. We are generally talking about informal, tacit knowledge which is passed from person to person through daily work. This competence also includes the development of production equipment (casts). In addition, there are a number of subcontractors in the area with experience in attaining the high levels of quality required by the boatyards.

As a consequence of the high levels of production competence in the boatyards and among subcontractors, the firms in the area are capable of producing boats of a very high quality. Generally, firms have indeed emphasised high quality and "tailor-made" aspects in sales strategies. This has been necessary due to the high costs involved in developing, producing and marketing small series of the same model by all the small and medium sized boatyards in the area. The boatyards are also skilled in carrying out smaller, incremental innovations (development of new boat models) in co-operation with constructors and subcontractors. The boatyards have not, however, managed to carry out more radical innovations since the 1960s when we saw experimentation with production methods. Boatyards have thus not managed to renew themselves in terms of production methods, and consequently (with a few exceptions) have to imitate trends set by foreign boatyards.

As mentioned, substantial experience-based and informal competence has been developed in relation to the production of plastic boats in the Arendal area. An obstacle to the industry is however a lack of professional administrative and technological competence, particularly among small firms. This has played an important role in the difficulties experienced since the late 80s. The founders of plastic boat firms in the 1970s and 80s were often workers with experience from within the industry. These people had substantial experience of the production process itself, and sometimes also in the development of casts. However, they had little experience of administration, marketing, strategy development and organisation of production.

The area's lack of professional competence has practically led to a standstill in the industry's technological development since the 1970s. Casting technology is old-fashioned and "low-tech", which in turn obstructs further development. Development is hindered by weak economic ability and lack of technological expertise in the foundries, as well as a general conservatism in the area. Further, production in the boatyards is still of a handicraft character. The area has lost its previous advantage in relation to foreign competitors, and an upgrading of competence and technology must take place if the industry is to have any possibility of future development.

Thus plastic boat firms in Arendal lack most types of professional competence within technology, strategy, marketing and in connection with organisation of production. This lack of competence is in part recognised by managers, who however are often too busy with daily problems and tasks to consider long-term strategic development. Firms also have limited financial resources for the pursuit of product development and exports. It costs around one million NOK to develop the production equipment and to develop a prototype for a new 25' boat. New production techniques - developed elsewhere - are available for casting, but the industry lacks the competence and economic resources needed to adapt these for use in the local industry.

Problems with professional competence in the small firms have not been eased through for example the establishment of technology centres in the area, or through wide formal co-operative ventures between boatyards and technology development. Nor has there been a development of plastics competence in local technical schools and colleges. Firms have had to be responsible alone for technological development and marketing - a difficult matter for small firms.

The situation of small firms in the plastic boat industry in Arendal is by no means unique. Surveys in the US[26] found that many small firms there "lack expertise, time, money and support to upgrade their current manufacturing operations, introduce new technologies and methods, implement better quality control, and improve workforce training"[27]. Lack of co-operation between firms and between firms and the public support apparatus has been identified as a general obstacle to technological upgrading by SMEs in the US.

Another, more successful illustration of competence needs in small firms is that of Emil Bosvik AS in Risør[28]. This firm has undergone radical restructuring of products and production organisation during the 1990s, which means that this firm belongs to category 3 above; radically innovative firms.

The firm was founded in 1949 and since the 1950s specialised in supplying the plastic boat industry in Arendal. Bosvik was the largest supplier of boat fittings in Scandinavia in the 1980s, with 75 employees. The decline in production in the plastic boat industry after 1989 meant that Bosvik lost almost its entire market in a short period of time. However, since the autumn of 1987, Bosvik had begun to develop a new type of glass wall-system for offices. This was done in order to identify alternative products and markets, as the boat-building industry had a low volume of turnover (500 million NOK per annum in Norway) and thus constituted a limited market. Thus Bosvik had an area in which to continue after the collapse of the boat

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[26] Here referring to firms with fewer than 500 employees.

[27] P. Shapira and J. D. Roessner, "Evaluating industrial modernization: Introduction to the theme issue", **Research Policy**, 15, 1996, p.181.

[28] The description of the development of Emil Brosvik is based on personal interview of manager Jan Gunnar Halvorsen.

industry, although the firm experienced many lean years before gaining a footing in new markets with new products.

The firm now has two main products, 1) office wall-systems, where they have a 75% market share in Norway, and 2) desks and wall sections, where they for instance recently won the contract to furbish the new government offices (1 000 - 1 200 workplaces). They also supply the new library in Alexandria. The office walls are produced entirely by Bosvik. The desks and wall-sections are developed and marketed by Bosvik, while most of the production is carried out by four subcontractors in the Østland area. This group is the largest supplier of office furnishings in Norway.

Bosvik has thus changed products, markets and organisation of production in the course of a few years. One lesson they identify from this experience is that it is easy for firms to continue doing what they have always done, and that firms are not good enough at analysing developments. Thus, there is a lack of strategic planning and possibly competence in this area amongst firms.

Emil Bosvik's competitive advantage lay in their high levels of production competence deriving from their production of boat fittings; experience based and tactic knowledge. Quality demands are high for boat fittings, and production is based on small series of products which are shaped in many different ways. The firm thus had an established small-series, customer-oriented "culture", also important to the new products. However the company did have to build up competence on the administrative side, in particular in project management, marketing and product development.

Obstacles to competence development

What then are the most important barriers to developing competence for innovative activity? Spilling provides the results of a survey in the summer of 1996 of more than 1 400 managers of Norwegian companies with between 2 and 50 full time positions[29]. One of the factors considered in the survey was what the managers perceived to be obstacles towards growth - what hindered firms from growing? Obstacles to growth are certainly different from obstacles to learning, but Spilling's survey can give us a degree of insight into factors which hinder learning, development of expertise and innovation in small firms. Barriers to growth are often tied to problems in developing competitive products and services that are in demand.

The most important barriers to growth in the survey were linked to firms' (strained) economic positions; severe competition, weak demand and low profitability. The second group of obstacles were linked to public regulations and taxes. A third important group of obstacles to growth was connected to conditions within the firms themselves. These are firms that do not want to grow; the firm has reached the size desired by the owner. Such attitudes are most widespread amongst small firms.

[29] O.R. Spilling, "Struktur og dynamikk: Små bedrifter i næringsutviklingen", in O.R. Spilling op cit. 1996, pp. 43-67, and O. R. Spilling, op cit., 1997.

Another factor cited is lack of management skills, and difficulties in recruiting skilled employees.

2.4: Summary

This chapter has analysed formal competence levels among small and medium sized firms and has discussed competence needs associated with innovative activity. As far as education levels (years in education) are concerned our main findings were that:

- Educational levels are lowest for the smallest firms, and increase evenly with firm size. This pattern applies to all the four main industries, with some variation. Thus in manufacturing and in banking and finance and business services there is little difference between small and large firms. Employees in manufacturing, however, have relatively low average education levels, whilst levels are high for banking, finance and business services.
- Educational levels have increased for all size-categories between 1986 and 1994, but increases were been greatest for large firms. Smaller firms therefore increasingly lag behind in relation to the large firms.
- Educational levels in SMEs are highest in city areas and lowest in the most peripheral areas of the country. In part, this reflects differences in business structure. City areas have an overrepresentation of jobs in industries with highest education levels, namely banking, finance and business services, as well as certain parts of the public sector. Rural areas, in contrast, have an overrepresentation of primary industries, which have the lowest education levels for SMEs. Thus the general pattern is that employees with the highest levels of education are recruited to those firms, industries and geographic areas where such labour is already plentiful.

The chapter has also analysed the needs for competence and lack of competence in SMEs on the basis of more qualitative studies. These studies suggest that

- Highly innovative SMEs often possess significant technological competence. Competence needs in relation to innovative activity in such firms appear to be greatest within strategy, business and market areas. Experiences from the NT Programme in Northern Norway further show that firms often find it difficult to identify such needs for competence, as they are highly preoccupied with the technological aspects of their activities.
- Firms involved in incremental innovation (changes to existing products or processes) often have employees with strong experience-based competences, which is very important to smaller, gradual innovations. However, experiences from the boat industry in Arendal show that this type of firm often lacks the professional technological competence necessary for more radical innovation. Further, these firms lack competence in strategy development, market planning and organisation of production.
- An important barrier to further growth, and perhaps to competence development, is for many firms the lack of desire (on the part of management, the owner and

founder of the firm) for further growth. Insufficient management skills was also cited as an important barrier to growth in Spilling's article[30].

[30] op cit., 1997.

Chapter three: SME target groups: The SME sector and regional clusters of SMEs

Introduction

A central issue in the formation of SME policy is the selection of target groups, a problem which is complicated by the large size and extreme heterogeneity of the SME population. This chapter advances an argument concerning potential target groups. It argues that many of the SME-intensive sectors in Norway are also characterised by identifiable regional clusters, and that these clusters are potential targets for SME-oriented policies.

As emphasised in Section 2.3, small and medium sized firms make up a large and extremely heterogeneous group of firms. In 1990, 208 000 firms with fewer than 100 full-time employees were registered in the *Bedrifts og foretaksregister*[31] of the Central Statistical Office (Statistisk Sentralbyrå, SSB)[32]. Only slightly more than 1 000 firms were registered in Norway with more than 100 full-time employees. Small and medium sized firms account for 620 000 FTEs, almost 70% of private sector employment in 1990.

Since SMEs make up the majority of firms in Norway and account for a significant share of employment, they are obviously too large a group to be the focus of economic policy tools. In this chapter we will attempt to redefine a target group of SMEs by identifying important SME sectors and areas, that is to say, business sectors and regional production systems where SMEs play an important role. This is one of the recommendations of the OECD LEED programme (*Local Economic and Employment Development*)[33], where interest is particularly focused on local networks and regional clusters. They argue that "it is more effective to deal with SMEs in the context of networks than to do so individually", and further that "clustering sets up an environment in which SME support programmes may have a good chance of success"[34]. How then can we identify such networks in Norway?

3.1: The role of clusters and networks and system effects in innovation

It is increasingly recognised that innovation decisions, including decisions involving the diffusion and adoption of new technology, do not occur in isolation. The actions of innovating firms should be seen as determined by the wider socio-economic

[31] This register comprises most of the private sector in Norway, excluding primary industries. Thus the register provides figures for those industries (excluding agriculture) in accordance with e.g. *The European Observatory for SMEs* categorisation of small and medium sized firms.

[32] A. Isaksen and O. R. Spilling, op cit., 1996 p. 106.

[33] OECD, **Networks of enterprises and local development**, OECD Publications, Paris, 1996.

[34] Ibid. p. 17

context within which they exist. A firm exists within more or less complex networks of suppliers and customers, sources of labour and skill, finance, and so on. These networks consists largely of inter-firm relations, but they also include public sector institutions such as technical institutes and universities. This set of institution operates within a framework of regulations (technical standards, health and safety regulations and so on) and laws relating to contracts, intellectual property right (patent and copyright laws) and employment. And finally there is the wider context of political and social values. Taken together, this set of public and private institutions, regulations and policy constitute an integrated set of relationships, or networks, which persist over time and can therefore be thought of as systems. There are good reasons for thinking about industrial development in terms of systems also because much of modern technology takes the form systems; artefacts do not exist individually but as components of larger integrated systems.[35]

There have been a number of attempts to conceptual such systems; technological system approaches (associated with the work of Thomas Hughes, G. Dosi and W. Bijker, for example); industrial cluster approaches (Dahmen, Michael Porter) and ‘national system of innovation’ approaches, which particularly emphasise institutional aspects and interaction among innovators and where the basic argument is that the relevant institutional framework has strongly national characteristics. Linked with this is the ‘national business system’ approach. In all these approaches, economic dynamics and performance are seen as primarily shaped by innovation activities, and the focus is on the learning through which technologies are created and used. The argument is that learning is a collective process, shaped by formal institutions and by social institutions, and that such knowledge-creating systems are central to economic performance issues.

When learning occurs, what is it which is being learnt? What are the main characteristics of the kinds of knowledge which are relevant to production? One way of looking at this question is to note the sharp contrast between the way knowledge is treated in neo-classical versus Schumpeterian models of production and innovation. Broadly speaking, neo-classical theory simply avoids the whole issue by assumption: it assumes that firms have unproblematical access to all of the relevant knowledge involved in the production function. This leads to implicit assumptions about knowledge: that it is easy to access, that it can be relatively simply transferred and that the historical context does not matter in acquiring new knowledge.

By contrast, work in the Schumpeterian tradition makes quite different assumptions about knowledge. This work tends to assume that knowledge is

- highly specific to particular firms and industries
- cumulative over time
- often tacit - embodied either in particular skills (at the personal level) or capabilities (at the level of the organisation)
- very difficult to transfer

Within the Schumpeterian tradition, such views about the nature of knowledge has led more and more to an emphasis on the nature of the learning processes which

[35] Thomas Hughes, **Networks of Power** (New York) 1984

underlay knowledge: the concept of 'the learning economy', or the 'learning region'.[36] Deriving from such views and from much recent analysis of technological change, are four central themes:

- firstly, that innovation and the creation of technology are cumulative learning processes which involve time: technological knowledge is built up by individual and organisational learning over time. The key point here is that learning is itself a historical and above all cumulative process. There seems to be two broad issues here about how this happens. On the one hand, to enter into a new 'learning trajectory' involves making a significant break with the past - it requires significant resources to actually enter onto a new path. On the other hand, accessing new technologies may be much easier if it is based on a historical familiarity with previous technologies.

- second, technological knowledge is bounded and tacit; it is embodied in people and is not easily transmittable by formal or written means. Access to specific people is particularly important, even as technologies advance and become more formally codified. The organisation of such access, and the development of inter-personal learning from key skilled people, is in many cases determining for technology access.

- third, knowledge creation is an interactive process. This means that technological knowledge is created by the interactions of different forms of learning; by interactions between different types of individuals and organisations; but also interactions between different organisations who have different interests. As we shall see below, many organisations in Scandinavia who were not themselves acquiring knowledge had interests nevertheless in the process. Their interactions and support with those who were actually doing the learning was an important part of the story.

- fourth, interactive learning rests on real institutional and social structures; knowledge creation rests on institutional foundations which extend well beyond the particular site of learning.

3.2: SME sectors in the Norwegian economy

Size structures vary considerably between the main Norwegian industries. If we look at the shares of employment in different size categories of firms, oil and mining emerges as the industry least dominated by small firms, followed by manufacturing (Figure 3.1). We find that construction and the various service industries have significantly higher shares of employment in small firms.

We also find significant differences in size structures within individual industries., as noted in Chapter One. For example, at three-figure sector level in manufacturing,[37] average firm size varies from around 10 FTEs in the two sectors furniture and metal

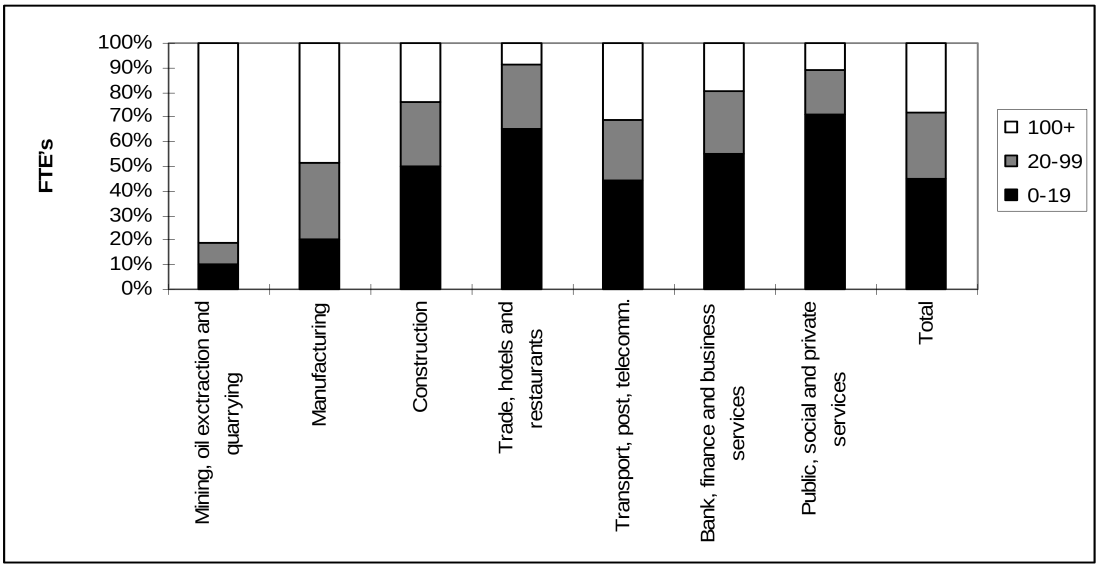
[36] B. Lundvall and B. Johnson, op cit.

[37] Isaksen and Spilling (op cit. 1996) use an adapted version of SSB's industry classification at so-called three-figure level, which gives us a division of 21 manufacturing sub-groups.

goods, to more than 130 FTEs in the sectors basic chemicals, iron and steel and aluminium.

Thus small and medium sized firms are of varying significance in different areas of economic activity. But what are the size structures of the most important industries? And what are "important industries"?

Figure 3.1: Share of employment in three size categories for the main industries 1990



The question of what constitutes an important industry is extremely complex, and we will not enter into an in-depth discussion of this here. One approach may simply be to identify the most important export industries, so that a pragmatic definition of "important industries" includes those which generate export income. OECD[38] calculated an indicator for export specialisation within 22 sectors in 13 industrialised countries[39]. Termed *Revealed Comparative Advantage* (RCA), this indicator shows the size of exports from each country in each of the 22 sectors in relation to the average for all the countries. The technical calculation is to divide the share of exports from one sector in a country by the average share of exports from the same sector for all the 13 countries. If the indicator is greater than 1.0 then the country has relatively more exports from this sector than is average for the 13 OECD countries. The country can then be said to have an export specialisation within this sector. Where the indicator is less than 1.0 then this sector is relatively less important for this country than on average for the 13 countries.

The RCA indicators for Norwegian manufacturing industries, and the relevant size-structures, are displayed in Table 3.1. The table reveals a fairly variegated pattern.

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[38] OECD, **Manufacturing Performance. A scoreboard of indicators**, OECD Publications, Paris 1995.

[39] The thirteen are: Japan, Australia, USA and Canada, as well as the European countries Norway, Sweden, Finland, Denmark, Netherlands, Germany, Britain, France and Italy.

Table 3.1. RCA indicator (export specialisation) and size structure for Norwegian industries

Industry	RCA-indicator	Number of employees, 1994	Share of employees in small companies	Share of employees in mediumsized companies
Manufacture of food products and beverages	1.35	50,497	18.9	41.2
Fish processing		12,140	19.3	56.5
Textiles/Clothing	0.26	8,257	26.4	54.2
Wood products/Furniture	1.37	22,219	31.8	45.4
Graphics	2.03	45,921	20.4	21.7
Pulp and paper		10,371	4.0	20.7
Manufacture of chemicals	1.01	11,100	5.3	23.0
Pharmaceuticals	0.35	2,425	3.0	11.8
Oil refining	4.55	1,736	27.6	7.4
Rubber/Plastics	0.56	6,258	27.4	49.8
Mineral prod.	0.75	8,161	30.7	39.4
Ferrous metals	1.66	5,699	3.9	19.3
Non ferrous metals	7.23	9,318	2.4	6.2
Metals	0.85	15,770	36.4	43.7
Machinery and equipment	0.54	21,696	22.8	36.0
Computers	0.42	816	10.2	18.3
Electrical App.	0.44	8,843	15.8	28.9
Communication	0.32	4,188	5.4	27.8
Ships/oil rigs	8.57	30,220	6.9	19.1
Ships		12,331	14.6	35.1
Motor vehicles	0.14	3,481	18.9	19.5
Aircraft/Parts for aircraft	0.35	2,486	3.4	7.8
Other means of transportation	0.26	2,603	2.7	4.6
Instruments	0.55	4,519	26.5	28.2
Other industry	0.26	3,200	27.2	37.3
Total industry		269,609	19.2	31.2

- Norway displays indicators above 1.0 - and thus has export specialisation in comparison with other OECD countries - in the following 8 industries; food and beverages (first and foremost fish products), wood products, pulp and paper and printing (it is likely that pulp and paper accounts for most of the export), basic chemicals, oil-refining, iron and steel production, non-ferrous metals and ship-building and oil-platform construction. On the whole, Norway specialises in the export of low-tech and raw material intensive manufacturing industries.

- These eight branches where Norway showed relatively high export rates accounted for 176 700 jobs in 1994, as much as 65.5% of all Norwegian manufacturing employment. This means that export specialisation takes place in large Norwegian manufacturing industries.

- The eight industries are characterised by both small scale and large scale production, but with the main bulk in large scale production. Food and beverages (and fish processing) has a relatively large number of medium sized firms, wood products has a relatively large share of employees in both small and medium-sized firms, while the shipbuilding industry has a small majority of employees in medium-sized firms. The remaining five industries have far smaller shares of employment in SMEs than manufacturing as a whole. Thus important Norwegian industries, understood as industries with export specialisation, are with a few exceptions dominated by large-scale production.

- Besides fish-processing and wood products, there are seven other typical small-scale Norwegian industries (i.e. where the share of employment in small and medium sized firms is greater than the average for manufacturing as a whole). These are; textiles/clothing, rubber/plastic goods, basic metals, metal goods, machinery and equipment, instruments and the residual "other manufacturing". Of these, the two mechanical engineering industries, metal goods and machinery and equipment, account for a large share of employment in Norwegian terms. The nine, typical small-scale industries account for a total of 140,577 jobs, approximately 50% of all Norwegian manufacturing employment in 1994.

The majority of these typical small-scale industries have relatively low levels of innovative activity amongst SMEs[40]. Machinery and "other manufacturing" have above average levels of innovative activity in small and medium sized firms, whilst the other industries have below average levels. Taken as a whole, only a little more than 20% of manufacturing SMEs can be considered innovative, when innovative firms are defined as those with sales accounted for by products developed during the preceding three years. We will therefore find a large share of manufacturing SMEs in typical small-scale industries, and the majority of these will be non-innovative.

Table 3.2. Size structure in sectors other than manufacturing.

Industry	Number of employees	Share of employees in small companies	Share of employees in mediumsized companies
Construction	68,033	60.8	20.5
Fittings and installations	36,820	69.2	24.3
Oil extraction	3,923	1.6	12.0
Wholesale trade	107,724	52.8	33.3
Retail trade	157,260	78.3	18.9
Hotels and restaurants	57,287	45.0	41.9
Land transport	52,991	58.5	17.8
Water transport	25,061	18.7	19.8
Services auxiliary to transport	12,643	39.3	34.4
Real estate	6,993	64.3	24.5
Business services	87,955	43.2	23.0
Renting of machinery and equipment	3,002	50.4	22.0
Renovation and cleaning	18,743	28.0	30.0
Private services	34,409	81.9	16.8

Manufacturing as a whole has a relatively small share of employment in small and medium sized firms. Shares of employment in SMEs are significantly greater outside manufacturing. All the sectors in Table 3.2, excluding oil drilling and sea transport,

[40] T. Sandven, "Innovation Outputs in the Norwegian Economy: How Innovative are Small Firms?", **STEP-report 5/96**, STEP-Gruppen, Oslo 1996.

have a greater shares of employment in SMEs than the 50.4% average for manufacturing.

Construction and the service industries have traditionally been far more domestically-oriented than manufacturing. The two most significant export industries in Table 3.2 are probably sea transport and oil drilling - the two industries with the lowest shares of employment in SMEs.

Business services is often considered to be a strategically important part of business activities. The sector provides an important knowledge infrastructure for other activities, including for instance different kinds of consultancy firms in data processing, as well as technical, administrative and organisational services. This too is a sector with a large proportion of employment in small and medium-sized firms.

3.3: Specialised production areas with large numbers of SMEs

We will now further restrict the target group - small and medium sized firms - by identifying geographic areas where small and medium sized firms play a particularly important role. The areas are defined using the following criteria[41]:

1. The areas consist of job-market regions. These are made up of aggregates of local municipalities, which are intended to form joint housing and job markets. Norway is divided into 103 job-market ('travel to work') regions[42].
2. We then further define regions according to their specialisation in one or more sectors. We categorise according to 39 sectors, and regions are considered "specialised" where the localisation quotient for a sector is greater than 3.0. Such a quotient shows that a region has more than three times as many jobs in this sector than would be "expected" in relation to the national average[43]. Various measures have been tested, and a localisation quotient of 3.0 seems sensible with respect to the aims of our analyses[44].
3. The next step is to apply a size criterion. The specialised production areas must include a minimum of 200 FTEs and must have at least 10 firms in the "dominant" sector - i.e. the sector constituting the region's specialisation. This criterion ensures that the smallest production areas are not included, and also excludes most so-called one company towns - i.e. areas dominated by one or a small number of large firms.
4. Finally, we chart the size-distribution of firms in different areas. We consider an area to be dominated by small firms in those instances where more than 75% of

[41] The first part of Chapter 3.2 is based upon Chapter 9 in A. Isaksen (ed.) op cit. 1997. The analysis of developments between 1990 - 1994 is based on new data from the **Bedrifts- og foretaksregister**.

[42] This division is a slightly modified version of SSB's prognosis-regions. Cf. A. Isaksen and O. R. Spilling, op cit., 1996, Appendix 2.

[43] Localisation quotient is calculated as share of employment per sector in relation to the sector's share of employment at a national level. Where a sector is equally important at regional and national level, the quotient will be 1.0. Where a sector for example has a 5% regional share as opposed to a 2% national share, the regional localisation quotient will be (5:2) = 2.5.

[44] Cf. A. Isaksen and O.R. Spilling, op cit. 1996, pp. 78-80.

employment in the sector constituting the area's specialisation is accounted for by small and medium sized firms[45].

The specialised production areas identified by these criteria *may* constitute an area type that has received a lot of attention from researchers and policy-makers since the 1980s. When we say "may", it is because the specialised production areas which are characterised in the literature as particularly dynamic also have additional characteristics - characteristics which cannot be identified by the type of statistical analysis carried out here.

In small-firm areas characterised as dynamic we tend to find local production networks, encompassing subcontracting systems and/or horizontal co-operation between firms on the same level in the chain of production. Further, business activities are founded upon place-specific social and cultural conditions. We find local interdependence and mutual trust between managers and between management and workers, which encourages co-operation within and between firms. Further, we may find locally rooted, experience-based competence in the area. These features cannot be identified by the use of statistical analyses alone. Statistical analysis can, however, provide a broad overview of certain features found in particular types of specialised production areas.

Specialised production areas received a lot of attention after several such areas in the US and Europe experienced growth from the 1970s and on, whilst at the same time employment stagnated or declined in these countries as a whole. In particular, experiences from the industrial districts known as the "third Italy" have evoked international interest. Despite the fact that many districts experienced problems during the 1990s, and despite the problem of how districts can survive an increasingly globalized world economy, experiences from the "third Italy" suggest possibilities for increasing the competitiveness of SMEs. It is thus suggested that SMEs "might not be at a disadvantage at all compared to large firms, so long as they are able to benefit from the advantage of clustering"[46].

The three first criteria above allow us to identify 62 specialised production areas in Norway in 1990. These, then, are job market regions where we find business sectors with location quotients greater than 3.0, and where these sectors also have more than 200 FTEs and 10 firms in the region. Note that these production areas fall under the sectors for which *Bedrifts og foretaksregisteret* provides data; this covers most of the private sector excluding primary industries and certain service industries.

Of the 62 specialised production areas, 55 were manufacturing based. These accounted for 63 000 FTEs in 1990, if we only include FTEs within those sectors constituting the regional specialisation. Thus these production areas accounted for approximately 22% of Norwegian manufacturing employment in 1990.

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[45] In addition we define large-firm dominated production areas as areas where 75% or more of employment in the relevant sector takes place in large firms. This leaves us with a sizeable residual where both small and large companies play a role. These areas are termed "mixed" and have between 25 and 75% of employment accounted for by SMEs.

[46] J. Humphrey and H. Schmitz, "Principles for promoting clusters and networks of SMEs", **Discussion Paper**, no. 1. Small medium enterprises programme. United Nations Industrial Development Organization 1995, p. 4

Of the remaining 7 production areas, two were in the oil sector, three in business services and two in other services. Several of these areas had large numbers of positions within the dominant sector, so that these areas as a whole accounted for 75 500 FTEs.

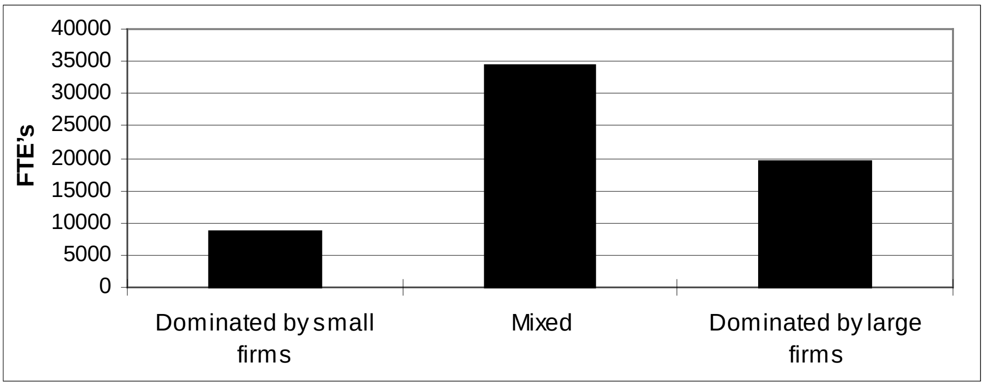
Within manufacturing we only identified 15 *small-firm dominated* production areas, i.e. areas where 75% or more of employment in the dominant sector is accounted for by small and medium sized firms. These areas did not have more than around 9 000 FTEs in their dominant sectors in 1990 (Figure 3.1). The small-firm dominated production areas comprised the following manufacturing industries; Fish processing (7 areas), textiles (2), wood products (2), furniture (3) and mining (1). There are thus relatively few specialised production areas in Norway which are dominated by small and medium sized firms. Such areas account for an extremely small share of employment and are centred around a small number of traditional manufacturing industries.

The mixed group of production areas - areas which have significant numbers of both SMEs and large firms - are far more significant in terms of employment than small-firm areas. We identified 32 mixed *manufacturing* areas with a total of almost 35 000 FTEs in 1990 (Figure 3.2). Several of these were in the same industries as the small-firm areas; we find six mixed production areas in fish-processing, five in wood products and one in furniture. There were fourteen mixed production areas in different mechanical engineering industries, one in mineral products and printing, and three in chemical-technical industry.

The small-firm areas and mixed production areas together accounted for 43 000 FTEs in 1990; 15% of manufacturing employment. These areas are particularly found in fish-processing, wood products and furniture, as well as in mechanical engineering industries.

Only nine of the specialised manufacturing production areas were dominated by large firms, but these accounted for a total of almost 20 000 jobs. Six of these areas specialised in mechanical engineering industries, one in mineral products and two in pulp and paper.

Figure 3.2: 1990 employment in different production area types in mining and manufacturing



The two production areas specialised in the offshore sector are both dominated by large firms. The three business service areas - all in the Oslo region - are classified as “mixed”. These areas accounted for 33 000 FTEs in 1990. Finally one of the production areas in the group “other services” was classified as mixed (wholesale trade in Oslo, 33 500 employees), while one was classified as small-firm dominated (hotel and restaurant in Hallingdal, 1 100 employees).

Are specialised production areas a sensible target group for SME policy?
Do small-firm areas and mixed production areas constitute a sensible target group for SME policy? General knowledge about these types of areas suggests that this *may* be the case. These areas have many firms in the same “narrow” sector, and may incorporate local production systems with e.g., subcontractors in a number of different sectors. Thus these areas may contain several firms with similar problems, and the industry or production system as a whole may suffer from particular bottlenecks. An important aim of policy activities in many specialised production areas has been to tackle such bottlenecks through sector-wide solutions.

Development in successful specialised production areas, such as the Italian industrial districts, is based among other things on policies which support networks of small firms rather than individual firms. These experiences lead to suggestions that “industrial policy for small firms must recognise that a focus on networks, rather than on single firms, can be a more productive avenue for public policy and investment”[47]. Network approaches and support for regional clusters of SMEs is also based on an understanding of the fact that small size and lack of resources may not be the greatest obstacle to innovative activity in small firms. The problem may instead be that firms are isolated, and have little contact with other firms, R&D institutes etc. It has further been pointed out that contact such as this is generally established within local business milieus, “thus underlining the significance of the territorial dimension of enterprise support policy”[48].

The fact that rapid transfers of knowledge take place between locally co-operating firms may make it more effective to support local networks of firms rather than individual firms. This is perhaps the greatest advantage of clustering, namely “the ability of their members to learn quickly from each other - and to forget the outdated practices that can delay innovation”[49]. Specialised production areas are thus considered to be innovative areas, but are first and foremost capable of incremental innovation. This reflects the fact that such areas often contain substantial skilled-worker, experience-based competence, which forms the basis for frequent, small changes to products and processes. However, specialised production areas made up of small firms can experience problems in carrying out radical innovations, due to lack of technical competence[50].

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47 C. Humphries, “The Territorialisation of Public Policies: The Role of Public Governance and Funding”, in OECD op cit. 1996, p. 248

48 K. Morgan, “Learning-by-interacting: Inter-Firm Networks and Enterprise Support”, in OECD op cit. 1996, p. 62

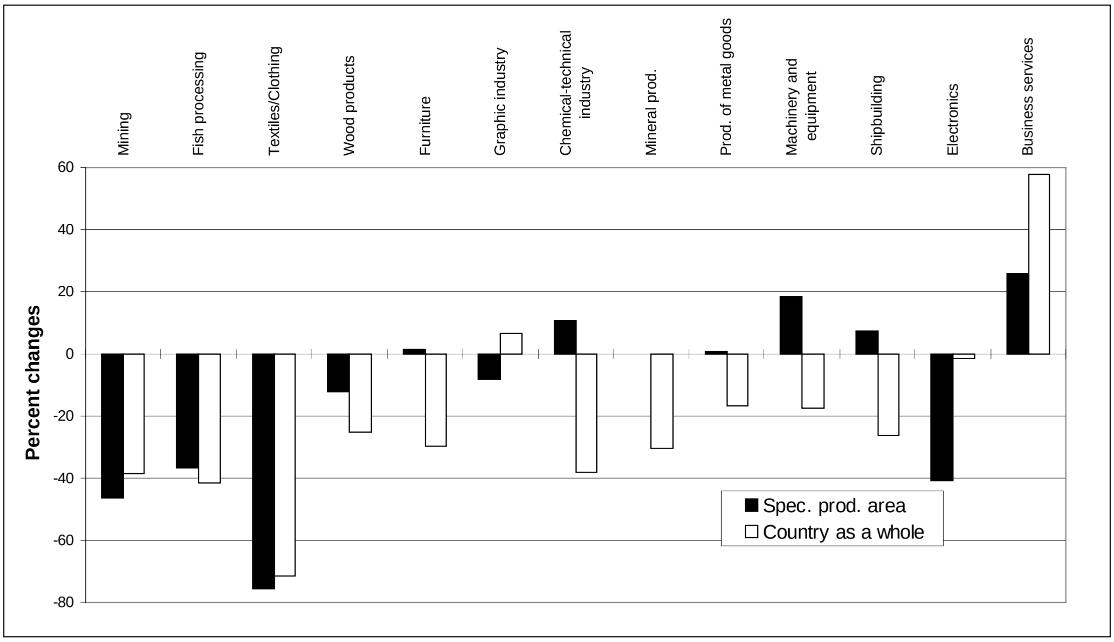
49 S. Rosenfeld, “Bringing Business Clusters into the Mainstream of Economic Development”, **European Planning Studies**, 5, 1, 1997, p. 10

50 B. Asheim and A. Isaksen, “Location, agglomoration and innovation: Towards regional innovation systems in Norway?”, **European Planning Studies**, 5,3 1997.

What then of the specialised production areas which we have identified in Norway? It is not possible to evaluate the potential for growth and innovation in these areas, or to examine the strategy needs of policy, on the basis of statistical work alone. The areas identified are of course extremely different, and will have very different support needs. We can, however, examine employment in the specialised production areas in relation to the country as a whole. Are these areas experiencing growth?

Developments are extremely different in different industries[51]. 8 of the 13 sectors in Figure 3.3 display better employment rates between 1970 and 1990 in the specialised production areas than the same sectors show in the country as a whole (Figure 3.4)[52]. These are furniture, chemical-technical production, mineral products, metal goods, machinery and shipbuilding. These production areas had increasing or stable employment figures whilst nationally, employment decreased. Fish-processing and wood products specialised production areas show slower decreases than the country as a whole.

Figure 3.3. Percent changes in employment 1970 - 1990 in specialised production areas[53] and the country as a whole, by sector



Mining experienced relatively greater falls in employment in the specialised production areas than in the country as a whole. For business services, growth was

[51] We have to be cautious when comparing development in the specialised production areas and development in the same sectors in the country as a whole, because some of the sectors only have one or a few production areas. Thus for printing, mineral products and machinery there was only one area of specialised production identified (small-firm or mixed) in 1990.

[52] Figure 3.3 includes both "stable" production areas, which could be classified as specialised production areas according to our criteria in both 1970 and 1990, "new" production areas which have emerged during the period examined and "ex-" production areas which fulfilled the criteria for specialised production areas in 1970 but not in 1990.

[53] Small firm dominated and mixed production areas only.

significantly slower in specialised production areas than in the country as a whole. This reflects the fact that growth in this area was greatest outside of Oslo during the 1970s and 80s, despite the fact that Oslo still accounted for a large share of employment in this sector in 1990 and a large share of the growth between 1970 and 1990.

In the three remaining sectors, significant falls in employment must be attributed to losses in a few centrally located production areas. For textiles, much of the decline took place in the Bergen area, where 5 400 jobs were lost between 1970 and 1990. These declines were more rapid than for the country as whole, and Bergen's share of employment in textiles fell from almost 20% to 13%.

The electronics industry (here also including electrical industry) experienced substantial job losses in the Oslo region. Oslo (municipality) accounted for 25% of the country's jobs in electronics and approximately 40% of jobs in electrical industry, as opposed to 8% and 10% respectively in 1990. The two other specialised production areas, Drammen and Horten, showed growing employment and a better development than the industry at a national level.

In printing, Oslo was the only specialised production area. This area accounted for 40% of employment in 1970, falling continuously until 1990. Job losses in certain production areas in Oslo and Bergen reflect the national decentralisation of Norwegian manufacturing throughout the 70s and 80s. The traditionally most industrialised areas suffered relatively greatest job losses in manufacturing. A restructuring of the economy in central areas also took place, however, in that the Oslo area developed new specialised production areas in the oil sector and producer services.

The period 1990 - 1994 also saw a slightly better development for the specialised production areas than for the country as a whole. Specialised production areas in manufacturing showed a small growth in employment (0.6%), whilst the equivalent sectors on a national basis experienced decline (-2.9%)[54].

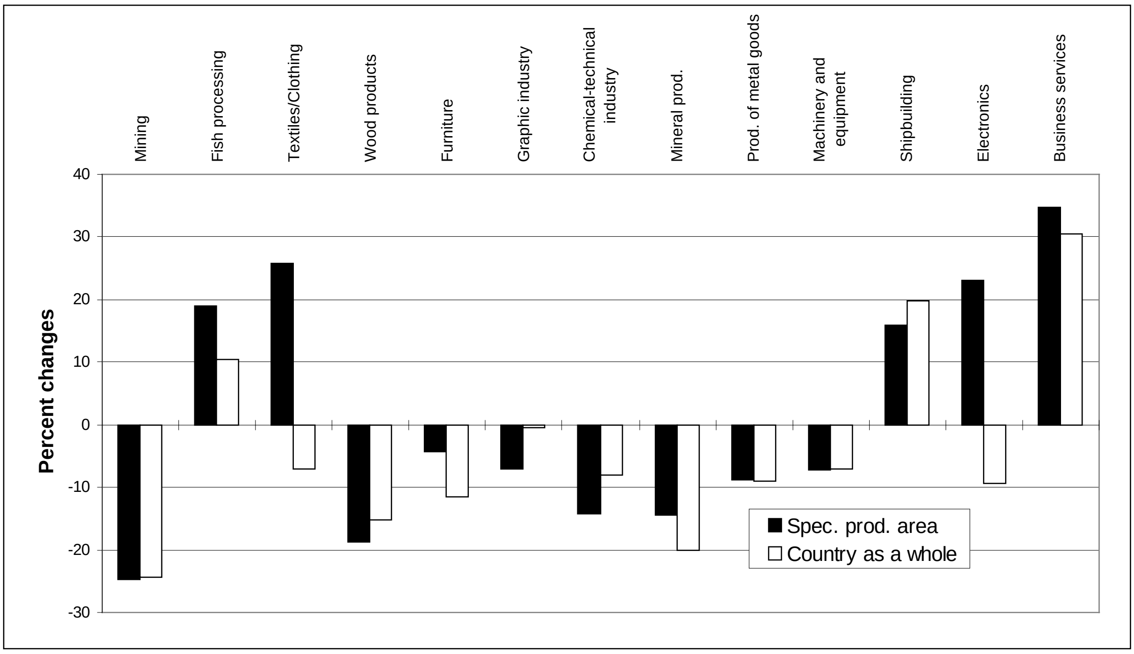
Employment was significantly stronger in specialised production areas than in the country as a whole in fish-processing, textiles, furniture and electronics (Figure 3.4). Textiles shows particularly striking growth rates in the specialised production areas. Much of this growth may be due to the relocation of firms from Bergen to surrounding areas. In any case, the areas around Bergen showed significant growth in textiles industry in this period. The three other textiles production areas (Ålesund, Stranda and Ulsteinvik), however, also display reasonably strong employment in this period.

In the electronics industry, the Horten area showed strong growth, whilst this area suffered job losses on a national basis between 1990 and 1994. The majority of specialised electronics industry production areas are defined as large-firm areas, and

[54] Figures for 1990 and 1994 are not entirely comparable. In 1990, employment is calculated as number of full-time employees, whilst in 1994 it is calculated as average number of employees per year. The consequences are not significant for our use of the data, however, as we are comparing developments in specialised production areas and the country as a whole between 1990 and 1994.

are therefore not covered here (these are Asker/Bærum, Arendal and Stavanger, which all showed significant growth, and Kongsberg, which showed a small decrease).

Figure 3.4: Percent changes in employment 1990 - 1994 in specialised production areas [55] and the country as a whole, by sector



In the sectors mining, wood products, metal goods, machinery, ship-building and business services, employment developments were approximately the same in the specialised production areas as in the country as a whole. For three sectors (printing, chemical-technical and mineral products), growth was clearly weaker in the specialised production areas.

This analysis of specialised production areas shows that there are a number of such areas in Norway. Few of these are dominated by SMEs. There is a much larger number of areas with a significant presence of both SMEs and large firms; these areas account for, for example, approximately 15% of total manufacturing employment.

These kinds of specialised production areas are considered to be an important target group for public policy[56]. This entails a shift of focus from individual firms to local/regional systems of firms. Such a policy will encompass a number of elements. One important element is to improve and adapt technological support systems to firms in a production area, because "smaller firms - particularly those that lack the resources and incentives to develop their own training, research or engineering departments, depend heavily on local services"[57].

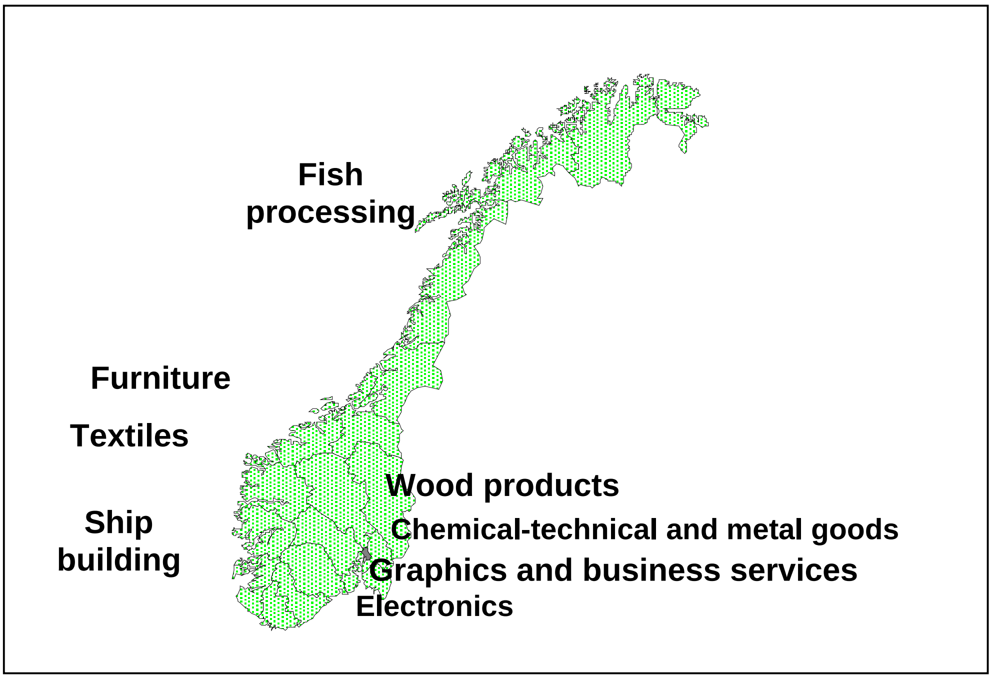
[55] Small-firm dominated and mixed production areas only.

[56] S. Rosenfeld, op cit. 1997.

[57] Ibid. p. 20

The specialised production areas identified are found in particular parts of Norway. Many of the areas are in Nord-Vestlandet and central Østlandet (Figure 3.5). The shipbuilding industry has five specialised production areas (with significant numbers of small firms) in Vestlandet, three of which are in Møre and Romsdal. This county also includes three of the four production areas for furniture and three of the five found for textiles. Fish-processing has thirteen production areas on the coast between Bergen and Finnmark.

Figure 3.5: Typical localisation of specialised production areas of different sectors.



The Oslo area includes the only production system for printing and three of the business services areas. The electronics industry is concentrated in Sør-Østlandet. Metal goods has seven areas, five of which are found in Øst- and Sør-Østlandet. Wood products has nine production areas spread across Southern Norway, but four are concentrated in inner Østlandet.

3.4: Summary: SME policy target groups

The majority of firms in Norway are small and medium-sized, and account for approximately 70% of private sector employment. Thus “SME” is an extremely broad concept - too broad to form the basis for an economic policy target group. In this chapter we have tried to redefine this group of SMEs in two ways. Firstly, we identified important SME-sectors, that is to say sectors which play an important role in the Norwegian economy and which have a significant share of small and medium sized firms. Secondly, we identified small-firm areas, in the sense of limited geographic areas (job-market regions) where relatively large shares of employment are within one sector and where there is a significant number of SMEs in that sector. These areas are termed specialised production areas.

One approach to the problem of how to define "important" sectors is to look at sectors which show significant amounts of exports. In manufacturing, many of the most important export industries are dominated by large firms to a greater extent than manufacturing as a whole. These large-firm dominated industries include pulp and paper, chemicals, oil refining, iron and steel production and foundries in general. Export oriented industries with significant numbers of SMEs include fish processing, wood products and, to a certain extent, shipbuilding and oil-platform construction. Other significant SME industries include metal goods and machinery and equipment. Of the non-manufacturing sectors, business services emerges as a particularly significant small-firm sector.

Very few specialised production areas are dominated by SMEs. If we include areas with significant numbers of both SMEs and large firms, we can (on the basis of the criteria applied in this chapter) identify 46 specialised production areas in manufacturing. These accounted for 43 000 FTEs in 1990 in those industries constituting regional specialisations, equivalent to 15% of total manufacturing employment. The production areas are generally found, of course, in those areas already identified as SME-dominated. This is particularly the case with fish-processing, wood products and furniture, chemical-technical and various sections of the mechanical engineering industry.

We were also able to identify five specialised production areas with significant SME presence in services. Four of these were found in the Oslo region in typical city sectors such as business services, wholesale trade and transport services.

Specialised manufacturing production areas are also located in particular areas of the country. Vestlandet, and Nord-Vestlandet in particular, include specialisations in furniture, textiles, shipbuilding and fish-processing. Specialised production areas in fish-processing are also found along the coast from Bergen to Finnmark. Østlandet and Sør-Østlandet incorporate specialised SME areas in wood products, chemical-technical production, metal goods and electronics. The Oslo area has specialisations in printing and business services.

The specialised production areas generally show a more positive employment development since 1970 than the same sectors on a national basis. These areas are considered to be potentially dynamic and innovative parts of the economy, and form an important target group for economic and regional policy. Such areas are important objects of public policy for many reasons. Firstly, they incorporate several similar firms, and the industry or production system may suffer from similar bottlenecks. An important aspect of public support in such areas is to tackle such bottlenecks through industry-wide support.

Another important aspect of areas such as these is that firms often enter into local networks and production systems. Economic policy in these areas has indeed been to support networks of firms rather than individual firms. The problem for many small firms is often that they are isolated; they have little contact with other firms, R&D institutions etc. Network approaches and support for specialised production areas of SMEs aim to establish this much-needed form of support system around the firm. An important method of support has often been to adapt technological support systems to firms in the production area, because small and medium sized firms rarely have the resources and competence to carry out research and development themselves.

By identifying important small-firm areas we have drastically reduced the target group of SMEs - in fact, too drastically. However, this type of area incorporates important geographic clusters of SMEs in important small-firm sectors in Norway. Small-firm areas thus form one important target group for SME policy which requires one particular solution - often in the form of technology and competence centres[58]. We are also talking about policy which often has to be adapted to the specific local conditions and which therefore should be locally-based. For other types of SMEs (outside specialised small-firm areas) different policy tools may be more applicable. Sejerstad for example, emphasises the importance of support tied to finance and organisation of product development and marketing[59]. In particular, he says, one should "concentrate on increasing small firms' competence in handling transregional and international co-operation and contract relations"[60].

[58] A. Isaksen, op cit. 1997.

[59] S. Sejerstad, "Bedrifter i nisjer og nettverk. Et steiftog i teori og empiri om regional næringsutvikling", **AFIs Rapportserie nr. 1/95**, Arbeidsforskningsinstituttet, Oslo 1995.

[60] Ibid. p. 69

Chapter four: Participation in policy initiatives by small firms

Introduction.

This chapter looks at industrial and innovation policy measures in Norway either aimed at SMEs or in which there is significant SME participation.[61] The objective here is to provide an empirical overview of the different programmes initiated by public agencies, and try to analyse these programmes with respect to the ways they address problems faced by small and medium-sized enterprises regarding innovation. This paper covers:

- the main policy agencies
- an overview of all programmes relevant to SMEs, with details of programme objectives, budgets and SME participation
- a preliminary overview of identifiable firms participating in public programmes, classified by size.

In Norway, policies for SMEs have overwhelmingly taken the form of large scale R&D programmes, or of programmes for the provision of start-up and risk capital. These have been provided primarily through two agencies at national level, namely the Research Council of Norway (NFR), and the State Regional and Industrial Bank (SND).

4.1: Methodology and sources.

This study is based on a range of empirical data. We here briefly present the sources and our methods for using the data. The programmes included in the study are all programmes initiated by either the Norwegian Science Council (**NFR**) or the Norwegian Industrial and Regional Development Fund (**SND).** Budgets are included as million Norwegian kroner (mnok).

Data regarding the programmes initiated by **SND** come from different sources: Each programme has its own "production paper" (*produktblad*) and most of the programmes are also described further in programme brochures. Concerning budgets for the SND-programmes these have been obtained through telephone calls to programme managers or programme directors. Some of the programmes initiated by SND are allocated money directly from the state budget or the programmes do not a have a predefined running period. This means that it has not been possible to obtain total budgets for the programmes in question (IPD, EG, IFU and OFU).

[61] This chapter draws on earlier STEP research by Kim Møller Pedersen and Mette Christiansen.

The programmes initiated by **NFR** are all, except for two programmes (Biotechnology and Food industry) initiated by the Division for Industry and Energy in the Council. The criteria for including these programmes are that they are directly linked to industrial development (though not exclusively directed at R&D). The reason for including “Biotechnology” and “Food industry” belonging under the Division for Bioproduction and Processing in NFR, is similar. Furthermore these two programmes are financed by the Ministry for Industry and Energy (the Industry Ministry), thus all the programmes initiated by NFR are financed by either the Industry Ministry or the Ministry for Local Government and Employment (the Regional Affairs Ministry). The programmes initiated by NFR are described in Programme Overview, Division for Industry and Energy (1995) and Budget for 1995, concerning both the Division for Industry and Energy and the Division for Bioproduction and Processing. Three programmes not initiated by either SND or NFR (EKK, SMB-E and Utplass) are described in Torvatn & Munkeby[62]. Programme budgets have been obtained by contact with programme managers or programme directors (in relevant public agencies). For the two programmes initiated and run by the Norwegian Export Council (NE) it has not been possible to obtain total budgets.

In order to calculate the share of SMEs participating in the sector-specific programmes we have acquired lists of firms (contract partners) participating in the programmes, from programme managers. We have then looked up these firms in “Financial Information from the Largest Companies in Norway” (1995-edition), where number of employees for each firm is listed. In the cases where we have not found the firm in the book (and in the two cases were number of employees were not listed) we have assumed the firm to be rather small (unfortunately there exists no account of criteria for listing of firms in the book, but it is reasonable to assume that firms which are not listed are SMEs. Where a firm participates in more than one project within the *same* programme the firm has been counted only once.

In the programmes falling under NFR other firms than the contract partners are usually involved in the programmes (without getting any direct financial support). These firms are not included in our numbers. According to a number of programme managers these firms are typically SMEs functioning as subcontractors to contract partners. This would apparently mean that the number of SMEs benefiting from the programmes is larger than indicated by our calculations.

4.2: SMEs and measures for industrial development.

In the following we present the overall programmes which constitute the major part of direct industrial measures initiated as programmes in Norway. We have included 60 programmes, and these will be presented through different tables showing

- the institutions involved (Table 4.1a-b),
- programme objectives and budgets (Tables 4.2a-c and 4.3a-b) and
- numbers of SMEs participating and budget shares for SMEs (Tables 4.4a-b and 4.5a-c)

[62] H. Torvatn and I. Munkeby, **En kartlegging av norske tiltak for næringslivet**, Rapport nr. STF82 A94010 SINTEF IFIM, Trondheim, 1994.

We begin with the institutions involved; the content and objectives of the programmes will be described in more detail below.

Table 4.1: Institutions involved with programmes as executor and commissioner.

Institutions / **Programmes**	Regions	Norwegian Exp. Council	Research Council (Div. for Ind. & E)	NHO (org.)	R&D institutes	Uni. & High school	SND	Con-sult.	Firms	Other public inst.
Biotechnology*			com		exe					
Food industry*			com/exe							
Nytek			com						exe	
Brønn			com/exe							
Lete			com						exe	
Gavot			com/exe							
Intof			com/exe							
Kapof			com						exe	
Ruth			com							exe
Must			com/exe							
Deep water techn.			com/exe							
Inpro			com	exe						
Expomat			com/exe							
Finkjem			com		exe					
Forfor			com		exe					
Plastics			com/exe							
Kapbio			com						exe	
Norinstall			com					exe		
Norwood			com						exe	
Norcon/norrock			com					exe		
Normin			com	exe						
Byggpro			com					exe		
Mekanor			com/exe							
Inbit			com		exe					
Proms			com						exe	
Marinor			com					exe		
Topp			com		exe					
Prosit			com						exe	
Profit			com	exe						
Ekspomil			com					exe		
MITD			com					exe		
Git			com/exe							
Protrans			com	exe						
Best			com			exe				
Eldorado			com		exe					
Telekom			com/exe							
Services			com/exe							
Local ship transport.			com/exe							
Ros			com		exe					
Teft			com		exe					
Forny			com		exe**					
Vekst			com/exe							
Rush			com			exe				
Funk			com					exe		
Bu 2000			com	exe						
EKK		com/exe								
ETA							com	exe		
Fadder							com/exe			
Fram							com	exe		
IFU							com/exe			
Mobil			com/exe							
NT							com/exe			
Network							com/exe			
OFU							com/exe			
SMB-E		com/exe								
Unike		com		com			com	exe		
Utplass	exe					exe		exe		com**
Integrated prod. dev.							com	exe		
Multiplan		com/exe					com/exe			
Establishing grant	exe						com			

Sources: Torvatn & Munkeby (1994), NFR Programoversikt (1995), interviews with prog. managers.

Note that in order to create an overview the different institutions are brought together in ten main categories thus the actual number of involved institutions is greater than indicated in the table.

*These programmes are initiated by the Division of Bioproduction and Refinement in NFR.

**the Regional Affairs Ministry.

*** Forny has been regionalised thus several R&D institutes function as operators.

In Table 4.1, we list programmes according to initiating organisation (com) and operating organisation (exe). The R&D institutes functioning as operators are mainly regional institutes, but in some cases sectoral R&D institutes are involved. The main consultancy is the Technological Institute (TI), but sectoral consultancies are also used as operators. As can be seen from Table 4.1, NFR has placed programme management within a firm in some cases, indicating perhaps the emphasis on engaging industry closely in the sector-specific programmes (so called user-controlled R&D-programmes). Branch organisations and other industrial organisations are included under NHO.

It is quite clear from Table 4.2a-c, that the Norwegian Science Council (NFR) is the main actor regarding direct policy programmes (involved in 46 of 60 programmes shown in the table). NFR functions both as a policy formulating, executing and management institution with responsibilities in all fields of science and technology. It is thus no surprise that NFR plays the most important role in relation to the sector specific programmes (nearly all the programmes NFR is involved with in Table 3 are sector specific). To carry out the programmes NFR uses firm managers, consultancies and regional and/or sector specific R&D institutes as programme management. In some cases however (15 of 46) the programme management is also placed within the Council. NFR enjoys a large amount of autonomy, but some of the programmes are initiated on behalf of governmental agencies (mainly the Regional Affairs Ministry and the Industry Ministry). Furthermore the Research Council has to report to relevant ministries on programme progress and evaluations. SND is mostly concerned with sector independent programmes (it initiates 11 programmes and operates 6). This reflects the fact that NFR is more oriented towards R&D activities and that SND is concentrating its efforts on strategic firm development (e.g. user-producer relationships, organisational structure, networks, management etc.). The Norwegian Export Council (NE) initiates four programmes that mainly are directed at improving Norwegian industry's efforts to export, e.g. introduce new products, campaigns abroad etc.

In Tables 4.2a-c, the 60 programmes are listed according to their specific objective.

Table 4.2a. Sector specific and sector independent programmes.

Programme	1995 budget	Objective
Biotechnology and food industry		
Biotechnology	28.6 MNOK	Promote commercialisation of R&D results
Food industry	29.1 MNOK	Promote R&D efforts as bases for market oriented and profitable production and distribution of high quality food
Total	**57.7 MNOK**	
Energy sector		
Nytek	17.2 MNOK	Product development
Total	**17.2 MNOK**	
Oil and gas sector		
Brønn	9.0 MNOK	Reduce operating costs and extend life-time of oil and gas fields
Lete	5.0 MNOK	Improve methods and reduce costs in locating oil and gas
Gavot	5.0 MNOK	Develop equipment to improve Norway as a gas supplier in Europe
Intof	1.0 MNOK	Improve technological competence in Norwegian offshore industry through research cooperation with Netherlands, UK and New Foundland
Kapof	26.5 MNOK	Commercialise new science-based results in offshore technology
Ruth	12.0 MNOK	Increase competence around oil extraction
Must	10.0 MNOK	Reduce costs of building and running small oil fields
Deep water technology (DWP)	5.0 MNOK	Cost effective and safe exploitation of oil fields deeper than thousand meters
Total	**73.5 MNOK**	
Processing industry		
Inpro	2.1 MNOK	Develop competent personnel at the Norwegian Technical University (NTH) as a service for firms
Expomat	82.8 MNOK	Productivity gains and product development in order to improve annual turnover in firms
Finkjem	32.0 MNOK	Improve science base in order to double production value in industry by year 2000
Forfor	4.1 MNOK	Improve products and processes to meet environmental demands
Plastics (plaststøp)	2.3 MNOK	Develop and implement technology to improve competitiveness
Kapbio	3.0 MNOK	Commercialise science results
Total	**126.3 MNOK**	
Building and construction industry		
Norinstall	9.5 MNOK	Focus on a systemic view and flexibility in the building and construction industry
Norwood	20.0 MNOK	Create horizontal and vertical cooperation within the wood and furniture industry
Norcon/norrock	26.7 MNOK	Increase firms own efforts to do R&D to increase exports and internationalisation
Normin	6.0 MNOK	Coordination of R&D in industry in order to improve utilisation of R&D results
Byggpro	10.7 MNOK	Improve competence and productivity for the building and construction industry and its customers
Total	**73.8 MNOK**	

Table 4.2b. Continued from above.

Programme	1995 budget	Objective
Mechanical engineering industry		
Mekanor	29.0 MNOK	Cooperation between firms in order to bring home, adapt and deploy technology developed abroad
Inbit	16.0 MNOK	Secure state of the art technology in Norwegian IT firms through firm cooperation
Proms	10.0 MNOK	Product development to increase exports
Marinor	8.0 MNOK	Reduce building time for ships with 30% and man-hours with 40% in ten years
Topp	16.0 MNOK	Productivity growth in high-tech industries
Profit	6.6 MNOK	Productivity growth in SMEs in high-tech industries
Prosit	9.0 MNOK	Develop Norwegian IT industry with the processing industry as a demanding user
Expomil	27.0 MNOK	Develop technology to reduce polluting emission to air and water
Total	**121.6 MNOK**	
Service sector		
MITD (maritime IT)	10.0 MNOK	Develop new business concepts and information systems using cooperation between suppliers, classification companies and authorities
Git	10.0 MNOK	Improve access, coordination between users and decrease use of barriers to geographical IT
Protrans	4.5 MNOK	Improve technological and organisational solutions to reduce logistics costs in transportation
Best	6.0 MNOK	Improve competitiveness through the use of information and telecommunication technology
Eldorado	1.5 MNOK	Creation of networks in high speed data- and telecommunications
Telecom	14.5 MNOK	Triple exports from Norwegian teleindustry
Services (tjenesteyting)	3.0 MNOK	Create economies of scale, economies of scope and interactive learning through networks
Local ship transportation (LST)	4.0 MNOK	Create competitive logistics and develop new products and services
Ros	2.0 MNOK	Focus on health, environment and safety as means of competition
Total	**55.5 MNOK**	
Technology transfer programmes		
Teft	25.0 MNOK	Create linkages between SMEs and R&D institutes
Forny	15.2 MNOK	Commercialise science results from the institute sector (new establishments)
Vekst	5.5 MNOK	Diffuse and deploy new technologies to SMEs
Rush	6.0 MNOK	Utilise R&D results in SMEs with little or medium R&D competence
Total	**51.7 MNOK**	

Continues on next page.

Table 4.2c. Continued from above page...

Programme	**1995 budget**	**Objective**
Sector independent programmes		
Funk	4.5 MNOK	Develop technical aids for functionally disabled people (reduce import)
Integrated product development (IPD)	6 MNOK	Reduce development time and use of resources connected to product development.
BU2000	12.0 MNOK	Increase cooperation between firms through development of organisational processes
EKK	23.0 MNOK	Motivate SMEs to increase efforts on foreign markets
SMB-E	40.0 MNOK	Increase number of SMEs exporting and increase exporting efforts in SMEs already exporting
Multiplan	10.0 MNOK	Increase Norwegian supplies to the UN and other world aid organisations
Unike	8.5 MNOK	Increase SMEs sales as subsuppliers to domestic and foreign firms (primarily Nordic)
Mobil	5.0 MNOK	Move scientists from the institute sector to industry
Utplass	6.0 MNOK	Create linkages between høyskoler and SMEs in Northern Norway
Eta	15.0 MNOK	New establishments based on the deployment of new technologies
Establishing grant (EG)	108.5 MNOK (94)	Create more and better establishments thus creating lasting and profitable employment effects
NT	18.1 MNOK	Strengthen industry in the north of Norway through technology diffusion and creation of novelty
Fram	25.0 MNOK	Increase profits in small firms by 5% within one year from completed participation
Network programme (NWP)	43.0 MNOK	Stimulate the creation of lasting and tight relations on a commercial bases between SMEs
Fadder	3.0 MNOK	Create linkages between high-tech firms and R&D institutes in Northern Norway
IFU	32.5 MNOK	Strengthen firms R&D competence through networks between suppliers and customers (SMEs)
OFU	147.0 MNOK	Improve public services through effective user-producer relationships between public sector and industry
Total	**507.1 MNOK**	

Sources:Torvatn & Munkeby (1994), NFR Programoversikt (1995) Division for Industry & Energy, 1995-budgets for Division for Industry & Energy and Division for Bioproduction & Refinement (NFR), programme brochures and interviews with programme managers.

Tables 4.2a-c should be seen in connection with Tables 4.3a-b below, where the programmes are grouped after objectives and total budgets in each group. As can be seen from Tables 4.2a-c, the range of programmes in both sector specific (39) and technology transfer and sector independent programmes (21) is widespread; however the key objectives can be reduced, as shown in Tables 4.3a-b. The sector independent programmes have the largest total budget for 1995 with a financial frame of 507,1 MNOK. Note however that OFU (147 MNOK) and EG (108,5 MNOK) alone account for 255,5 MNOK. Of the sector specific programmes the processing industry (126,3 MNOK) and mechanical engineering industry (121,6 MNOK) received most in 1995.

Table 4.3a. Programmes grouped according to objectives.

Sector-specific programmes	
Increase R&D efforts/ use	Finkjem, Norcon/Norrock*
Increase technological competence	Intof, Ruth, Inpro
Increase managerial/ organisational competence	Byggpro*, MITD*, Ros
Technology diffusion (across sector)	Plastics*, Normin, Mekanor*, Best
User-producer/ networking (vertical and horizontal interfirm linkages)	Norinstall, Norwood, Mekanor*, Inbit, Prosit*, MITD*, Git, Eldorado, Services
Exports/ internationalisation (increase efforts/ sales)	Norcon/Norrock*, Proms*, Telecom
Commercialise science-based results	Kapof, Kapbio
Increase productivity	Expomat*, Byggpro*, Topp, Profit
Reduce costs of production	Brønn, Lete, Must, DWT, Marinor, Protrans
Product development (incl. services)	Nytek, Gavot, Expomat*, Forfor, Plastics*, Proms*, Prosit*, Expomil, LST
Sector-independent programmes (incl. "technology transfer" programmes)	
Increase R&D efforts/use (bridgebuilding)	Teft, Utplass*, Fadder
Increase technological competence	Utplass*
Increase managerial competence	Fram
Technology diffusion	Vekst, Rush, NT
User-producer/ networking (vertical and horizontal interfirm linkages)	BU2000, Unike*, NWP, IFU, OFU
Exports/ internationalisation (increase efforts/ sales)	EKK, SMB-E, Multiplan, Unike*
Commercialise science-based results	Forny, Eta*
Reduce costs	IPD*
Product development	Funk, IPD*
New establishments	Forny*, Eta*, EG

Source: Same as for Tables 4.2a-c.
*Appears twice, incl. in both budget figures in Table 4.3b.
Note that the programmes Biotechnology and Food industry are not included.

When linking Tables 4.2a-c and 4.3a, it is possible to get an idea of the different priorities concerning objectives within each industrial sector. The programmes aimed at the oil and gas sector concentrate on reducing the costs of production and increasing the technological competence in the industry, whereas the programmes aimed at the mechanical engineering sector mainly focus on user-producer relationships and product development. Programmes aimed at the service sector concentrate their efforts on interfirm linkages.

Nine programmes are concerned with bridge building between industry and R&D institutes ("increase R&D efforts/use/bridgebuilding" and "commercialise science-based results") and from Table 4.3b below, we can see that these programmes had a collective 1995- budget of 152,4 MNOK. It is however likely that most of the sector specific programmes includes some degree of contact between R&D institutes and firms; thus the actual budgets for this activity are probably somewhat higher. From Table 4.3b below, it becomes apparent that for all programmes taken together the single largest category both in terms of number of programmes (14) and in terms of 1995-budget (351 MNOK) is the user-producer and networking group.

Table 4.3b. Number of programmes in groups of objective and 1995-budget.

Sector-specific programmes	
Increase R&D efforts/ use	2 programmes (total 1995 budget 58.7 MNOK)
Increase technological competence	3 programmes (total 1995 budget 15.1 MNOK)
Increase managerial/ organisational competence	3 programmes (total 1995 budget 22.7 MNOK)
Technology diffusion (across sector)	4 programmes (total 1995 budget 43.3 MNOK)
User-producer/ networking (vertical and horizontal interfirm linkages)	9 programmes (total 1995 budget 108 MNOK)
Exports/ internationalisation (increase efforts/ sales)	3 programmes (total 1995 budget 51.2 MNOK)
Commercialise science-based results	2 programmes (total 1995 budget 29.5 MNOK)
Increase productivity	4 programmes (total 1995 budget 116.1 MNOK)
Reduce costs of production	6 programmes (total 1995 budget 41.5 MNOK)
Product development (incl. services)	9 programmes (total 1995 budget 161.4 MNOK)
Sector-independent programmes (incl. "technology transfer" programmes)	
Increase R&D efforts/use (bridgebuilding)	3 programmes (total 1995 budget 34 MNOK)
Increase technological competence	1 programme (total 1995 budget 6 MNOK)
Increase managerial competence	1 programme (total 1995 budget 25 MNOK)
Technology diffusion	3 programmes (total 1995 budget 29.6 MNOK)
User-producer/ networking (vertical and horizontal interfirm linkages)	5 programmes (total 1995 budget 243 MNOK)
Exports/ internationalisation (increase efforts/ sales)	4 programmes (total 1995 budget 81.5 MNOK)
Commercialise science-based results	2 programmes (total 1995 budget 30.2 MNOK)
Reduce costs	1 programme (total 1995 budget 6 MNOK)
Product development	2 programmes (total 1995 budget 10.5 MNOK)
New establishments	3 programmes (total 1995 budget 138.7 MNOK)

Source: Same as for Tables 4.2a-c.

If we try to relate the programmes to the problems faced by the different types of SMEs (high-fliers, low technology innovators and non-innovators), it seems that the majority of the programmes are directed at high-fliers and/or low technology innovators. The programmes cover the most important competitive factors: product properties, customer specifications, delivery time/quality and product price. These factors are covered through programmes targeting respectively product development, user-producer relationships, logistics, productivity and costs of production. It appears that only one programme deals exclusively with the management and implementation of strategic planing: Fram. There are however other programmes dealing with managerial and technical competence (Intof, Ruth, Inpro, Byggpro, MITD, Ros and Utplass), thus the total 1995-budget for competence-oriented programmes was 68,8 MNOK. However not all of these programmes are directed exclusively at SMEs (see Tables 4.5a-b below).

One of the important experiences to be derived form earlier programmes is that in relation to SMEs it is often necessary to abate the "technology-part" of the programme and focus more on "basic" managerial and technological skills. Another important lesson to be learned from experiences from completed programmes is that SMEs often have problems in defining the technological problems they encounter and the possibilities for solutions found in R&D institutes. Furthermore the major part of SMEs lack both technological and adaptive skills to foresee the effects of a technological development process themselves, thus in cases where new technology implies radical internal changes, SMEs will tend to need external help in putting these changes into a strategic context[63]. Since the SMEs receiving technological assistance from R&D institutes will vary in their receptiveness, they will accordingly require varying degrees of support in order to successfully adapt and deploy new technology. This calls for flexibility in programme design, so that projects can be tailored to meet the individual needs of each participating SME.

What is the extent of SME participation? In Tables 4.4a-b below, the programmes are listed according to number of SMEs and large firms (200>) participating as contract partners.

[63] G. T. Kvam, **Teknologioverføring fra et FoU-Miljø til Små og Mellemstore Bedrifter**. Norges Tekniske Høgskole, 1995.

Table 4.4a. Total budget, running time and SME participation in the programmes.

Programme	Firms as contract partners[64] (1995)	Total budget[65]	Running time
Energy sector			
Nytek	17 of 20 are SMEs (85%)***	85.2 MNOK	1995 - 1998
Oil and Gas sector			
Brønn	12 of 16 are SMEs (75%)*	68.2 MNOK	1994 - 1999
Lete	12 of 16 are SMEs (75%)*	34.3 MNOK	1994 - 1997
Gavot	9 of 11 are SMEs (81.8%)	33.9 MNOK	1994 - 1998
Intoff	Only SMEs	9.8 MNOK	1992 - 1995
Kapof	33 of 43 are SMEs (76.7%)	110.1MNOK	1991 - 1996
Ruth	Only SMEs**	57.7 MNOK	1992 - 1995
Must	9 of 15 are SMEs (60%)	44.7 MNOK	1993 - 1997
Deep water technology	6 of 9 are SMEs (66.7%)	66 MNOK	1995 - 1999
Processing industry			
Inpro	Only large firms	7.1 MNOK	1993 - 1996
Expomat	Only large firms	457.7 MNOK	1991 - 1996
Finkjem	Only large firms	181.3 MNOK	1991 - 1996
Forfor	5 of 21 are SMEs (23.8%)	41.2 MNOK	1992 - 1996
Plaststøp	12 of 15 are SMEs (80%)	6.2 MNOK	1993 - 1995
Kapbio	Only SMEs**	9 MNOK	1994 - 1996
Building and Construction			
Norinstall	9 of 12 are SMEs (75%)	34.4 MNOK	1994 - 1997
Norwood	16 of 26 are SMEs (61.5%)	58.2 MNOK	1993 - 1996
Norcon/ Norrock	11 of 19 are SMEs (58%)	114.6 MNOK	1992 - 1996
Normin	34 of 39 are SMEs (87.2%)	18.3 MNOK	1993 - 1996
Byggpro	19 of 27 are SMEs (70.4%)***	48.8 MNOK	1991 - 1995
Mechanical engineering industry			
Mekanor	12 of 19 are SMEs (63.2%)***	91.7 MNOK	1994 - 1997
Inbit	59 of 87 are SMEs (67.8%)	59.5 MNOK	1993 - 1996
Proms	9 of 14 are SMEs (64.3%)	20 MNOK	1994 - 1997
Marinor	16 of 17 are SMEs (94%)	23.3 MNOK	1993 - 1995
Topp	9 of 39 are SMEs (23%)	73.2 MNOK	1992 - 1995
Profit	Only SMEs	6.6 MNOK	1994 - 1996
Prosit	6 of 8 are SMEs (75%)	31 MNOK	1993 - 1996
Ekspomil	17 of 20 are SMEs (85%)	99.7 MNOK	1992 - 1996
Service sector			
MITD	9 of 29 are SMEs (31%)	40 MNOK	1994 - 1997
Git	20 of 25 are SMEs (80%)***	36 MNOK	1994 - 1997
Protrans	28 of 44 are SMEs (63.6%)***	33.6 MNOK	1993 - 1996
Best	Only large firms	28.2 MNOK	1993 - 1997
Eldorado	No firms so far	6 MNOK	1993 - 1996
Telekom	6 of 8 are SMEs (75%)***	60 MNOK	1994 - 1998
Tjenesteyting	No firms so far	58 MNOK	1995 - 1999
Nærskipsfart	7 of 14 are SMEs (50%)	57 MNOK	1995 - 1998
Ros	19 of 38 are SMEs (50%)	24.2 MNOK	1993 - 1997
Technology transfer programmes			
Teft	Only SMEs	123 MNOK	1994-1998
Forny	Only SMEs	75.6 MNOK	1994-1998
Vekst	Only SMEs	16.5 MNOK	1994-1996
Rush	Only SMEs	24 MNOK	1995-1998

[64] In cases where one firm participates in several of the projects ranging under a programme, the firms are counted only once.

[65] All numbers are in total for running time. Total budget accounts for total public budget, thus financial or other efforts (e.g. man-hours) provided by the firms are not included.

Table 4.4b. Total budget, running time and SME participation in the programmes.

Programme	Participating firms (1995)	Total budget	Running time
Sector independent programmes			
Funk	Only SMEs	33 MNOK	1990-1997
Integrated product development	Only SMEs	not available	1995-
BU2000	Only SMEs	72 MNOK	1994-1999
EKK	Only SMEs	not available#	1986-1995
SMB-E	Only SMEs	not available#	since 1988
Multiplan	Mainly SMEs (95%)##	30 MNOK	1994-1996
Unike	Only SMEs	12 MNOK	1994-1997
Mobil	Only SMEs	15 MNOK	1994-1996
Utplass	Only SMEs	21 MNOK	1994-1996
Eta	Only SMEs	59.9 MNOK	1991-1996
Establishing grant	Only SMEs	not available#	since 1989
NT	Only SMEs	100 MNOK	1993-1996
Fram	Only small firms (5-20)	150 MNOK	1992-1997
Network programme	Only SMEs	not available#	launched 1995
Fadder (supervisor)	Only SMEs	25 MNOK	1987-1996
IFU	Only SMEs	not available#	1994-1997
OFU	Mainly SMEs****	not available#	since 1986

Sources:

NFR, Division for Industry & Energy: Programoversikt 1995. The counts of SMEs is based on lists of participating firms obtained from the programme managers for each programme, we then looked up the firms in "Financial information from the largest companies in Norway 1995" where number of employees for each firm is stated (1993-numbers, which may have caused inaccuracies in the count, since some firms may have "crossed the border" between large and SME since 1993). In the count we have not included R&D institutes, branch organisations and public institutions. In the cases were the firm was not listed in "Financial information...." we have assumed the firm to be small or medium-sized.

*The programmes Lete and Brønn are operated together until the end of 1997, thus there are all in all 16 firms participating in the two programmes.
**Mainly directed at R&D institutes and/ or scientists.
***Many of the participants are R&D institutes or industrial organisations, thus not included in the figures.
****In 1994 the OFU-contracts were distributed across firm sizes as follows:
0-19 employees: 30 projects: 49,4 MNOK
20-99 employees: 14 projects: 14 MNOK
100> employees: 15 projects: 41,8 MNOK
The frame available in these programmes is determined annually.
95% SMEs is an estimation from the programme manager.

Tables 4.4a-b show the share of SMEs participating as contract partners in sector specific and non-sector specific programmes. There are many firms that participate in the programmes indirectly, e.g. as subcontractors. Thus the number of firms involved in the programmes can be substantially higher than expressed through Tables 4.4a-b. As can be seen from Table 4.4a-b, the sector specific programmes involve both SMEs and large firms (31 of the programmes) in most of the cases, but some programmes involve solely large firms (Inpro, Expomat, Finkjem and Best) and some solely SMEs (23 programmes, mostly sector independent). The technology transfer and other sector independent programmes (horizontal programmes) involve almost solely SMEs.

Table 4.5a. Share of SMEs participation and budget for programmes.

Firm participation	Total budget (MNOK)	1995-budget (MNOK)
Only large firms	674.3	122.9
1%-50% SMEs	235.6	36.1
51%-60% SMEs	159.3	36.7
61%-70% SMEs	377.8	95.2
71%-80% SMEs	380.2	85.8
81%-90% SMEs	237.1	55.2
91%-99% SMEs	53.3*	165.0
Only SMEs	822.9**	424.4***
Total	2940.5	1021.3

Source: Tables 4.2a-c and Tables 4.3a-b.
* Total budget for OFU not available.
** Total budget for IPD, EKK, SMB-E, EG, NWP and IFU not available.
*** Figure for EG (108,5 MNOK) is the 1994-budget.

Table 4.5b. Share of SMEs participation and budget for programmes.

Firm participation	Total budget (MNOK), cumulated	1995-budget (MNOK), cumulated
Only large firms	674.3	122.9
50% or less SMEs	909.9	159.0
60% or less SMEs	1069.2	195.7
70% or less SMEs	1447.0	290.9
80% or less SMEs	1827.2	376.7
90% or less SMEs	2064.3	431.9
99% or less SMEs	2117.6	596.9
100% or less SMEs	2940.5	1021.3

Source: Tables 4.2a-c and Tables 4.3a-b.

Table 4.5c. Share of SMEs participation and budget for programmes.

Firm participation	Total budget (MNOK),cumulated	1995-budget (MNOK),cumulated
Only SMEs	822.9	424.4
91% or more SMEs	876.2	589.4
81% or more SMEs	1113.3	644.6
71% or more SMEs	1493.5	730.4
61% or more SMEs	1871.3	825.6
51% or more SMEs	2030.6	862.3
1% or more SMEs	2266.2	898.4
0% or more SMEs	2940.5	1021.3

Source: Tables 4.2a-c and Tables 4.3a-b.

Tables 4.5a-c show the budgets in relation to participation of both SMEs and large firms. If we compare the number for "only SMEs" and "only large firms", the difference in total budget is relatively small (respectively 822,9 and 674,3 MNOK). When looking at the budgets for programmes with 51% or more SMEs however, we can see that these programmes dispose of more than 2/3 of total budgets for all programmes. If we use the 1995-budgets, programmes with more than 51% SMEs get almost 85% of the money.

It is impossible to determine the exact amount of funding available for each SME and each large firm on the bases of the above data. The tables do on the other hand indicate that the largest share of funding goes to SMEs.

4.3: International programmes

Two main international programmes are relevant. The emphasis on SMEs is especially visible in CRAFT/ TSM (Technology Stimulation Measures for Smes) which is part of EU's 4. Framework programme aid in 1995, 1,6% of the total budget for the this programme. The participation in CRAFT has been low for Norwegian firms, although NFR have several different measures to inform and connect firms to the programmes within CRAFT. There is no rule of fair return and the support received by Norwegian firms may be low compared to the Norwegian budget contribution.

The second major international programme is EUREKA. EUREKA does not offer financial aid, but offers different "off the shelf" services and a seal of excellence to participating firms. Firms in need of financial support must apply for this through national channels. Of the total number of projects under EUREKA approximately 25% involves SMEs. One of the most important SME services offered through EUREKA is the partner-seek conferences. It has been a EUREKA objective to increase SMEs participation and in the projects initiated in 1995 approximately 50% involved SMEs. In an evaluation from 1993 of Norwegian participation in EUREKA projects it was concluded that small firms made most use of the EUREKA co-operation. In Norway the EUREKA work is placed within NFR.

Conclusion

Many of the programmes described above are in final phases, and there are therefore questions concerning programme renewal and future policy with respect to SME support programmes. It seems clear that many of the programmes run by both NFR and SND, within both sector-specific and cross-sectoral programmes, address highly relevant issues for SMEs. The largest programme categories, for example, relate to user-producer interactions, networking, and the creation of links between firms and the infrastructure. These budget priorities certainly address fundamental issues in what we know about innovation and its problems in SMEs.

However two problems appear important in this complex mix of programme activities. The first is co-ordination between the different functions at which these programmes are aimed. Many firms are likely to face problems across the range of functions which are addressed: in managerial competence, in networking, in performing R&D and so on, and it remains unclear to what extent programmes are flexible in providing support across the multiple activities (and potential obstacles) which comprise successful innovation. A second issue is that of targeting with respect to SME clusters within the sectors which are covered by programmes. A key idea expressed earlier in this report is that within stable (or even declining) industries, we can identify growing product groups which are frequently associated with regional clusters. These clusters might well provide a framework which could allow collective delivery and exploitation with respect to bridge-building, management and marketing strategy, R&D services and so on, enhancing the impact of many of the programme activities described above.

Chapter five: Policy issues

This chapter sums up some of the policy issues which emerge from the analysis in this report.

SME policy is an area in which significant change has occurred, both in Norway and in other countries, based on the often-neglected fact that policy-makers do learn and adapt over time. On the one hand, in recent years we have seen a shift away from policies aimed at advanced technology creation primarily for large companies, towards a focus on SMEs as innovators and employment creators. On the other hand, policy methods and instruments have developed rapidly. SME policy has been organised less around the supply of R&D inputs than towards a much broader array of initiatives addressing framework conditions, non-R&D inputs to innovation and organizational issues. Long-standing policy instruments such as R&D programmes and fiscal incentives to R&D have been supplemented by initiatives related to foresight activities, innovation financing (both venture capital and project financing), training and quality management actions, technology transfer schemes, intellectual property rights, management strategies and business planning (often provided via consultancy services), and so on. The balance of such activities has varied considerably across countries, and there has been variation also in the design and operation of specific instruments.

These international developments have been reflected in Norway, although it might be more accurate to say that in some areas Norway has led the way. The mix of policy instruments described in Chapter 4 covers virtually all areas which analysts and policy-makers have identified as important to SME activities in recent years. In particular, these programmes have emphasized technology transfer issues, in recognition of the fact that virtually all SMEs - whether they are technology creators or not - must access technology, knowledge and skills from outside the firm. The primary policy issues for the future concern whether the emphasis on SMEs should be continued and perhaps strengthened, whether the emphasis on technology transfer should continue, whether there should be greater integration between the types of services on offer to SMEs, and how policy instruments should be designed and focused. How should such issues be addressed in the context of specific Norwegian conditions?

This report has argued that an emphasis on SMEs in research and innovation policy is strongly justified by Norwegian conditions and should continue. On the one hand, SMEs are an increasingly important component of the industrial structure. Particularly in the low and medium R&D-intensive sectors which make up the largest share of the industrial system, SMEs are responsible for significant shares of output and growing shares of employment. Moreover, many of these sectors, or product groups within them, are growing and are likely to continue to play an important role in the growth pattern of the economy as a whole. Across all of these sectors, innovative small firms are present, generating higher proportions of their sales from new products than larger firms. This does not mean that there should be no policy concern for larger firms, but it does suggest that the challenges and problems faced by SMEs should remain an important focus for research and innovation policy. Our argument is that such policy should pay particular attention to low and medium R&D-intensive industries.

The challenges and problems for SMEs are often severe. Chapter 1 of this report showed that the survival rates of SMEs are relatively low, and that turbulence in labour markets and turbulence in the SME population as a whole are high. When committing resources to innovation, SMEs spend more as a proportion of their turnover than larger firms, and face higher risks. Developing high-grade competence, both in management and technological capabilities, necessary for innovation remains a problem. The general distribution of innovative activity among small firms is highly uneven, and there appears to be scope for improvements in at least some parts of the SME population.

The need for high-grade competence - across all of the activities involved in innovation - is present across the main industrial sectors, even where these are not obviously 'high-tech' in character. The view taken in the report is that although the use of formal skills is growing in SMEs across all sectors, this should remain an important focus for policy concern. A central reason for this is that so-called low-tech and medium-tech sectors are almost always users of advanced technologies, either in the form of knowledge 'embodied' in intermediate and capital goods, or in the form of 'disembodied' knowledge originating from other firms or R&D-performing institutions. The report offers a number of cases of this, and these cases could easily be extended. When embodied and disembodied spillovers are taken into account, we have a different perspective on the so-called 'traditional' or resource-based sectors of the Norwegian economy. They can be seen as technology and knowledge intensive, facing major challenges in terms of technology access, technology management and learning by interaction with other firms and with the science-technology infrastructure.

How can initiatives related to competence, interactive learning and technology access be targeted, given that the SME population is both very large and very heterogeneous? The report offers one particular approach to this question. It identifies a number of 'specialised production areas' in Norway - localities or regions characterised by clusters of firms within the same sector. In some key sectors, such as fish products, furniture, mechanical engineering, graphics production and even parts of the chemical industry, these clusters are dominated by SMEs or have important SME participation. The report shows that these local clusters often perform better than their industry nationally, and are particularly important in sectors where Norway has international trade specialization.

What kinds of policy challenges and options emerge from this kind of analysis? There is one policy option which we regard as misconceived, and unlikely to be successful. This is 'technology transfer' policy of the traditional type - that is, policies which aim at transferring research results from R&D-performing agencies into applications in firms. The basic problem with such policy is that it misunderstands the nature of the innovation process. Innovation is not R&D-driven; it should be seen as a problem-solving activity in which R&D is just one of the problems which might appear. Against this background, the view taken here is that there are two broad issues for Norwegian policy-makers at the present time. Firstly, there is a need for a more co-ordinated approach to the delivery of services to SMEs across a range of sectors. Secondly, there is the option of focusing SME policy on the infrastructural needs of regional SME clusters; that is, a more sector-specific support policy.

Co-ordinated delivery of services

The key problem in the growth and survivability of small firms is innovation performance. Many SMEs succeed in developing one or a few new products, but have great difficulty in developing product portfolios, and great difficulty in managing the overall process of innovation. This is in large part due to the complexity of the process in relation to the resources and skills of the firm. Successful innovation involves market exploration and search, the solution of financing problems, research and technical problem solving, training, prototype development and testing, engineering tooling up and trial production, and so on. Not least, successful innovation involves the integration of technology creation into a business strategy. Small firms frequently lack the full range of capabilities and competences which are necessary in solving the inevitable problems which arise in all of this.

There are policy initiatives at the present time which address specific aspects of these problems in Norway. The problem is the link between them. A first policy challenge is that the overall balance between the types of initiative on offer needs to be re-assessed. For example, the analysis above suggests that one major problem is that the development of business strategies, and the integration of innovation into the strategy of the firm, is a serious problem. One solution for this my be a greater emphasis on consultancy services offering technology audits and advice on strategy formation and implementation. Another solution might be a greater emphasis on integrated programmes. With the exception of the SND's NT Programme there is no 'one stop' agency which has anything like the capability to identify specific problems in participating firms across the whole spectrum of SME innovation difficulties. The NT Programme has not confined itself to any one form of policy support; it addresses business planning, links with universities, acquisition of capital goods etc., depending on the specific needs of the client firm. The NT Programme experience may not be generalisable to a national level, since the programme has a readily identifiable client base which may not be extendible beyond the Northern Norway region. Nevertheless, we would argue that the basic principle of an integrated SME innovation support programme with a range of services on offer is a challenge which policy-makers should consider.

Infrastructural needs of SME clusters

Norway is characterised by a large network of technological institutes offering R&D and other services to firms. A major problem perceived by policy-makers in recent years has been that of improving links between this infrastructure and firms, and making the infrastructure more responsive to industrial needs.

Our analysis suggests that the infrastructure plays a central role in developing, maintaining and transmitting technological knowledge in key sectors of the Norwegian economy. This is particularly the case with a number of the specialized production areas or clusters which we have identified as strongly-performing components of the Norwegian economy. If our argument that these sectors are often technology-intensive and knowledge-intensive is correct, then a policy challenge emerges. It may be possible to improve the performance of these clusters by targeting their collective technology development needs, and at the same time targeting the non-technology aspects of innovation performance within the clusters. The policy option is thus to develop sector-specific technology creation and diffusion programmes targeted at a limited number of clearly identifiable clusters. R&D and other services provided form such clusters need to be confined to use within the locality or region, of course. But the clusters provide a method of focusing foresight activities, performing R&D, acquiring foreign technologies, developing market strategies and so on. Once again, an integrated approach might be desirable.

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

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