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Performance and co-operation in the Oslo region business sector

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Preface

This report, together with Step report 4/99, is the result of the Step groups work for the RITTS Oslo Project, Stage 1 (Regional Innovation and Technology Transfer Strategies an Infrastructures). The Oslo and Akershus Business Council initiated the project in 1998, with financial support from the Commission of the European Union. The main purpose of the STEP work within the framework of the RITTS project has been to analyse the current situation in the innovation system of the Oslo/Akershus region. In order to do this, we have mapped interactions between business activities and the research and technology environment in the region. The analysis has been based on five different data sources: (i) The Norwegian firm and enterprise register; (ii) VAT-register; (iii) the Statistics Norway employment register; (iv) the Norwegian Community Innovation Survey; and (v) the STEP CoTech Database.

We would like to thank Oslo and Akershus Business Council and project leader Knut Halvorsen for the opportunity to engage in RITTS Oslo Project research.

Oslo, December 1999.

Heidi Wiig Aslesen
Project leader

Abstract

The Oslo region is clearly one of the most knowledge-intensive and dynamic areas of Norway. The business activities are marked by high use of research and development (R&D), the employees are the highest educated in the country and companies collaborate more with universities, research groups and foreign partners than the rest of the country.

These are the main features of the Oslo region economy:

i) Some Oslo-based companies are in a the innovation forefront. The chemical and machinery industry are among the most innovative industries in Norway, and the Oslo companies in these industries are amongst the most frequent innovating companies both within these industries and in Norway.

ii) Firms in the Oslo-region spend more on R&D than the average Norwegian firm. However, few firms answer that universities or higher education institutions are very important information sources for innovation, suggesting that a large share of firms do not look to the scientific infrastructure when innovating. Mobility from the scientific community to business in the region is also low.

iii) Firms in the Oslo-region have a higher share of firms taking part in innovation collaboration. They are also slightly more satisfied with the collaboration partner than firms elsewhere in the country. The most important means of technology transfer in these innovation collaborations are practical face to face collaboration and documentation.

iv) Firms in the Oslo-region have a slightly higher share of firms collaborating with universities and/or higher education institutions than national average. This is also valid for their co-operation with research milieus.

v) A larger share of firms in the Oslo-region co-operate with an international partner, than the national average. These companies have a larger share of firms collaborating with foreign research institutes and universities (especially among manufacturing firms) and with foreign private partners (especially among service firms), than average for Norwegian firms.

vi) People employed in the Oslo-region have a more than a proportional share of persons in all higher education groups. Companies rely heavily on the skills and competence of their workforce to improve their position on the global market. In our surveys, employees are emphasised as the most important source of information for innovation for the largest share of firms. Almost every second Oslo firm engage in training of employees linked to technological innovations.

However, there are some indications to some systemic failures in the region. One of the main findings are that Oslo-based firms do not differ much from the average Norwegian firm in terms of innovation and economic results from such activity:

i) The share of innovative firms is the same as the national average

ii) The share of sales from new products in turnover is the same as the national average

These findings may be surprising since one expects that the concentration of economic activity as found in city areas would have some implications for firms innovation behaviour. The use of R&D, firms' innovation co-operation and the skill of the workforce should have led to more biased innovation activity and economic results from such activity. Therefore, at first glance, these findings on innovation do appear a bit surprising. But when taking into account the economic activity undertaken within this particular region, the findings are not that surprising: Firstly, the capital area is an administrative area with state, county and municipal administration. Secondly, the region appears to have an unfavourable industry structure; it locates a more than proportional share of industries that have a low score on the particular innovation indicator used in this report (i.e. printing and publishing).

The results in this report suggest a dichotomy of companies in the Oslo region. One the one side, there are some companies with strong network relationship in the region, a considerable number of firms that are among the most innovative, firms that to a large degree are collaborating and which are satisfied with their collaboration partners. On the other hand there are industries in the region that rarely innovate, suggesting unused endogenous potentials in the region.

Keywords: Akershus; Industry stucture; Innovation; Innovation system; Oslo; Region

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1. Performance and co-operation in the Oslo region business sector: Main findings

Introduction

The aim of this report is to map the activities of the business sector in the Oslo region, especially the strengths and capabilities of the regional innovation system. Key aspects to address include describing the business sector in the Oslo region in terms of employment and share of firms, and thereafter illuminate the performance and main forms of interaction between the business sector and other actors in the economy, first and foremost the scientific infrastructure.

Our intention is to provide an empirical basis for understanding contact between the 'demand' side and the 'supply' side of the region. Broadly speaking, this consists of interaction between industry on the one hand and the knowledge infrastructure on the other. Our study has four basic steps:

i) Mapping the business sector in the Oslo-region, we measure the most important economic activities in the region by looking at employment figures.

ii) We also map the human resources found in industries in the region, indicating the knowledge intensity of different industries. This overview also enables us to map the industries in the region that have the largest share of highly skilled employees. We also look at patterns of personnel mobility between different sectors of the economy in the region.

iii) The share of companies innovating among different manufacturing and service firms in the region is also analysed, together with the performance of that activity. We are also interested in how firms innovate, and examine firms' objectives for innovation and also their sources of information for innovation.

iv) Firms' innovation-collaboration patterns with other actors are also of great interest. Of particular interest are the relationships firms perceive as most successful. In addition, it will be interesting to see what forms of interaction

firms value the most. These findings will give us an idea of the extent and the success of interaction in the innovation process.

Industrial structure in the Oslo region - knowledge intensive services

The Oslo region is a dominant national service centre. Employment in private and public services represented in 1996 as much as 80 percent of total employment in the region. There are several indicators pointing at the Oslo region as a knowledge intensive service area: While employment in the Oslo region accounts for about ¼ of national employment, the region's share of employment in research is much higher than this average; 40 percent. A search for the largest industries as share of national employment shows that there are three dominant service industries located in this region. These are 'activities auxiliary to financial intermediation' (70 percent of national employment), 'computers and related activities' (65 percent) and 'air transport' (60 percent). Health care accounts for about 50 percent of employment in the public sector, and is greater than public administration and education together.

Manufacturing industries do not show the same measures, but there exist some large part of important national industries in the region. The largest manufacturing industries are printing and publishing (30 percent of all manufacturing employment in the region), food and beverages (20 percent) and chemicals (10 percent). As share of employment on a national level, five industries have a larger share of national employment than overall average (1/4 of employment). These industries are tobacco (76 percent[1]), office machinery and computers (57 percent), publishing and printing (38 percent), radio and television (36 percent) and chemicals (26 percent).

The largest single private service industry is wholesale and trade, representinging about 25 percent of all private service employment. This industry is followed in size by 'other business activities' (20 percent) and 'retail trade' (18 percent). The Oslo region has a significantly lower share of employment in telecommunication services compared to the regional share of national employment; about eight percent of telecommunication employment is in companies located in the Oslo region.

There has been a decline in new firm formation the last four years. Despite this decline, the share of new registered firms in 1998 is higher in the Oslo region than in other counties in the country. In Oslo there are 14.6 percent new registrations pr 100 enterprises, the share for Akershus is 12.5 percent. New registrations can present important contributions to innovation in a region; the high numbers for the Oslo region do suggest a dynamic region.

Distribution of competence in the Oslo-region

The Oslo-region contains as much as 43 percent of all Norwegian employment with highest level of education. The region has 27 percent of national employment, meaning that the region has a more than a proportional share of persons with highest levels of education. In fact, the region has more than a proportional share of persons in all higher education groups. This is probably due to the fact that the region contains the capital, which implies the presence of state, county and municipal administration in the region, all employing persons with higher education. In addition, many big firms and national institutions have their headquarters in Oslo. When looking at the share of persons with educational backgrounds in natural sciences and engineering, the difference between Oslo and other big cities like Bergen, Trondheim and Stavanger is not so marked. When looking more closely into mobility patterns between the research institutions (R&D institutes, universities and scientific colleges) and different sectors of the economy, the rates of persons leaving these institutions to work in the business sector seems low. These numbers, however, must be seen in context of other ways of diffusing new knowledge.

Innovation activity in the Oslo-region

The 'Norwegian Community Innovation Survey' showed that there are few differences between firms located in the capital area of Norway and the average Norwegian firm, when looking at innovation at an aggregated level. However, examining the data on a more dis-aggregated level there are differences. To make it clear what we mean by innovation in this report, we will present the definition of technological innovation; A technological innovation comprise implemented technologically new products and processes and significant technological

[1] Two companies with respectively 30 and 400 employees

improvements in products or processes. Measuring technological innovation is a difficult task. When interpreting results of an innovation survey one must have in mind that technological innovation is probably the single most heterogeneous economic activity, and that when quantifying innovation performance one is limited to indicators that are easy to quantify. Besides this, one must also have in mind that there is a general problem of accuracy and reliability when collecting data through survey questionnaires. The answers given by the survey must therefor not be treated as accurate measures but as rather well informed estimates by people responsible in the firms.

When investigating innovation activity among different manufacturing industries, one detects a slightly higher share of innovating firms in the Oslo-region than the average for the country in industries like 'Petroleum refining, chemicals', 'Machinery and equipment' and 'Other manufacturing', one must remember that on this level of detail the number of observation is limited. When looking at manufacturing industries' innovation performance (measured as share of turnover that was accounted for by new or improved products), the Oslo-region also stands out as performing better in some industries than the average for the country. The industries are 'Office machinery, computers, electrical machinery', 'Pulp and paper, basic metal' and 'Machinery and equipment'. In manufacturing the Oslo-region also has a slightly higher share of innovators than the average for the country among firms with more than 100 employees.

It has been difficult to find international comparisons of innovation performance from other capital areas, but we have found international comparisons at national level. For international comparisons of innovation performance (share of firms with innovation activity) one can use the results of Eurostats Community Innovation Survey which has selected results from 12 EEA[(1)] Member States. It shows that compared to other European countries, the share of innovative manufacturing firms in Norway is slightly lower, and that the share of innovative service firms is particularly lower than the European average.

[(1)] European Economic Area (EU and EFTA)

In planning public policy directed towards industry and specifically towards technological development and innovation it is important to know 'how' firms innovate. One way of exploring 'how' firms innovate is to look at firm's innovation expenditure effort, and how it is distributed on different innovation activities. We found that the structure of the amount spent on innovation in manufacturing industry differs between the Oslo-region and the average for Norway. Innovative firms in the Oslo-region spend more internal R&D and acquisition of R&D services than the average Norwegian firm. This might be an effect of the large share of 'suppliers' in the region; the region locates a large share of the countries R&D institutions and R&D headquarters. The higher share might also be an effect of some very large firms using large amounts on i.e. R&D. This will disrupt the picture, suggesting not to look at the total amount spent on innovation costs, but instead count the share of firms engaged in different innovation activities. When using this method, the structure of the innovation pattern does not differ much between firms in the Oslo-region and the average Norwegian firm. It is worth mentioning that the second most cited innovation activity in the Oslo-region is 'training linked to technological innovation'; suggesting continuous learning and development in the firm. In the service industry, the structure of innovation expenditure and the structure of innovation activity is very similar among firms in the Oslo-region and Norway.

Other aspect of analysing 'how' firms innovate is to investigate firm's objectives for innovation and further which factors that trigger innovation. There are few differences between firms in the Oslo-region and the average Norwegian firm when analysing these factors. Firms' objectives for innovation are largely linked to the products or services they sell, rather then to the production process. Improving product quality is the most important reason to engage in innovation, followed by 'Open up new markets or increase market share'. The latter factor seems to be more important for service firms in the Oslo-region than the average Norwegian firm, suggesting an offensive strategy. There are little difference between firms in the Oslo-region and the average Norwegian firms when looking at the most important source of information for innovation; 'Sources within the enterprise' is emphasised by the largest share of firms, closely followed by 'Customers' and 'Other enterprises within the enterprise group'.

Information is a valuable asset to firms in that it enables firms to undertake and exploit innovative activity. Collaborative agreements might link information acquisition with the production of knowledge. The reasons for collaborative agreements to occur are manifold, the aim is however to form more efficient mechanisms for the transfer of knowledge. In our study we found that firms in the Oslo-region have a higher share of innovation collaboration than the average Norwegian firm. This is true both for manufacturing and service firms. Firms in the Oslo-region use foreign partners to a larger degree than the average Norwegian firm, suggesting a role as bridge builders to international milieus. There is however a difference between what types of foreign partners manufacturing and service firms emphasise; manufacturing firms in the Oslo-region has twice as many firms engaged in innovation collaboration with foreign public partners than the average Norwegian firm (17.6%-8.8%). This suggests that firms in the region can be seen as bridge builders to universities and R&D-institutions abroad. For services, innovative firms in the Oslo-region has a 13 percentage point larger share of foreign private collaboration partners than the average Norwegian firm.

The innovation survey, however, tell us little about the collaboration process. The Co-tech database has looked more closely at the collaboration process between firms and their partners.

Innovation collaboration in Norway and in the Oslo-region

The innovation collaboration survey carried out by Step in 1998, has been able to draw a number of conclusions, even though the sampling methods have not made it possible to carry out a thorough statistical analysis of the Oslo-region. The data indicate that it is quite probable that the tendency to collaborate is actually markedly higher in the Oslo-region than the average for the rest of the country. In terms of collaboration partners, firms in the Oslo-region work most frequently with suppliers of materials and components and with private customers. This is a general tendency in innovation related collaboration, and shows that innovation is an *interactive process*, in which successful mutual learning and influencing among significant

partners is a crucial factor. Firms in the Oslo-region collaborate much more frequently with public customers, markedly less with research institutes, and only slightly more with entities in the university and higher education category than firms elsewhere in the country. Given the status of Oslo as the administrative centre of Norway, the first fact appears not to be surprising. The fact that the University of Oslo and other institutions in higher education does not play a more prominent role might be more surprising. We have also looked into how collaboration happens, but the data here do not allow specific analyses of the situation in the Oslo-region. In general, with only a couple of exceptions, it is *informal face-to-face collaboration*, and the use of reports and other *documentation* that are the most important dimensions of collaborative relationships. As for perception of how important *partners* are, the partner categories that are most often considered very important contributors to key innovation projects also tend to be the partner categories which are used frequently in collaborative innovation efforts. Private customers, for instance, are used extensively as partners, and get the highest share of top marks for significance. Research institutes come fifth in this ranking, a position that matches well the frequency with which they are used as partners in innovation. The same holds for partners in the university and higher education sector: They score low also on this ranking. They are relatively rarely involved in collaborative relationships, and even when they are involved, they do not get very high marks for their contributions. Finally, we find that innovating and collaborating firms in the Oslo-region on average are more satisfied with the contributions of their partners than firms are elsewhere in Norway, both in terms of the rate of firms awarding top marks and in terms of average marks awarded. These differences are not very large, however. We wish to make a final note on the figures concerning the role of the University and other institutions' level of involvement in innovation collaboration. The numbers in themselves are quite clear: The level of direct involvement is modest. In evaluating this fact however, it is important to note that the role of the university is not limited to direct engagement in business innovation. Substantial benefits of the work going on in the university may flow to business and industry by way of diffusion of educated people, and dissemination of results that are available to all, and not limited to particular collaborative relationships.

Data sources

This report presents an analysis of the Oslo-region based on five different data sources:

- **'The industrial structure in the Oslo-region':** In the first part of the report, we present findings from the 'The Norwegian firm and enterprise register' and the VAT-register, together with the 'Statistics Norway employment register', which give us figures on employment- and firm structure in the Oslo-region. By using the VAT-register, we will be able to present numbers of new firm formation in the region, and to look into which manufacturing industries in the region are growing.
- **' Distribution of competence in the Oslo-region':** In the second part, we will use the 'Statistics Norway employment register' to look at education levels in different industries, and further highlight mobility patterns in the Oslo-region.
- **'Innovation activity in the Oslo-region':** In the third part, we will use the 'Norwegian Community Innovation Survey' carried out by Statistic Norway in 1997. The analysis will focus on the extent of innovation activity in the Oslo-region, and will further investigate how the process of innovation is carried out in the firms.
- **'Facts on innovation collaboration in Norway and in the Oslo-region':** The fourth part of the report is based on the 'The STEP Cotech database', compiled by the STEP-group during 1998. The objective of the survey was to examine the co-operation process more closely by establishing what kind of partners work together on successful innovation projects, and what kinds of interaction there are between collaborators.

2. Industrial Structure in the Oslo region

By Thor Egil Braadland

Introduction

Reading the newspapers' descriptions of economic activity in the Oslo region, emphasis tends to lie on IT-related industries and services, on finance and other competence-based technology producers and -users. This is to some extent correct, but there is more to it than this. This section of the paper attempts to bring some stylised facts into the discussions on what actually are important activities in the Oslo region. We will also look into new-firm formation in the region, and look at which manufacturing industries have experienced growth in recent years.

What are the economic particularities of the Oslo region, the industrial *sui generis* of the capital region? One way to describe the Oslo region is as a dominating location for public and private services. But the region is also enriched with substantial shares of manufacturing activities in some national industries, such as printing and publishing and the tobacco industry.

The region is defined as the two counties Oslo and Akershus. Table 1 provides a brief introductory overview of industries in the Oslo region, based on employment figures on standard NACE 2-digit level.

Table 1: Industries in the Oslo region, NACE 2 digit, manufacturing industries, private and public services, measured in employment in Oslo region companies, 1996

Industry	*Employees*
Health care	66845
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	46070
Retail Trade, Except of Motor Vehicles / Motorcycles; Repair of PHG3	31621
Public administration and defense	30755
Education	26620
Hotels and Restaurants	16407
Financial Intermediation, Except Insurance and Pension Funding	11700
Publishing and Printing	10802
Land Transport; Transport Via Pipelines	10790
Sale, Maintenance and Repair of Motor Vehicles, Motorcycles; Automotive Fuel	9758
Computers and Related Activities	9433
Architectural and Engineering Activities and Related Technical Consultancy	9303
Legal, Accounting, Book-Keeping and Auditing Activities	8213
Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	8200
Labor Recruitment and Provision of Personnel	8025
Mail and distribution	7637
Food Products and Beverages	7433
Air Transport	5381
Water Transport	5262
Miscellaneous Business Activities N.E.C.	4915
Industrial Cleaning	4831
Insurance and Pension Funding, Except Compulsory Social Security	4811
Real Estate Activities	4232
Chemicals And Chemical Products	4144
Advertising	3294
Other Transport Equipment	3032
Machinery and Equipment	2668
Telecommunications	2158
Technical Testing and Analysis	1923
Electricity, gas and water supply	1860
Renting Of Machinery and Equipment Without Operator and of PHG	1855
Radio, Television and Communication Equipment and Apparatus	1752
Metal Products, Except Machinery and Equipment	1652
Furniture and Manufacturing N.E.C.	1465
Activities Auxiliary to Financial Intermediation	1438
Electrical Machinery and Apparatus N.E.C.	1428
Investigation and Security Activities	1290
Sewage and renovation	1245
Medical, Precision and Optical Instruments, Watches and Clocks	1073
Rubber and Plastic Products	984

Other Non-Metallic Mineral Products	984
Wood And Wood Products, Except Furniture; Manufacture of	925
Office Machinery and Computers	462
Tobacco Products	431
Basic Metals	399
Textiles	269
Pulp, Paper and Paper Products	228
Transport Equipment	190
Clothing	163
Leather; Luggage, Handbags, Saddlery, Harness and Footwear	43
Coke and Refined Petroleum Products	13
SUM private services, public services and mfg industries	**386.412**
Share of total employment	88 %

What is 'employment in the Oslo region'?

The employment dataset we use allows two approaches in mapping industrial structure in the Oslo region; what we respectively term the social approach and the industrial approach. The social approach involves mapping the working *inhabitants* in the Oslo region, and subsequently looks at in which sectors, industries and company sizes these people work. Such mapping would grasp what people living in the Oslo region do for a living, how people in the Oslo region live. However, the Oslo region is marked by a high share of commuting from counties around the area. What we have termed the sociological approach would not cover the full economic picture in the Oslo region, as there are more people working in the Oslo region than actually living in it. In order to get a full picture of the actual economic situation, we have chosen to use the industrial approach. This approach takes as its starting point the *companies* located in the Oslo region, and then maps the employees in these companies.

This means that we measure industrial activity in the Oslo region by looking at the number of employees working in companies based in the Oslo region. Employment figures represent an interesting proxy to economic activity and industrial structure, as it reflects the 'social footprints' of business activities. However, it is important to notice that there is no indicator that captures the term 'industrial structure' in any canonical way. Of the many measures which aim to grasp economic activity,

employment figures do not necessarily represent the best or most exact way of measuring such activity. High employment in a particular industry could just as well be interpreted as a sign of an economically stagnant, labour-intensive industry with low turnover per employee. In this view, economic activity could just as well - or perhaps better - be interpreted in more explicit economic ways, such as value added, turnover or export value per employee.

However, employment is not to be regarded as an inferior indicator on industrial activity. There are four clear advantages to using this indicator: i) Employment is a direct social and measurable impact of economic activity, ii) Stable employment in an industry is a usable indicator on lasting (industrial) activity, iii) Employment statistics are comparable and relatively reliable measures by which to capture and illuminate industrial structures (differences in activities by company sizes and industrial classes), and iv) Good employment data-sets are available to provide detailed information on industry, company size and employment in the Oslo region.

To sum up, by 'employment in the Oslo region' we understand the collective of persons with personal income from a working place located within the boundaries of the Oslo region. In the following, we include all persons with any income. Note that these figures therefore also include part-time workers such as students and pensioners, and people about to leave work. However, these do not represent significant shares of employment[2].

Employment - the actual picture

Real sizes

Companies located in the Oslo region account for ¼ of all Norwegian employment, in all 440.000 persons. The region has two dominant sectors, namely the public sector and the private services sector. Private services represent almost half of all employment in the region, while almost 1/3 of all employment in the area is in the public sector (Table 2). Employment in the building and construction sector is about half the size of manufacturing industries, and about ten percent of private services in

the region. The share of persons working in this sector in this region is slightly higher than same share on a national level (five percent compared to twentyfive percent).

Relative size

Employment in the Oslo region represents about ¼ of all employment in Norway. There are three sectors in the region that absorb a remarkably higher share of national sectoral employment than this 25 percent share; private services, research and 'others'. ('Others' refers first and foremost to employment in private organisations and recycling). The largest sector in the Oslo region, measured in share of national employment, is research. From the table we can see that 40 percent of all Norwegian private research employment (i.e. excluding university and college research) is located in Oslo region companies. Almost the same share of national sectoral employment is found within the 'others' (organisation and recycling) category, at 39 percent. Private services account for 32 percent of all employment in Norway, which represents six percentage points more than the Oslo average of national employment.

There are fewer people in manufacturing industries and building and construction in the Oslo region than the national average indicates. 14 percent of national employment in manufacturing industries is found in the Oslo region, while for building and construction the share is 18 percent. Public sector employment in the Oslo region accounts for 20 percent of all national employment in public sector. In other words, the share of persons working in public sector in the Oslo region is lower than national average.

[2] With a wage cut-off on 100.000 NOK, we lose about 12-14 percent of the persons.

Table 2: Employment in the Oslo region and Norway, 1996, by sector.

Area	Employees	Share employment	National employment	Share national employment	Definition (NACE)
Public sector	134.962	31 %	688.734	20 %	40, 41, 641, 75-90
Manufacturing	40.540	9 %	288.240	14 %	15-36
Private services	210.910	48 %	659.732	32 %	50-72, 74, ex. 641
Research	3.999	1 %	9.845	40 %	73
Building and construction	21.165	5 %	119.056	18 %	45
Others	26.641	6 %	68.893	39 %	un-cat., 0-14, 37, 91-
Total	438.217	100 %	1.831.500	24 %	

In the following, we will look more closely at how employment is distributed in sub-sectors of these economic areas. The four sectors are public sector, manufacturing industries and private services.

Public sector

A large proportion - about 1/3 - of Oslo region employment is within the public sector, with a total of 135,000 employees. About half of this public sector employment is in health care (Table 3). This accounts for more than twice as much as public administration and defence, which make up about ¼ of employment. Employment in education represents 1/5 of the public sector employment in the Oslo region (1996).

Table 3: Employment in public sector in the Oslo region, 1996.

Area	*Employees*	*Definition (NACE)*
Public administration and defence	30.755	75
Education	26.620	80
Health care	66.845	85
Sewage and renovation	1.245	90
Electricity, gas and water supply	1.860	40, 41
Mail and distribution	7.637	641
SUM	134.962	

Manufacturing industry

Employment

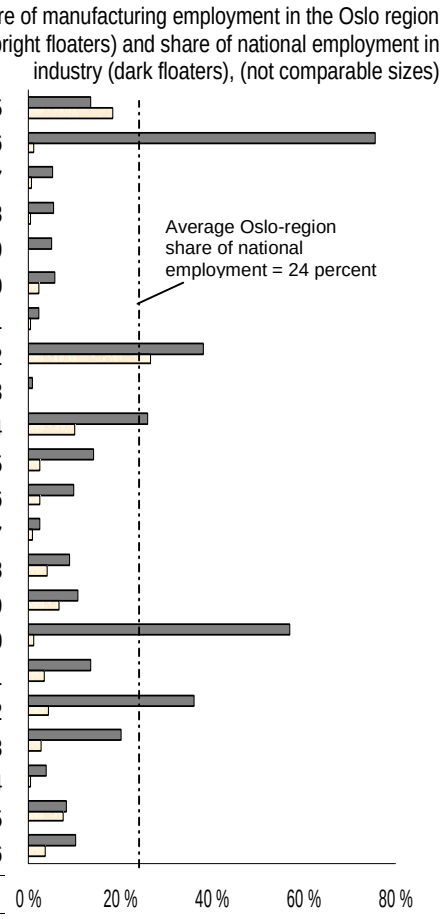
Employment in the Oslo region manufacturing industry represents about 10 percent of all employment in the region. The total number of employees in this sector is 40,500. The largest manufacturing industries are printing and publishing (30 percent of all employment in manufacturing industries), food and beverages (20 percent) and chemicals (10 percent) (Table 4, bright floaters).

The table also shows the size of the different industries in the Oslo region relative to national employment within the same industries (dark floaters). As we recall from earlier, the Oslo region represents a total of 24 percent of national employment. The table shows that there are five industries that have a larger share of national employment than this 24 percent average. These industries are tobacco (76 percent), office machinery and computers (57 percent), publishing and printing (38 percent), radio and television (36 percent) and chemicals (26 percent).

Manufacturing in the Oslo region represents only 14 percent of national employment in manufacturing industries. 'Medical and optical instruments' are also included in the overview if we lower the threshold to this level, representing about 20 percent of national employment.

Table 4: Employment in manufacturing industries in the Oslo region, share of total manufacturing employment in Oslo (bright floaters) and share of national industry employment (dark floaters), 1996[3].

Industry	Employment	NACE
Food Products and Beverages	7433	15
Tobacco Products	431	16
Textiles	269	17
Clothing	163	18
Leather; Luggage, Handbags, Saddlery, Harness and Footwear	43	19
Wood and Wood Products, Except Furniture; Manufacture of	925	20
Pulp, Paper and Paper Products	228	21
Publishing and Printing	10802	22
Coke and Refined Petroleum Products	13	23
Chemicals and Chemical Products	4144	24
Rubber and Plastic Products	984	25
Other Non-Metallic Mineral Products	984	26
Basic Metals	399	27
Metal Products, Except Machinery and Equipment	1652	28
Machinery and Equipment	2668	29
Office Machinery and Computers	462	30
Electrical Machinery and Apparatus N.E.C.	1428	31
Radio, Television and Communication Equipment and Apparatus	1752	32
Medical, Precision and Optical Instruments, Watches and Clocks	1073	33
Transport Equipment	190	34
Other Transport Equipment	3032	35
Furniture and Manufacturing N.E.C.	1465	36
SUM	40.540	



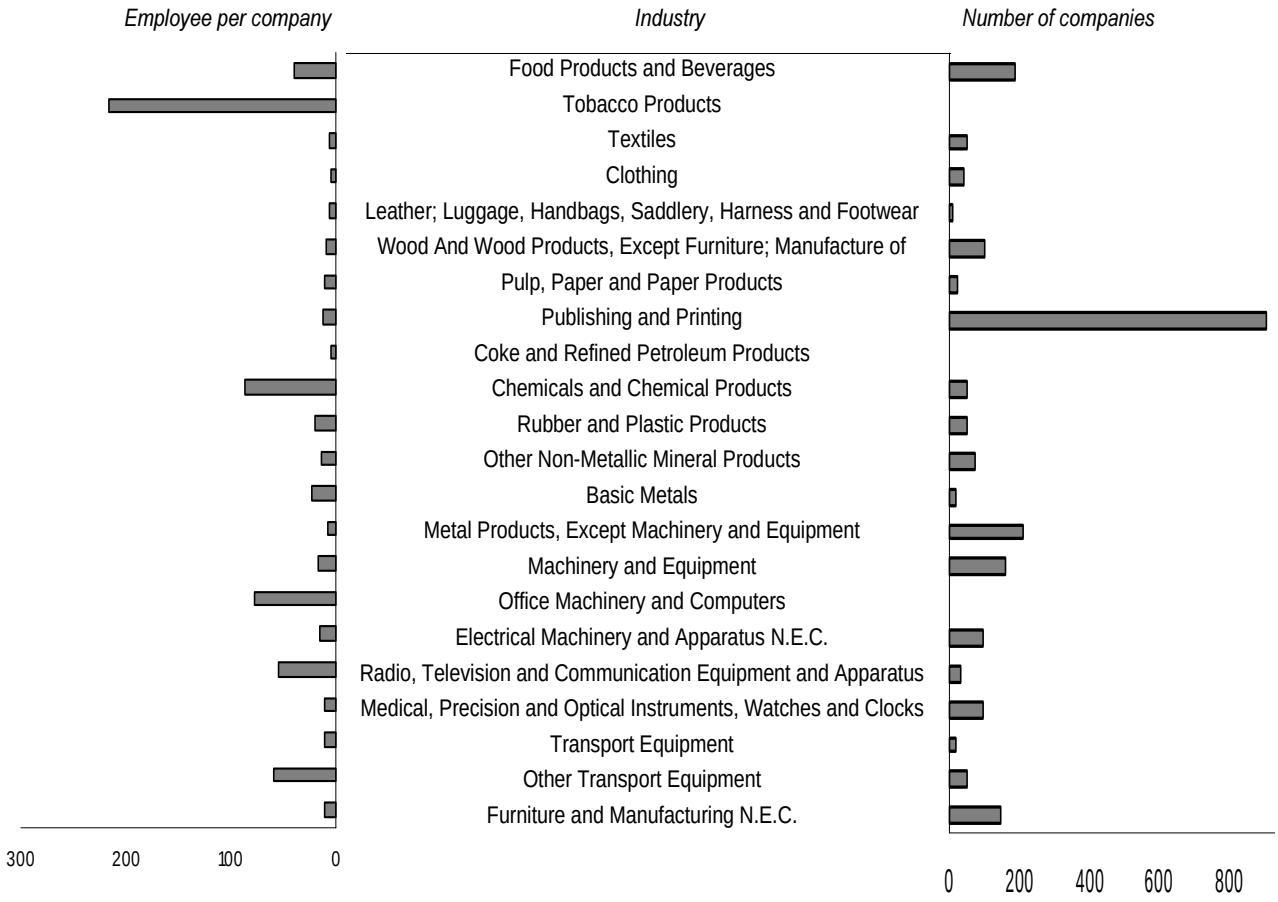
Number of companies

The picture of industrial structure in manufacturing industries is further elaborated when we take into account the number of companies and average number of employees per company in the Oslo region. Table 5 examines the relation between employment and companies in different manufacturing industries.

We see that the average largest units are found in production of tobacco; two companies account for 431 employees, representing an average of 215 employees per company. Tobacco is followed by chemicals (48 companies, 4144 employees = 86 employees per company) and office machinery and computers (6 companies, 462 employees = 77 employees per company).

[3] N.E.C. = Not Elsewhere Categorised

Table 5: Average number of employees and number of companies in different manufacturing industries in the Oslo region, 1996



What becomes obvious is that the industrial structure of the manufacturing industries appears slightly different now than when we only looked at number of employees. In Table 6 we have used average number of employees (1,842) and number of companies (105) to categorise the individual industries in four broad categories; *minor industries* (few companies, few employees), *hegemonic industries* (few companies, many employees), *artisan industries* (many companies, few employees) and *dominant industries* (many companies, many employees)

Table 6: Minor manufacturing industries, artisan industries, hegemonic industries and dominant industries in the Oslo region. Industries with higher number of employees per company than average in bold. Industries where Oslo has a magnitude relative to national average (i.e. more than 24 percent of industrial employment) are underlined.

	Few employees		*Many employees*	
Few companies	Minor industries	Wood and wood products, electrical machinery, medical and optical instruments, other non-mineral products, rubber and plastics, Textiles, Clothing, **Radio and Television**, Pulp and Paper, Basic Metals, Transport Equipment, Leather, **Office Machinery And Computers**, Coke And Refined Petroleum Products, **Tobacco Products**	Hegemonic industries	**Other transport equipment**, **chemicals**,
Many companies	Artisan industries	Metal products, furniture,	Dominant industries	Printing and publishing, food products, machinery and equipment

Private services

Private services is the single largest sector in the Oslo region with respect to employment; almost one of two employees worked in private services in 1996. There are of course large variations both in activity and employment between different industries within these services. The largest single service industry is wholesale and trade, representing about 25 percent of all private service employment. This industry is followed in size by ‘other business activities’ (20 percent) and ‘retail trade’ (18 percent). Other business activities covers areas as legal, accounting, bookkeeping and audition activities, architectural activities, technical testing and analysis, advertising, labour recruitment and provision of personnel, security activities and industrial cleaning. The individual employment figures for these industries are given in Table 8. The largest industry is architecture, followed by bookkeeping and labour recruitment.

Table 7: Employment in private services in the Oslo region, 1996

Industry	Employment	NACE
Sale, Maintenance and Repair of Motor Vehicles, Motorcycles; Automotive Fuel	9758	50
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	46070	51
Retail Trade, Except of Motor Vehicles / Motorcycles; Repair of PHG[4]	31621	52
Hotels and Restaurants	16407	55
Land Transport;Transport Via Pipelines	10790	60
Water Transport	5262	61
Air Transport	5381	62
Supporting and Auxiliary Transport Activities;Activities of Travel Agencies	8200	63
Telecommunications	2158	642
Financial Intermediation, Except Insurance and Pension Funding	11700	65
Insurance and Pension Funding, Except Compulsory Social Security	4811	66
Activities Auxiliary To Financial Intermediation	1438	67
Real Estate Activities	4232	70
Renting of Machinery and Equipment Without Operator and of PHG[4]	1855	71
Computers and Related Activities	9433	72
Other business activities	41794	74
SUM	210910	

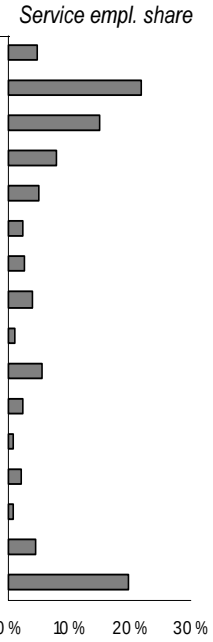
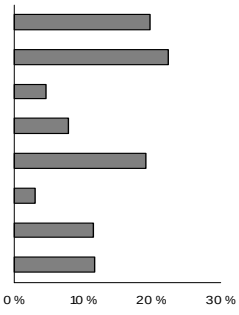


Table 8: Employment in 'Other business activities' in the Oslo region (NACE 74)

Industry	Employment
Legal, Accounting, Book-Keeping and Auditing Activities	8213
Architectural and Engineering Activities and Related Technical Consultancy	9303
Technical Testing and Analysis	1923
Advertising	3294
Labor Recruitment and Provision of Personnel	8025
Investigation and Security Activities	1290
Industrial Cleaning	4831
Miscellaneous Business Activities N.E.C.	4915
SUM	41794



More interesting, however, are Table 9 and Table 10, which present the share of different Oslo region service industries and their share of national employment in respective industries. The general picture is that most services are over-represented in this region. 12 of 16 service industries (on a 2-digit NACE level) have more employment in the Oslo region than the region's average share of national employment should indicate. There are three national service industries which are dominantly located in the Oslo region, and these are activities auxiliary to financial intermediation (70 percent), computers and related activities (65 percent) and air transport (60 percent). The Oslo region has a markedly lower share of employment in telecommunication services compared to the regions' share of national employment;

[4] Personal And Household Goods

about eight percent of telecommunication employment work is in companies located in the Oslo region.

Table 9: Private service industries in Oslo and their share of national industrial employment, 1996

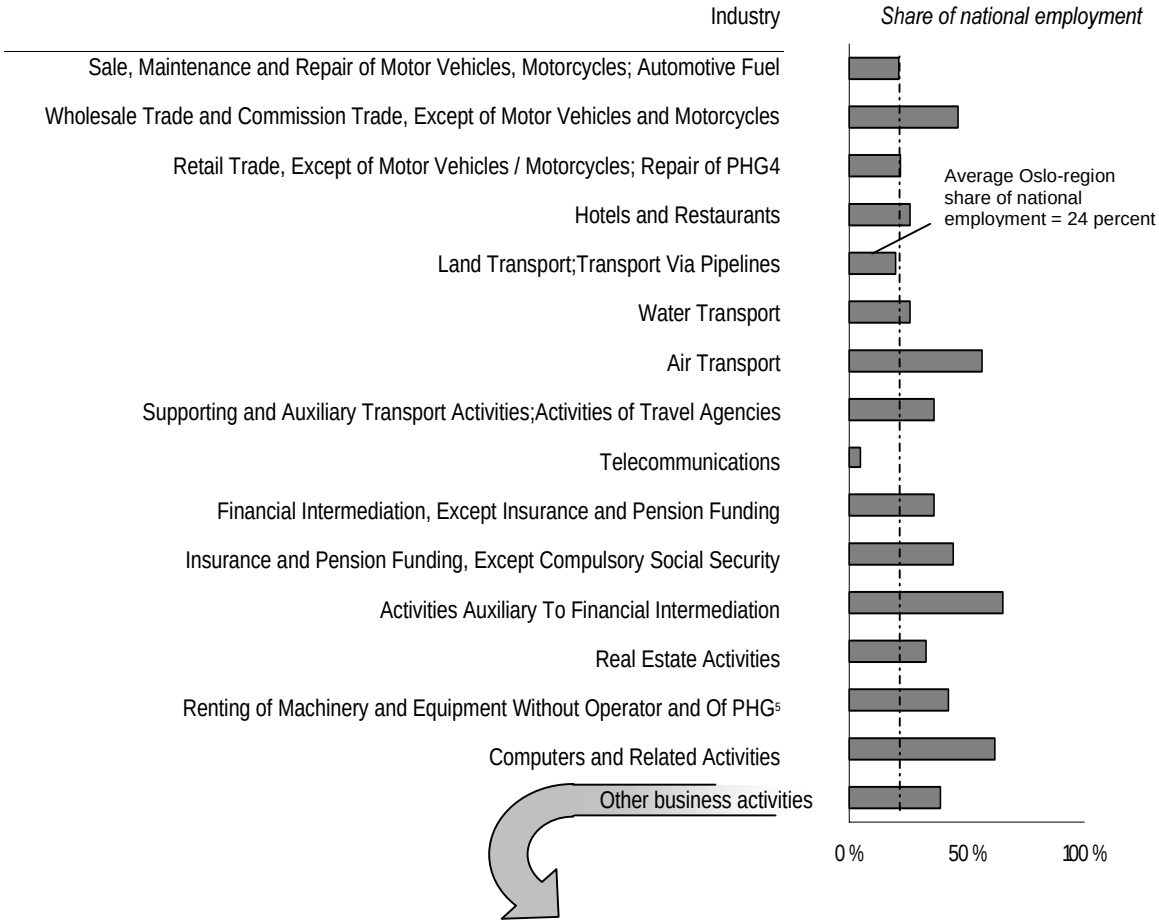
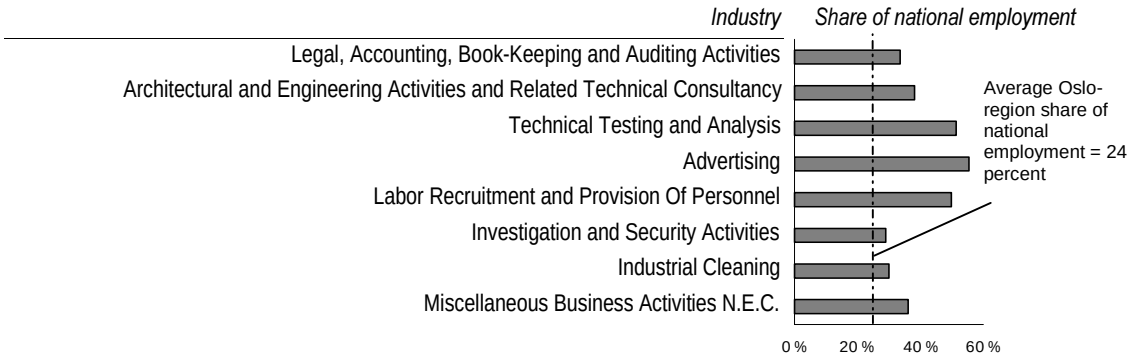


Table 10: 'Other industries' in Oslo and their share of national industrial employment, 1996 (NACE 74)

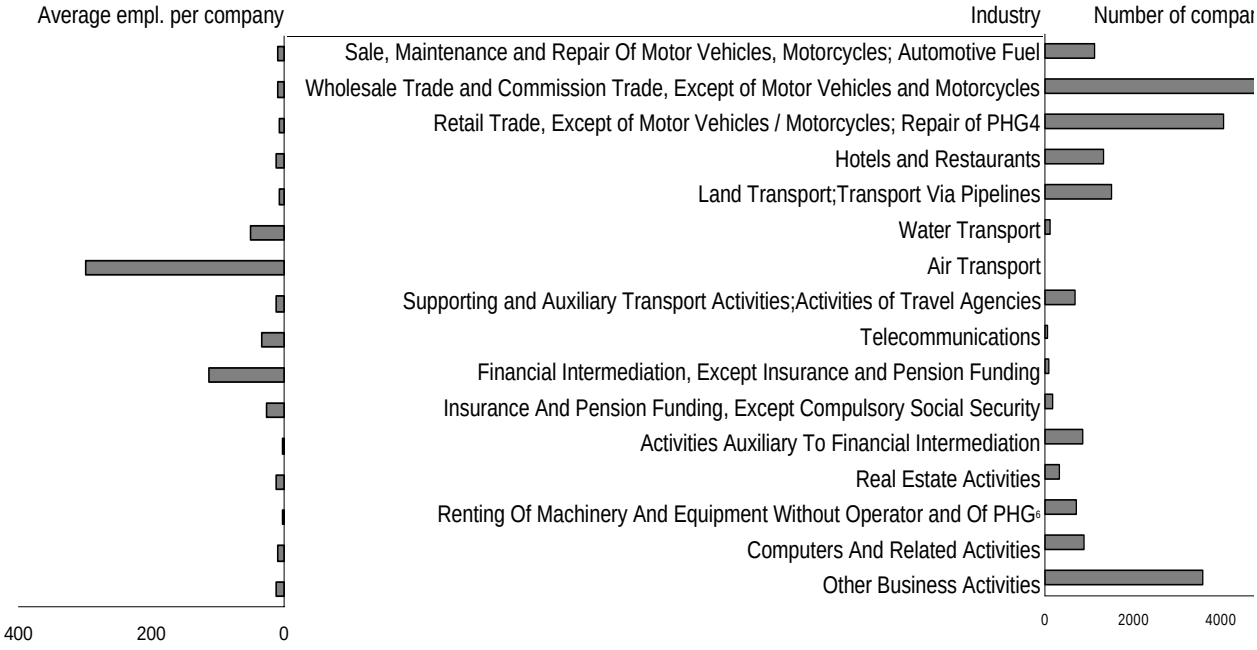


[5] Personal And Household Goods

From Table 10 we also see that there are three service industries with particularly high shares of national employment within the same industries. These are 'advertising', 'technical testing and analysis' and 'labour recruitment and provision of personnel'.

Table 11 gives us a further illustration of the industrial structure within service industries. The table shows the average number of employees in industry, and number of companies within each industry. As we can see, there are two important industries with dominantly large actors, namely the air industry and financial intermediation. Both these industries represent substantial employment diffused on few companies.

Table 11: Average number of employees in different service industries, and number of companies, Oslo region, 1996.



As with manufacturing industries it is possible to map the service industries in four categories; *minor industries* (few companies, few employees), *hegemonic industries* (few companies, many employees), *artisan industries* (many companies, few employees) and *dominant industries* (many companies, many employees). As before,

[6] Personal And Household Goods

few here refers to *below average,* i.e. less than 13,182 employees and 1,308 companies.

Table 12: Minor service industries, artisan industries, hegemonic industries and dominant industries in the Oslo region. Industries with higher number of employees per company than average in bold. Industries where Oslo has a magnitude relative to national average (i.e. more than 24 percent of industrial employment) is underlined.

		Few employees		*Many employees*
Few companies	Minor industries	Sale and Repair Of Motor Vehicles, **Water Transport**, **Air Transport**, **Supporting And Auxiliary Transport**, **Telecommunications**, **Insurance**, Activities Auxiliary To Financial Intermediation, **Real Estate**, Renting Of Machinery And Equipment, **Computers And Related Activities**	Hegemonic industries	**Financial services**
Many companies	Artisan industries	Land Transport	Dominant industries	Wholesale Trade, Retail Trade, **Hotels And Restaurants**, **Other business activities**

New firm formation

This section will look more closely at the establishment of new companies in the Oslo region. We also have data on business close ups for manufacturing industry in the Oslo-region. The data is based on the Directorate of Taxes' VAT register[7], which registers and de-registers firms. Using register-data to investigate the establishment of new firms, it is important to have in mind that there are limitations. Some new registered firms are not all 'new', they may, for instance, have changed their form of ownership (i.e. from sole traders to joint-stock companies). Certain industries in the

[7] In Norwegian: Skattedirektoratets database over foretak som er pliktige til å betale merveridavgift, mva-mantallet.

service sector, like banking, insurance, culture, sports, teaching, health, research, consultancy and broadcasting do not pay tax, and are therefore not included in the VAT register. In addition, only enterprises which have a turnover of more than 30,000 NOK are registered in the database. The database will therefore not give a precise picture of newly established firms, but comparisons of data sources indicates that the database can be very useful in studying new registrations and de-registrations in manufacturing industry and for some industries in services. Seen all together the database will give a lower share of new registered firms because of lack of coverage for certain industries. On the other hand, for industries that are covered in the database, the share of new registrations can be higher then the actual number because firms that are not 'new' are registered as such.

Table 13. Frequencies of new registrations in the period 1994-1998. Counties in Norway.

Frequencies of new registrations	1994	1995	1996	1997	1998
Oslo	16.1	15.9	16.7	16.6	14.6
Akershus	12.6	14.4	13.9	14.1	12.5
Vestfold	10.3	11.1	10.8	10.9	10.3
Hordaland	11.2	10.9	10.6	11.3	10.2
Rogaland	10.2	10.4	12	10.9	10.1
Finnmark	11.6	11.5	10.9	11.2	9.5
Troms	10.1	9.6	9.8	10.1	9.3
Østfold	8.6	8.7	9.1	9.6	9
Vest-Agder	10.8	10.5	11.5	10.3	8.9
Telemark	9.8	10.4	10	9.9	8.8
Buskerud	9.4	9.6	9.9	10.3	8.7
Sør-Trøndelag	8.1	9.3	9.8	9.3	8.3
Nordland	9.8	9.1	9.4	8.4	7.9
Hedmark	8.2	8.3	8.2	8.3	7.9
Aust-Agder	9	10.1	10.5	9.4	7.8
Møre og Romsdal	7.9	8.1	7.6	7.7	7.4
Oppland	7.4	7.5	7.3	7.6	7.1
Nord-Trøndelag	6.9	7.5	7.4	7.3	6.6
Sogn og Fjordane	6.2	6.4	6.5	6.2	6
ALL	10	10.3	10.5	10.4	9.4

Source; Næringslivets ukeavis, 30/4-99

The table shows that new registrations in 1998 were declining from previous years in all counties, and especially in the counties of Oslo and Akershus. The lower share of new registrations is explained by the unstable economy the country has experienced

in recent years, but still the conclusion is clear; it should be made easier to start new businesses to prevent a further decline in firm formation. New firm formation provides an important contribution to innovation and restructuring of the economy. On the other hand many of the new registered firms are simply one-man companies or part-time activities, which can neither be called innovative nor growth oriented.

In spite of the lower share of new registered firms in 1998, the Oslo region still has the highest frequency of new registrations. The numbers reflect the size of the economy in these counties, but when controlling for the number of enterprises in the region, the picture is much the same[8]. Oslo has 14.6 percent new registration per 100 enterprises in 1998, Akershus has 12.5 percent new registrations per 100 enterprises, while the average percentage for the country is 9.4.

Table 14. Frequencies of new registrations in manufacturing industry in the period 1990-1998. The Oslo region (Oslo and Akershus).

Manufacturing industry	1990	1991	1992	1993	1994	1995	1996	1997	1998
Food, Beverages & Tobacco	18.8	15.6	17.1	15.9	18.4	18.6	15.9	20.2	17.4
Textiles, Apparel & Leather	11.9	13.9	10.1	13.9	17.8	13.8	11.9	11.1	11.4
Wood Products & Furniture	12.9	8.0	13.6	8.6	12.3	8.2	8.7	10.0	7.0
Paper, Paper Products & Printing	13.7	16.3	16.8	15.6	14.6	14.8	11.8	12.0	10.8
Chemical Products	6.3	8.8	12.2	6.8	7.5	9.6	8.1	6.7	6.4
Non-Metallic Mineral Products	3.8	10.4	12.1	7.1	16.0	12.2	11.8	13.2	15.5
Basic Metal Industries	16.7	10.0	18.8	13.3	25.0	10.5	17.6	15.0	26.1
Fabricated Metal Products	9.8	10.8	9.5	8.6	7.4	8.6	9.4	8.6	7.0
Other Manufacturing, nec	6.6	9.9	8.1	10.1	11.1	14.9	8.2	12.7	8.5

[8] Olav Spilling, Næringslivets ukeavis 30/4-99.

Table 15. Frequencies of de-registrations in manufacturing industry in the period 1990-1998. The Oslo-region (Oslo and Akershus).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Food, Beverages & Tobacco	19.2	16.5	15.2	19.6	16.5	13.8	12.3	14.5	15.4
Textiles, Apparel & Leather	12.3	13.9	13.1	16.2	8.7	10.1	11.2	10.8	9.0
Wood Products & Furniture	13.1	10.1	11.2	11.4	10.1	8.7	7.6	10.0	7.9
Paper, Paper Products & Printing	14.5	13.9	17.0	13.4	11.2	11.1	10.7	11.2	9.4
Chemical Products	8.0	12.9	13.4	8.6	9.4	6.4	6.2	11.6	6.4
Non-Metallic Mineral Products	13.2	15.6	18.7	11.8	14.8	8.5	4.7	6.6	14.4
Basic Metal Industries	5.6	30.0	25.0	6.7	6.3	21.1	0.0	0.0	8.7
Fabricated Metal Products	13.8	14.0	13.1	10.8	7.9	11.2	7.5	10.3	8.7
Other Manufacturing, nec	14.6	8.2	11.4	9.5	10.6	7.2	11.3	13.2	10.6

The tables above show both new registrations and de-registration among manufacturing industry in the Oslo-region, in the period from 1990-1998. The table of new registrations show that the rates have fallen in recent years except in non-metallic mineral products and basic metal industries. ‘Food, Beverages & Tobacco’ has seen fluctuations during the last 10 years, with a peak in 1997 with a 20.2% share. In 1998 the share was 17.4% . ‘Paper, Paper Products & Printing’ has had a decline in new registrations since 1991, with a 1998 share of 10.8%.

It has been established fewer firms last year compared to earlier years, but on the same time the number of de-registrations has decreased. The table shows that the share of firms that has shut down their activity the last year is smaller than earlier years. From the early 1990’s until 1998, the share of de-registration has constantly gone down. This could suggest a larger share of firms being more capable of surviving, than earlier years. One explanation could be that in years when the economy is turbulent, it is harder to start up a firm. If you then have succeeded in this, you have made experiences that could have a positive impact on running your business.

3. Distribution of competence in the Oslo-Region. Administration, Health, Education – and what else?

By Anders Ekeland

Introduction

There has been an increasing interest in the role of human resources in the economy since the mid-eighties, especially human resources in science and technology (HRST). The importance of human resources has been stressed in a number of important documents[9]. Programmes like "Human capital and mobility" organised by the European commission in 1992, was also a clear indication of this increased attention on human resource issues. As a consequence the need for measurement of HRST, the OECD Secretariat together with the European Commission and the Group of National Experts on S&T indicators, initiated work on a statistical framework that resulted in the so-called Canberra Manual. The OECD published it in 1995. The full title is "Manual on the Measurement of Human Resources Devoted to Science and Technology". The Canberra manual states in the introduction:

> "Highly skilled human resources are essential for the development and diffusion of knowledge and constitute the crucial link between technological progress and economic growth, social development and environmental well-being. While the number and distribution of scientists and engineers were recognised as important indicators of a nation's S&T effort when the first S&T indicators were being designed in the early 1960s, countries and international organisations usually saw a need for internationally comparable data on human resources only in the context of short-term policy issues, for example, the "brain drain" debate and the "ageing" of the S&T workforce. In consequence, very few countries established and systematically maintained coherent systems for the monitoring of stocks and

[9] See among others: "Background report concluding the Technology/Economy Programme (TEP)", especially chapter 6 "The Supply of Scientist and Engineers: Current Trends and Concerns" and chapter 7 "Human Resources in the Production System and New Technologies".

> flows of scientific, technical and engineering personnel deemed necessary for longer-term analysis or the examination of a wider range of issues. Hence, despite intermittent efforts in the 1980s, the methodology, collection and analysis of quantitative information on human resources devoted to S&T (HRST) at the OECD was confirmed to personnel engaged in R&D only."

But as will be discussed in greater detail below the register data available in Norway and the other Nordic countries makes the measurement of human resources – in science and technology and in other fields - much more feasible. The key to measuring the economic impact of human resources - is to establish the connection between the employee and the workplace/employer. There is a surprisingly wide range of questions that can be studied once this nexus is made, since our working lives are so central to both the economy and us as individuals. To mention some examples:

- comparative analyses of the stocks and flows of human resources between firms, sectors, regions
- establishment of new firms, spin-offs
- after high-tech bankruptcies – what happens to the core personnel?
- are the education system matched to the needs of the economy?
- returns to education
- traditional labour market issues

In addition we get a "dual" approach to these issues. We can characterise the individuals by the firms they work in and the firms by the characteristics of their employees.

Register data

In Norway (and the other Nordic countries), each individual and each organisation (enterprise, establishment) has a unique identification number, which is used in a variety of administrative and statistical registers. That makes it possible to combine – or "join" – to use the relational database term - information from these registers. That

means that data that were never meant to be combined, like the tax- and examination register can be merged into one dataset making it possible to study the profits and/or the wages of the employees to say something about the "return" to education.

The main administrative registers used are population registers, taxation registers, social security registers, registers of buildings and dwellings, business- and examination register.

These multiple "joins" using either the persons ID-number of the firms ID-number result in annual information for each individual on demographic variables, formal education, occupational status, actual occupation (only main occupation[10]), enterprise and establishment of employment, salaries, etc. These registers are a very valuable and up to now rather under-utilised source of information for research. In this report we are just going to use registerdata to give a first rough statistical description of distribution of competence in the Oslo-region using a persons highest achieved educational level as a proxy for competence.

Educational classification

The basic classification is of course the International Standard Classification of Education (ISCED). Norway has its own classification system that is more detailed but fully compatible with ISCED. In this report we have used the Norwegian standard for practical reasons. The relation between ISCED and the Norwegian standard are roughly described in the table below:

[10] In the datasets used here every person employed is associated with one and only one employer each year. In most cases this is unproblematic, because most of us just have one job. Those who have two jobs, mostly one of them are clearly the primary occupation, but there are examples of persons having two full-time jobs. Mostly that is due to the well-know fact that people are not taken out of the registers. In such cases the most recent full-time job is selected as the main occupation.

Table 1. The International Standard Classification of Education and the Norwegian standard.

	From year	To year	Norway	ISCED
Primary school	1	6	100000	10000
Secondary school	7	9	200000	20000
High-school, level I	10	10	300000	30000
High-school, level II	11	12	400000	30000
University level I (one or two years)	13	14	500000	50000
University level II (three or four years)	15	16	600000	60000
University level III (more than four years)	17	18	700000	70000
Ph.D., research competence	18		800000	70000

The Norwegian standard is different from ISCED on high school level for reasons that are of no importance in this context, since we will concentrate on people with at least twelve years of formal education. We will lump together everything below level 5 (ISCED and the Norwegian standard) into one group. The Norwegian – as most national standards – in contrast to ISCED do differentiate people with Ph.D.'s from the highest "normal" academic degree. But for the purposes of this chapter, we do not need this level of detail[11]. The Norwegian classification code is 6-digit and ISIC is 5-digit, but in most analysis only the first digit – the level of education and the second digit – the main field of education is used. But the classification allows analysis of very specific educational groups using all the digits (subdivisions).

Industrial classification

The level of detail of the NACE classification applied in this chapter is generally the same as in the other chapters, i.e. 2-digit NACE is used for the manufacturing sectors. For service sectors broader categories have been defined. For example, the category 'other community, social and personal services' has been defined as sectors NACE 91-97 together. In this chapter universities and research institutes are singled out even though they are on a three-digit level. Universities are defined as institutions giving PhD level education. Research institutes have been further subdivided into institutes mainly serving industry and/or doing R&D in natural sciences and institutes in the fields of social sciences and humanities.

[11] Since the "modern", Anglo-American Ph.D. became a part of our university education the last ten years, the number of Ph.D.s has "exploded" one has to do a more detailed analyses not to get misleading results when it comes to number of Ph.D.s in various branches etc.

This paper brings accurate and recent statistics on employment in the Oslo region. The region is defined as the two counties Oslo and Akershus. It is very important to note that it is the persons ***working*** in these two counties that constitutes the population. The same rule applies to the other counties. This means that the numbers will only be roughly comparable to most other official statistics because they are as a rule made on the basis of where people ***live***.

There are two exceptions to this rule, Svaldbard and some foreign firms, mainly connected to the offshore industry. Then the registers use a special county code. We have chosen to use the residential county for employees in these cases.

Distribution of competence

In the following we shall try to get an overview of the distribution of persons using their highest achieved educational level as an indicator of competence. The data makes it possible to construct various 'experience measures' by looking at how long and in what kind of firms (sector, size, wage-level etc.) they have worked in. But for the present purposes and operating on such an aggregate level, such measures adds more complexity than clarity.

Table 2. The counties share of different educational groups.

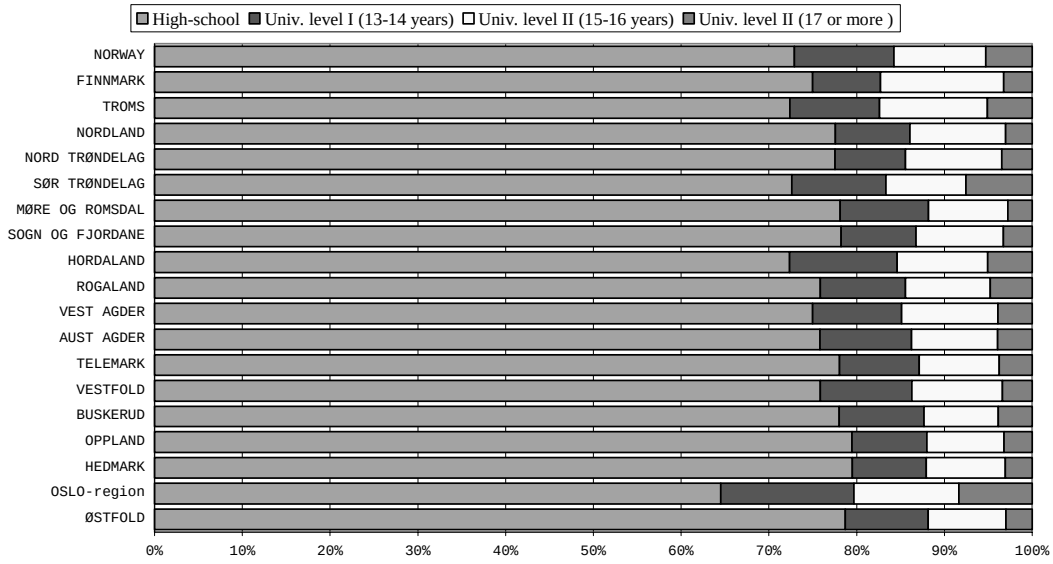
County	High-school	Univ. level I (13-14 years)	Univ. level II (15-16 years)	Univ. level II (17 or more)	Share of employment
ØSTFOLD	5 %	4 %	4 %	3 %	5 %
OSLO-region	24 %	37 %	31 %	43 %	27 %
HEDMARK	4 %	3 %	3 %	2 %	4 %
OPPLAND	4 %	3 %	3 %	2 %	3 %
BUSKERUD	5 %	4 %	4 %	3 %	5 %
VESTFOLD	4 %	4 %	4 %	3 %	4 %
TELEMARK	4 %	3 %	3 %	2 %	3 %
AUST AGDER	2 %	2 %	2 %	1 %	2 %
VEST AGDER	3 %	3 %	3 %	2 %	3 %
ROGALAND	9 %	7 %	8 %	8 %	9 %
HORDALAND	10 %	10 %	9 %	9 %	10 %
SOGN OG FJORDANE	3 %	2 %	2 %	1 %	2 %
MØRE OG ROMSDAL	5 %	5 %	4 %	3 %	5 %
SØR TRØNDELAG	6 %	5 %	5 %	8 %	6 %
NORD TRØNDELAG	3 %	2 %	3 %	2 %	2 %
NORDLAND	5 %	4 %	5 %	3 %	5 %
TROMS	3 %	3 %	4 %	3 %	3 %
FINNMARK	2 %	1 %	2 %	1 %	2 %
Sum	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**

The table shows the share of each county of different eductational groups. As expected the Oslo region has relatively less, 24% vs. 27% persons with their highest education below university level. Correspondingly the region also has a more than a proportional share in the all the university-level educational groups. Especially marked is the difference between the 27% of all employment, and 43% of the total

number of people in Norway in the highest educational group, i.e. people with 17 or more years of education.

When it comes to the structure of competence, i.e. the relative shares of various levels of education - the Oslo-region is still the leading region, but the more like the others.

Figure 1. Educational groups by county, 1997



The Oslo-region is has a high educational level. The region has a higher percentage share of people with higher education in all the different levels of higher education, and especially on the very highest level. The only regions to come close are of course the counties around the other “big” cities (in a Norwegian context) – i.e. Hordaland (Bergen), Sør-Trøndelag (Trondheim) and Rogaland (Stavanger).

Table 3. Educational groups in some Norwegian counties with important urban centres.

	High-school 1 – 12 years	Univ. level I (13-14 years)	Univ. level II (15-16 years)	Univ. level II (17 or more)
OSLO-region	65 %	15 %	12 %	8 %
ROGALAND	76 %	10 %	10 %	5 %
HORDALAND	72 %	12 %	10 %	5 %
SØR TRØNDELAG	73 %	11 %	9 %	8 %
NORWAY	73 %	11 %	10 %	5 %

The table shows that Oslo has the highest share in all university level educational groups. Sør-Trøndelag equals the Oslo-region in the highest educational group, but have less on Univ. level I and II.

These counties are chosen because they are large cities in a Norwegian context. All of them besides Rogaland has a university. Hordaland is the centre for the offshore industry and also has several institutions of higher education. All regions have R&D institutes.

Table 4. The competence intensive sectors, University level III, four regions

Sector	Hordaland	Oslo-reg.	Rogaland	S-Trøndelag
Oil and Mining	7	1	26	3
Other Transport Equipment	2	0	5	0
Wholesale Trade ex. Motor Vh.	1	5	5	2
Computers And Related Activities	2	4	2	2
R&D,natural sci. and engineering	4	4	3	14
R&D, social sciences	1	1	0	2
Other Business Activities	8	15	10	9
Public administration and defence	10	18	10	9
Education	13	7	11	9
Higher Education Institutions	21	10	4	24
Health care	15	11	12	12
Other social services	3	5	3	3
The secotrs taken out of the table	13	19	9	11
Sum total	100	100	100	100

The table shows the distribution of the highest educational group in a 2-digit NACE sectoral breakdown. We have taken away the majority of sectors where none of the regions have more than one or two percent. Since there are 49 sectors all together and 12 sectors in the table above, this means that less than a quarter of the industrial branches uses any significant amount of the highest educated persons.

It is especially the traditional manufacturing branches that are missing from the table, but also the trade branches. That is due to several interacting factors. Basically these sectors employ relatively few highly educated. Secondly the urban regions have great share of their employment in the tertiary sectors. But one should also be aware that the classification used is an *industrial* classification being much more detailed in the manufacturing sectors on a two-digit level than in "services" and the public sector, to a certain degree concealing the great differences inside those sectors. But still there are marked differences between the regions:

The oil industry

As expected Rogaland is a heavy user of highly educated people in this sector in contrast to the other regions. But one has to bear in mind two things. First that the Oslo region has a technical consultancy sector and many small firms actually serving the oil sector, but classified elsewhere. Secondly that the great weight of the state administration, great hospitals etc. dwarfs the absolute number of people in the Oslo-region serving the oil sector.

R&D in natural sciences and engineering

It is notable that all four regions has few Univ. II persons in R&D in natural sciences and engineering, Sør-Trøndelag has a share of 14 % of the highest educational level in scientific R&D. Not surprising, given the fact that the technical university and several major R&D institutes of the SINTEF group is located in Trondheim.

The education intense sectors

In the bottom of the table there is cluster of sectors that are the heavy users of highly educated persons. "Other business services" includes as mentioned above a lot of technical consultancy. Besides that there is the "reproductive sectors", education, health – and general administration.

The knowledge intensity

The above tables showed the distribution of competence over sectors, but for many analytical purposes the share of highly educated *in each sector* is more suitable measure.

Table 5. The relative share of educational groups in each sector, Oslo-region

	High-school	Univ. I+II	Univ. III
Agriculture, Forestry, Fishing	85 %	11 %	4 %
Oil and Mining	39 %	31 %	30 %
Food Products And Beverages	87 %	10 %	2 %
Tobacco Products	85 %	11 %	4 %
Textiles	92 %	8 %	0 %
Clothing	92 %	6 %	2 %
Leather And Footwear	96 %	4 %	0 %
Wood Except Furniture;	88 %	9 %	3 %
Pulp, Paper And Paper Products	84 %	15 %	1 %
Publishing And Printing	72 %	25 %	4 %
Coke And Ref. Petroleum Products	98 %	2 %	0 %
Chemicals And Chemical Products	55 %	29 %	16 %
Rubber And Plastic Products	90 %	8 %	2 %
Other Non-Metallic	77 %	19 %	4 %
Basic Metals	37 %	40 %	24 %
Metal Products, Except Machinery	90 %	9 %	1 %
Machinery And Equipment	82 %	12 %	6 %
Office Machinery And Computers	57 %	22 %	21 %
Electrical Machinery misc.	69 %	22 %	9 %
Radio, Television etc.	43 %	33 %	24 %
Precision Instruments, Watches	60 %	30 %	11 %
Transport Equipment	87 %	10 %	2 %
Other Transport Equipment	83 %	14 %	3 %
Furniture And Manuf. N.E.C.	86 %	13 %	2 %
Electricity, gas and water supply	84 %	12 %	4 %
Sale& Rep. of Motor Vehicles,	89 %	11 %	0 %
Wholesale Trade ex. Motor Vh.	72 %	24 %	4 %
Retail Trade, Ex. Motor Veh	84 %	15 %	1 %
Hotels And Restaurants	85 %	15 %	0 %
Land Transport, Pipelines	86 %	11 %	3 %
Water Transport	60 %	38 %	2 %
Air Transport	70 %	28 %	2 %
Transport Activ., Travel Agencies	73 %	24 %	3 %
Mail and distribution	88 %	11 %	0 %
Telecommunications	49 %	40 %	11 %
Financial, Ex. Insurance&pension	60 %	33 %	7 %
Insurance And Pension Funding,	57 %	35 %	8 %
Aux. To Financial Intermediation	44 %	47 %	9 %
Real Estate Activities	69 %	26 %	5 %
Renting Of Machinery	81 %	19 %	1 %
Computers And Related Activities	41 %	43 %	16 %
R&D,natural sci. and engineering	34 %	23 %	42 %
R&D, social sciences	21 %	25 %	53 %
Other Business Activities	56 %	31 %	13 %
Public administration and defence	48 %	34 %	19 %
Education	28 %	60 %	12 %
Higher Education Institutions	26 %	29 %	45 %
Health care	59 %	35 %	6 %
Other social services	60 %	31 %	9 %
Sum Total	65 %	27 %	8 %

The table shows as expected considerable variation in the intensity of formal education. Sectors like “Oil and mining”, “Chemicals and Chem. Products”; “Basic Metal Products except Machinery” have a high intensity. In a general sense these results are reasonable, but one should be aware of possible biases in these numbers. Some large industrial firms have their headquarters in Oslo and they are often traditionally classified according to the industrial sector they belong to according to their products. That means that highly educated managers, economists, accountants, IT-personnel etc. are classified as “chemical” or “basic metal” workers. We have taken a quick glance at the firms in the manufacturing sector in the Oslo-region with more than 50 employees and we recognised several cases of “manufacturing” firms where only information and management services are produced. Only a much more detailed and subtle analysis could tell how much the numbers presented above should be corrected downwards to give a picture closer to common sense.

From the table above it is clear that the highest educational group is a pretty good indicator for the “knowledge-intensity” of a given sector. We shall use this to simplify the comparison of the four regions.

Table 6. Share of highest educational group in knowledge-intensive sectors, four regions.

	Hordaland	Oslo-reg.	Rogaland	S-Trøndelag
Oil and Mining	26 %	30 %	16 %	26 %
Chemicals And Chemical Products	2 %	16 %	13 %	2 %
Basic Metals	4 %	24 %	4 %	4 %
Metal Products, Except Machinery	0 %	1 %	1 %	0 %
Office Machinery And Computers	40 %	21 %	21 %	40 %
Electrical Machinery	6 %	9 %	7 %	6 %
Radio, Television	4 %	24 %	18 %	4 %
Medical, Precision Instruments,	18 %	11 %	11 %	18 %
Telecommunications	9 %	11 %	11 %	9 %
Financial, Ex. Insurance%Pension	4 %	7 %	6 %	4 %
Insurance And Pension Funding	4 %	8 %	7 %	4 %
Activ. Aux to Financial Intermed.	4 %	9 %	8 %	4 %
Real Estate Activities	3 %	5 %	4 %	3 %
Computers And Related Activities	20 %	16 %	16 %	20 %
R&D,natural sci. & engineering	53 %	42 %	42 %	53 %
R&D, social sci. & humanities	52 %	53 %	52 %	52 %
Other Business Activities	14 %	13 %	12 %	14 %
Public administration and defence	11 %	19 %	15 %	11 %
Education	13 %	12 %	11 %	13 %
Higher Education Institutions	42 %	45 %	45 %	42 %
Health care	5 %	6 %	5 %	5 %
Other social services	6 %	9 %	8 %	6 %

The overall picture is that the four regions are similar at this rather high level of aggregation. There are of course differences, in “chemical products”, “basic metals”, “office machinery and computers”. As mentioned above, there are reasons to suspect that i.e. the fact that basic metal turns out to be very knowledge-intensive is just reflecting the fact that the administration and also the R&D department are located to the Oslo-region. In this latter case it might then be accidental if the R&D department is a separate legal unit – contributing the very high knowledge-intensity in the R&D sectors – or is part of the firm and then increasing the knowledge intensity in one of the manufacturing or service sectors.

Human resources in Science and Technology

Traditionally – as reflected in the statistical standard “The Canberra Manual” mentioned in the beginning of this chapter – there has been much focus on highly educated persons with a background in natural sciences, mathematics and/or engineering. One might question whether this focus is justified, or how meaningful it is to analyse as one group so different scientific fields as botanical and quantum physics, but we think it is useful as a starting point for further analysis.

Table 7. Relative shares of scientific fields, Univ. level II+III, four regions

	Natural Sci.& Engineering	Medical, dentist veterinarian	All other fields
HORDALAND	21 %	18 %	61 %
OSLO-region	25 %	13 %	61 %
ROGALAND	28 %	14 %	58 %
SØR TRØNDELAG	30 %	16 %	54 %

The table shows that the distribution is rather similar, the Oslo region being placed third, behind Sør-Trøndelag with the Technical University and Rogaland, which due to the off-shore industry has been very engineering heavy.

Table 8. Distribution of engineers and natural scientific competence, Univ. level II+III, knowledge intensive branches.

	Hordaland	Oslo-reg.	Rogaland	S-Trøndelag
Oil and Mining	11 %	2 %	31 %	6 %
Other Transport Equipment	5 %	1 %	9 %	1 %
Electricity, gas and water supply	6 %	6 %	4 %	5 %
Wholesale Trade, Ex Motor Vh.	4 %	9 %	7 %	4 %
Telecommunications	1 %	3 %	1 %	1 %
Computers And Related Activities	4 %	9 %	4 %	5 %
R&D,natural sci. & engineering	7 %	5 %	2 %	16 %
R&D, social sci. & humanities	0 %	1 %	0 %	1 %
Other Business Activities	14 %	22 %	14 %	14 %
Public administration and defence	7 %	10 %	6 %	6 %
Education	7 %	4 %	5 %	6 %
Higher Education Institutions	11 %	5 %	2 %	18 %
Health care	3 %	4 %	2 %	3 %
Sum "marginal" sectors	20 %	21 %	13 %	13 %
Sum total	100 %	100 %	100 %	100 %

Again there are marked differences, in "Oil and mining" and "Other business activities", but as mentioned before the technical consultancy firms is a major component of the latter sector, and several of them is actually serving the off-shore industry. The Oslo-region has a high percentage of natural scientist and engineers in Computers, Telecom. Sør-Trøndelag on the other hand has more of this kind of competence in higher education and R&D institutes.

The "marginal sectors" are those who have zero, one or two-percentage point of the total employment of natural scientists and engineers.

Competence and the size of firms and institutions

Educational groups are not evenly distributed over the size of firms and institutions. In the table below we have chose the following grouping of firms: one-man and micro firms 1 – 3, then comes the "small-group" firms from 4 to 19. Such firms are small enough to be run with a minimal staff and middle management. Then comes – in a Norwegian context - the medium sized firms and institutions from 20 – 49. It is important to remember that we are not only talking about private sector firms. The public sector is the major employer for persons with education on university level.

Table 9. Relative shares of educational groups in different size classes, four regions

	Number of empl.	High-school	Univ. I (13-14)	Univ. II (15-16)	Univ. III (17 ++)
Norway	1 -3	81 %	10 %	5 %	4 %
	4 - 19	80 %	10 %	8 %	3 %
	20 - 49	72 %	11 %	13 %	4 %
	50 - 250	70 %	11 %	13 %	6 %
	Over 250	64 %	14 %	12 %	9 %
Hordaland	1 -3	81 %	10 %	5 %	4 %
	4 - 19	79 %	10 %	8 %	3 %
	20 - 49	71 %	11 %	13 %	5 %
	50 - 250	70 %	12 %	13 %	5 %
	Over 250	66 %	14 %	11 %	8 %
Oslo-reg.	1 -3	73 %	14 %	7 %	6 %
	4 - 19	73 %	13 %	8 %	5 %
	20 - 49	65 %	14 %	14 %	7 %
	50 - 250	59 %	15 %	15 %	11 %
	Over 250	57 %	16 %	14 %	12 %
Rogaland	1 -3	84 %	8 %	5 %	3 %
	4 - 19	82 %	8 %	8 %	3 %
	20 - 49	73 %	9 %	14 %	3 %
	50 - 250	73 %	10 %	12 %	5 %
	Over 250	70 %	12 %	10 %	8 %
S-Trøndelag	1 -3	83 %	8 %	4 %	4 %
	4 - 19	80 %	9 %	7 %	4 %
	20 - 49	75 %	10 %	12 %	4 %
	50 - 250	64 %	12 %	16 %	9 %
	Over 250	66 %	12 %	9 %	13 %

The table shows a very similar structure in all the four regions and for Norway. The general level of education is rising monotonous with firm size as can be seen from the share of high-school level (and below) educated persons. That is roughly true for the other educational groups, so that the share of university level III in firms/institutions over 250 employees expresses the "ranking" of the region, but Sør-

Trøndelag deviates a bit from this nice pattern by having a higher concentration of the highest educated in the "Over 250" size-class that the Oslo-region. The Oslo-region is in a class for itself having knowledge-intensive large firms and institutions.

The previous table showed the relative shares of educational groups, the "row" shares. The table below looks at the distribution of educational groups over size-classes.

Table 10. Distribution of educational groups according to firm-size, four regions

	Number of empl.	High-school	Univ. I (13-14)	Univ. II (15-16)	Univ. III (17 ++)	All employees
Norway	1 -3	8 %	7 %	4 %	5 %	7 %
	4 - 19	24 %	19 %	14 %	11 %	21 %
	20 - 49	15 %	14 %	16 %	11 %	15 %
	50 - 250	26 %	27 %	32 %	31 %	27 %
	Over 250	28 %	34 %	34 %	42 %	31 %
Hordaland	1 -3	7 %	6 %	3 %	5 %	7 %
	4 - 19	25 %	19 %	17 %	13 %	23 %
	20 - 49	18 %	17 %	22 %	16 %	18 %
	50 - 250	26 %	28 %	31 %	25 %	27 %
	Over 250	24 %	31 %	26 %	41 %	26 %
Oslo-reg.	1 -3	8 %	7 %	4 %	5 %	7 %
	4 - 19	24 %	19 %	14 %	11 %	21 %
	20 - 49	15 %	14 %	16 %	11 %	15 %
	50 - 250	26 %	27 %	32 %	31 %	27 %
	Over 250	28 %	34 %	34 %	42 %	31 %
Rogaland	1 -3	7 %	5 %	3 %	4 %	6 %
	4 - 19	26 %	19 %	18 %	13 %	24 %
	20 - 49	18 %	18 %	25 %	12 %	18 %
	50 - 250	29 %	30 %	33 %	34 %	30 %
	Over 250	20 %	28 %	21 %	37 %	22 %
S-Trøndelag	1 -3	8 %	5 %	3 %	4 %	7 %
	4 - 19	27 %	21 %	15 %	13 %	24 %
	20 - 49	19 %	17 %	19 %	10 %	18 %
	50 - 250	29 %	36 %	48 %	39 %	32 %
	Over 250	17 %	22 %	15 %	35 %	19 %

The table shows both that the distribution of employees regardless of educational level differs, and that the Oslo-region has the greatest density of highly educated in the larger size-classes. As much as 42% of the highest educated works in the largest firms/institutions, closely followed by Hordaland.

The Oslo-region and the Research system

The relationship between the various sectors of the economy and the research system defined as the higher education institutions[12] and the research institutes – is a complex question. There exists an extensive literature on "university-industry relations". One aspect of these relations is the flow of persons – functioning as a diffusion mechanism for newly developed academic research and not the least creating networks and making the research institutions aware of the problems facing industry. The estimated mobility rates might have many causes, some beneficial to the diffusion of knowledge others not. One should also keep in mind that a too high mobility rate – while giving industry more competent employees in the short run might be detrimental to the quality of the research institutions – and consequently of the supply of highly competent persons in the medium and long run.

Consequently the mobility rates estimated on the basis of register data cannot give more than one piece of the puzzle. Weather one finds low or high mobility rates between various sectors and institutions there remain much work to be done to put such numbers into the overall picture. Low mobility might be compensated with good informal or formal network connections; high mobility might just be a sign of hot labour marked, unreasonable wage differences etc.

Basically studies of mobility starts with input – output table that maps the delivering sectors in year T and the receiving sectors in T+1. The sectoral breakdown, the choice of either enterprise or establishment level etc. influences the *level* of the rates. But often one is more interested in analysing the pattern in the rates. Below we show one such table for the Oslo-region with a 10-sector breakdown. A more fine-grained sectoral breakdown would have been desirable but, even a 10-sector breakdown is hard to fit on an A4 page.

[12] In their turn defined as those who graduates candidates on ISCED level 7

Table 11. Mobility of higher educated (Univ. level II+III) in the Oslo-region, 1996-97

	Stayers	Primary…	Manufacturing	Utilities…	Trade…	Transport…	Financial…	Business…	Research	Universities…	Public adm…
Primary sectors, mining, oil	86	4	1	3	1	0	0	2	0	0	1
Manufacturing	79	0	9	1	4	1	0	5	0	1	1
Utilities and construction	76	0	4	11	1	1	0	5	0	0	2
Trade, hotels, restaurants	76	0	2	0	11	1	0	7	0	0	2
Transport, communication	63	0	1	1	2	18	1	5	7	0	2
Financial services	79	0	1	0	0	0	14	4	0	0	1
Business services, real estate	75	0	2	1	3	1	1	15	0	0	1
Research	87	0	1	1	1	0	0	3	2	2	3
Universities, other high. Ed.	91	0	1	0	0	0	0	2	1	2	3
Public adm,defence, health	82	0	0	0	1	0	0	1	0	0	14

The most important is the *stayers* column – showing the percentage that stayed in the same establishment. We are only looking at those who where employed both years, so-called net-mobility[13] The table should be read from left and up, i.e. from the delivering year 1996 to the receiving year 1997. In other words where those who changed employer from 1996 to 1997 went. Not surprising Universities and R&D have the most stable employment around 90% compared to "transport and communication" of 6% stayers. But as the grey diagonal elements show, most people move between firms/institutions in the same sector – at least on this highly aggregate level. That is not so marked for the R&D and University sector. To keep it simple R&D is not subdivided further in this table.

[13] If one takes into account those going out of employment for various reasons and those getting employment in the 'receiving year' (graduates, persons reentering) one gets a picture of the 'gross' mobility

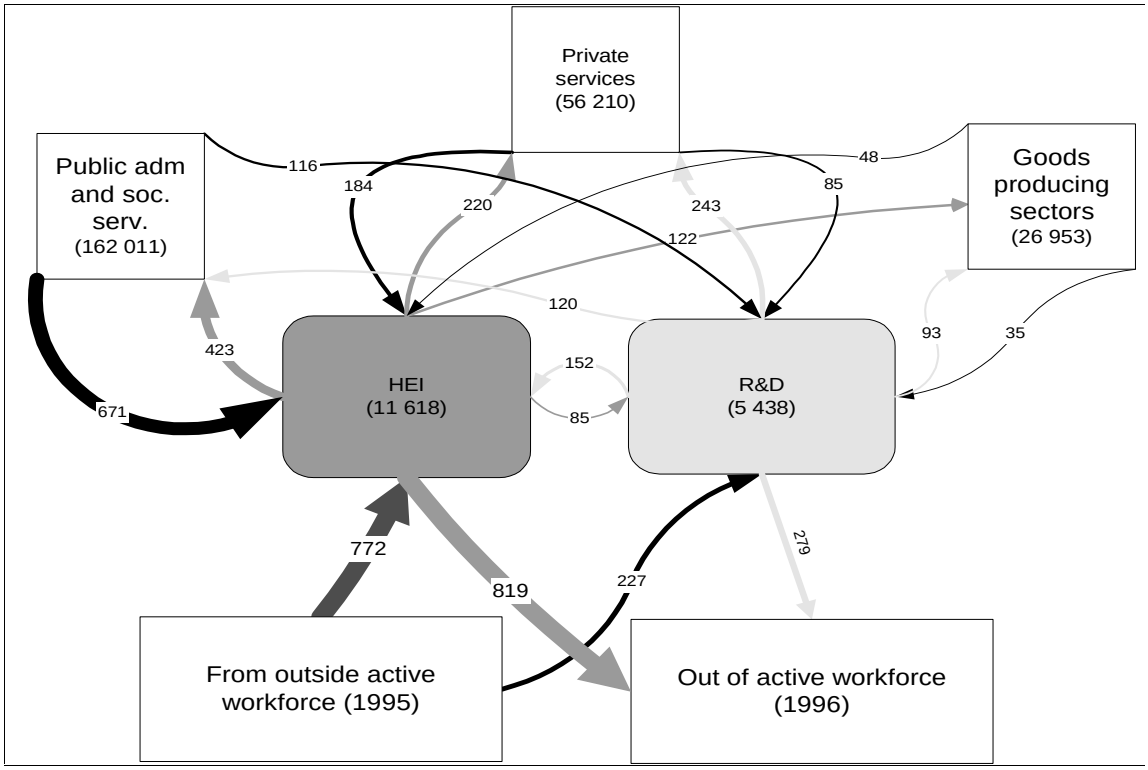
Table 12. Mobility of higher educated (Univ. level II+III) in Sør-Trøndelag, 1996-97

	Stayers	Primary…	Manufacturing	Utilities…	Trade…	Transport…	Financial…	Business…	Research	Universities…	Public adm…
Primary sectors, mining, oil	78	15	1	1	0	0	0	1	0	0	3
Manufacturing	83	1	5	2	1	0	0	4	1	1	1
Utilities and construction	82	0	1	7	1	1	0	5	1	1	2
Trade, hotels, restaurants	71	1	2	1	14	1	0	6	0	0	3
Transport, communication	65	0	2	0	3	19	1	6	2	1	2
Financial services	75	0	0	0	0	0	21	2	0	0	1
Business services, real estate	80	0	1	0	1	0	0	13	1	1	1
Research	85	2	1	0	1	0	0	2	4	4	1
Universities, other high. Ed.	90	1	0	0	0	0	0	1	2	3	2
Public adm,defence, health	61	0	0	0	0	0	0	1	0	1	36

Comparing the Oslo-region and Sør-Trøndelag shows that the pattern is roughly the same. The R&D sector is more mobile, not a great surprise given the close ties between the technical university and the large R&D institution, SINTEF. The high internal mobility in the public sector is a bit harder to explain. It might partly be a statistical artefact, caused by reorganisation – and consequently new identification numbers for one or more large public institutions.

To visualise this a bit one might do even more heroic aggregation of the sectoral structure and get figures like the two presented below.

Figure 2. Researcher mobility in Norway. A sectoral breakdown.



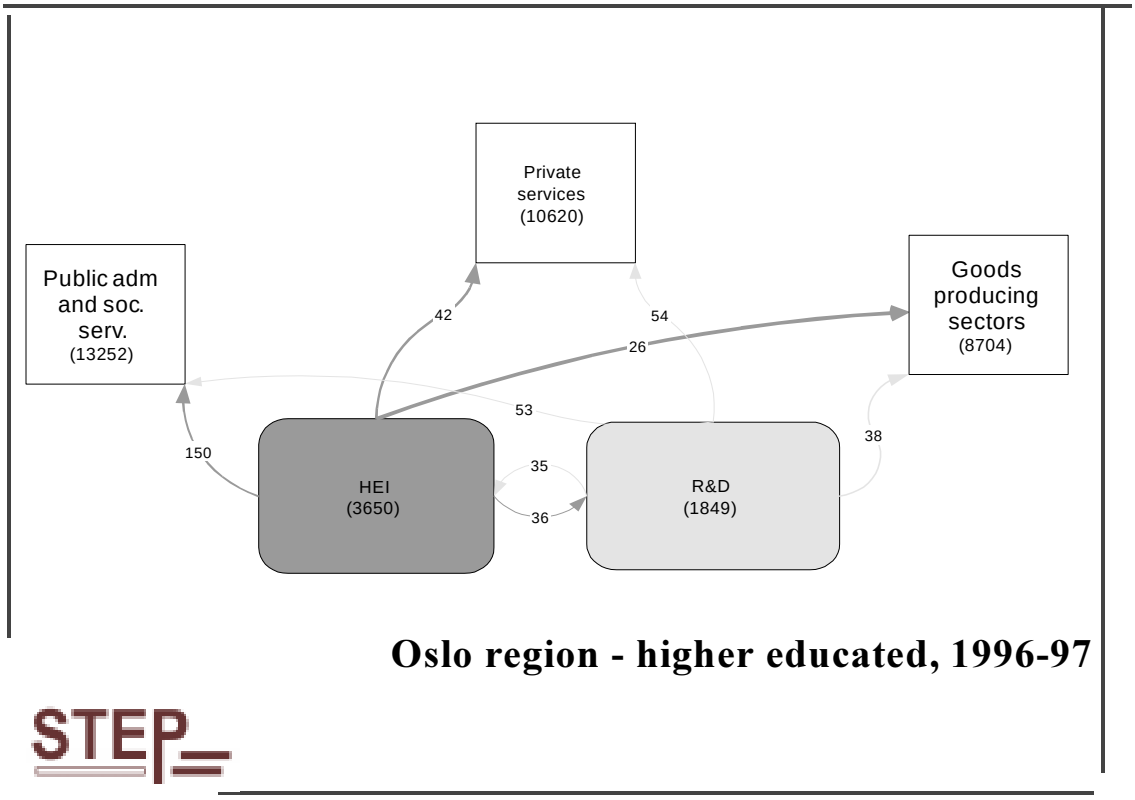
First a figure showing the streams on a national level, the thickness of the arrows are used to indicate how large the flows are. The numbers are employees with at least an ISCED level 6 education (15 years ore more). The figure shows that entry from "outside active workforce" (studies, military service, child care) and exit out of the workforce is an important mechanism for renewal and change, those entering generally being young and those leaving the work-force tendentially being older (retirement etc). Event though the three sectors Public administration, Private services and Goods producing sector are heroic aggregates the flows are rather complex. But if we looks at the mobility out of the R&D sector alone and to the other sectors as shares, and further look at other sectors as receivers of people from the R&D sector, we get the following small table:

Table 13. Mobility out of the R&D sector, and the receivers of people from the R&D sector. Norway.

	Share of R&D sector	Share receiving Sector
Goods producing	1,59 %	0,35 %
Private services	4,16 %	0,43 %
Public Adm.	2,06 %	0,07 %
Higher Education	2,60 %	1,31 %

This is two ways of looking at the same phenomenon. The ‘share of the R&D sector’ shows the mobility as a percentage of the employment in the total R&D sector in the Oslo-region. Private services has the highest shares highest, followed by Higher Education Institutions (HEIs) and Public administration. Looking at the receiving sectors, the share of higher educated employees that comes from the R&D-sector to Public administration are only 0,07 % compared to 1,31% to private services.

Figure 3. Mobility in the Oslo-region. A sectoral breakdown.



The same figures for the Oslo-region, but simplify it further – the entry – exit boxes and arrows are taken out. Again we can make a small table over the streams/arrows from the R&D sector in relative terms.

Table 14. Mobility out of the R&D sector, and the receivers of people from the R&D sector. The Oslo-region.

	Share of R&D sector	Share of receiving sector employment
Goods producing	2,06 %	0,44 %
Private services	2,92 %	0,51 %
Public Adm.	2,87 %	0,40 %
Higher Education	1,89 %	0,96 %

If we compare the national level data with Oslo there are differences. The Private services are not so clearly in the lead. The mobile researchers as a share of the employees with higher education in Public administration is higher etc. But there are a lot of qualifications to the construction of such figures, so one should be very careful to use the numbers *only* as a starting point and stimulus for further and much more detailed analysis[14].

Comparative data

There are very few comparable numbers from other countries. There are one comparative study of Norway, Sweden and Finland. There are a few specialised studies on mobility in other countries, roughly comparable. It is difficult to sum up the results of these various studies, because there are many considerations of method and dataquality. The stylised facts about such numbers is that mobility:

- are highly sensitive to the business cycle. The Nordic countries probably have roughly similar patterns of mobility from the University and R&D sector when the higher level of unemployment in Finland and Sweden is taken into account. But only mobility from one year to another has been studied, no longer time series.
- for the individual institute, or group of institutes (technological) the mobility rate varies more, due to cohort phenomena, spin-offs both into business and creating new institutions.
- The Nordic data has not yet been broken down to a regional level in the other Nordic countries as far as we have now. But this is possible and further research projects in the Nordic countries are planned.

Where do the highly and newly educated work?

For some analytical purposes it is interesting to look at the distribution of the newly educated in the economy. There are many ways to do this. One could look at the

[14] A more detailed analysis of the technological research institutes is found in a conference paper "Researcher mobility – data, models and policy" presented at conference in June 1999.

candidates from the education institutions in the Oslo region. But since Oslo do not have a specialised technical university it would not cover those who went to the technical university in Trondheim to study, but with the clear intention of returning to the region. One might take those living in the Oslo region and who graduated a certain year and follow them. But that would not cover those who came to Oslo from other parts of the country and ended up in Oslo – as many who study in Oslo do. We have chosen yet another approach, taking as our starting point those that

- worked in the Oslo region in 1997
- graduated in 1994, with the highest level, ISCED 7 education

The same kind of numbers are constructed for the other regions.

Table 15. Distribution over sectors, graduates from 1994, four regions

	Oslo region	Sør-Trøndelag	Horda-land	Roga-land
Not employed	0,5 %	0,2 %	0,4 %	0,0 %
Primary sectors, mining, oil	0,5 %	3,1 %	3,4 %	22,1 %
Manufacturing	6,3 %	4,3 %	6,9 %	10,8 %
Utilities and construction	2,9 %	2,4 %	2,4 %	1,4 %
Trade, hotels, restaurants	5,6 %	2,1 %	1,6 %	5,2 %
Transport, storage, communication	3,3 %	1,0 %	0,8 %	0,8 %
Financial services	3,2 %	1,9 %	0,8 %	0,8 %
Business services, real estate	21,0 %	12,1 %	11,6 %	22,9 %
Research	4,9 %	19,5 %	5,9 %	3,3 %
Universities, other higher education	12,1 %	33,0 %	29,0 %	4,7 %
Public adm.,defence, health,social work	35,9 %	18,1 %	34,5 %	26,2 %
Other non-public services	3,8 %	2,4 %	2,6 %	1,7 %
N =	**2103**	**421**	**493**	**362**

Again the overall pattern is similar, but with some marked differences. Rogaland is strong in oil and weak in university sector, Sør- Trøndelag is strong in research, less in the public sector. Oslo is strong in Business services, the university is not so dominating as in Bergen and Sør-Trøndelag - *relatively.*

Conclusions - main results

The starting point is that the Oslo-region (Oslo and Akershus counties) has a 27% share of total employment in Norway. In terms of competence, what mainly characterises Oslo is the following:

A highly educated work-force

A more than proportional share in all higher education groups, with 43% of the persons with the highest level of education (ISCED level 7). This is an expected consequence of being the capital, of having both central government, county and municipal administration. In addition many big firms and national institutions have their headquarters in the Oslo region. Oslo region also has the oldest and largest university.

Not so strong in natural sciences and engineering

But if one looks at the share of persons with an educational background in natural sciences and engineering, the difference between Oslo and the other big cities, like Bergen, Trondheim and Stavanger is not so marked.

A possibly to low mobility of persons from higher education institutions and R&D institutes to other sectors of the economy– but to early to draw firm conclusions

The mobility between the research institutions (R&D institutes, universities and other higher education institutions) and different sectors of the economy seems low, but these numbers must be seen in context of formal and informal networks and other ways of diffusing new knowledge. The numbers and figures presented in this report must just be seen as a starting point for further analysis.

4. Innovation activity in the Oslo-region

By Heidi Wiig Aslesen

In this chapter we will analyse innovation activity in the Oslo-region. The analysis is based on the Community Innovation Survey for Norway carried out by Statistics Norway in 1997. The aim of this analysis is twofold; firstly we are interested in looking at the extent of innovation activity; secondly to highlight how innovation takes place. By 'extent of innovation' we mean establishing the share of innovators in the region and how they perform. This will give us a picture of innovation activity among manufacturing and service firms in the region. Further, we look into the innovation processes in different sectors of the economy, to get an idea of what kinds of innovation activities are emphasised by firms and of where they find sources of information that are relevant in the innovation process. Our findings from the Oslo-region will be compared to national averages[15]. We also make use of newly published statistics from Eurostat to compare Norway with European firms.

The next section starts out by discussing the reasons why we are interested in innovation activity, and how we understand innovation to occur. Further we will look more closely at the methods used in the Community Innovation Survey (CIS) and finally, present the sample of firms in the Norwegian innovation study.

Innovation and the system of innovation

The idea that innovation plays a key role in the dynamics of economic growth has become an integrated part of thinking around economic policy. Theoretical and political interest in the effects of innovation has led to interest in how innovation actually takes place in firms or industries. Today, innovation is looked upon as a non-linear process, including other elements than formal R&D. Innovation activities such as acquisition of machinery, purchase of patents and licenses and design might

[15] When comparisons are made between the Oslo-region and the average for Norway, one must remember that the Oslo-region accounts for a large share of the average number.

be very important ingredients for firms' innovation activity. There has been a gradual realisation that in terms of technological innovation the emphasis has shifted from the single act philosophy of technological innovation to the social process underlying economically oriented technical novelty.[16] Innovation is a process of interactive learning, characterised by continuos internal and external feedbacks, that initiate steady changes to products, processes and services. Firms combine the different factors differently in innovation processes. This makes them not only produce differentiated products, processes or services, but it generates innovation differently. The implication is that firms innovate differently and industries innovate differently, making it hard to find one model that can describe the innovation process.

The interactive model of innovation emphasises two forms of interaction for firms; the first form takes place within a firm or within a group of firms working closely together; the second takes place between firms and the science and technology system within which they are located. Freeman[17] defines a national system of innovation as the network of institutions in the public and private sector whose activities and interactions initiate, import, modify and diffuse new technologies. The importance of this concept is that it places explicit emphasis on "intangible"[18] investments made in an effort to stimulate technology adaptation and advances by a diverse series of actors rather than solely depending on the efforts of the research and development community[19]. At the regional or local level studies have underlined the importance of organisational factors, alongside the more traditional economic variables, in defining a technological and industrial development trajectory. Innovation is first and foremost a collective and social endeavour, a collaborative process in which the firm, especially the small firm, depends on the expertise of a wider social constituency than is often imagined (workforce, suppliers, customers,

[16] "Technology and the economy; the key relationships; Report of the group of experts of the Technology/Economy Programme (TEP)". OECD, Paris 1992. Pg. 24.

[17] 1987, as quoted in OECD, 1992, op.cit.,pg 80.

[18] Intangible investment covers, in addition to investment on technology, expenditure on training, a range of business services, marketing, and the acquisition and exploration of software.

[19] Claire Nauwelaers and A. Reid, 1995. "Innovative regions? A comparative review of methods of evaluating regional innovation potential". Project Sprint/EIMS 94/98.

technical institutes, training bodies, etc.) [20]. The attention that has been given to the study of regional innovation systems is related to the idea that the interrelationships between agents in a regional economy have an impact on the competitiveness of individual firms and subsequently the region as a whole. The performance of the regional innovation system will depend much on the organisational capacities of these networks of relationships.

By the use of the Community Innovation Survey for Norway, we are able to get some insight into the innovation performance of the industry located here, and further see to what degree firms in the region relate to other actors in the innovation process. This will give us an indication of how the operative systems of innovation of firms located in the Oslo-region function.

The Community Innovation Survey for Norway[21]

In 1997 Statistics Norway carried out, for the second time, an innovation study in Norway based on the Community Innovation Survey (CIS). The first CIS data collection was carried out in 1993 after a joint initiative from EUROSTAT and DGXIII of the European Commission. Actual data collection and financing was left to national authorities. In the Norwegian case, Statistics Norway carried out both surveys. At the core of this effort was the "CIS harmonised questionnaire", as it was called, including all questions and categories to be used in the survey. With a few exceptions, the 1993 questionnaire was based on adapting the first version of the "Oslo manual" [22] - a set of OECD recommendations regarding collection of innovation data. The 1997 survey was based on a revised version of the Oslo manual, so there were some modifications to the questions asked earlier. It also included the service sector in its study, a first important effort to throw light on the innovation activity in this sector. The 1997 survey also made use of the 'law of statistics', which

[20] Philip Cooke & Kevin Morgan, 1994."The creative Milieu: A Regional Perspective on Innovation" in The Handbook of Industrial Innovation, Mark Dodgson & Roy Rothwell (Ed.), Edgar Elgar Publishing.

[21] Parts taken from Svein Olav Nås and Ari Leppälahti "Innovation, firm profitability and growth". Step-report R-01 1997.

[22] Innovation Manual: Proposed Guidelines for Collecting and Interpreting Innovation Data (Oslo Manual). OECD, Directorate for Science, Technology and Industry, Paris 1992.

obliges all recipients to respond to the questionnaire. The study therefore had a response rate of almost 90%, making the data better than earlier years.

There are essentially two ways of collecting innovation data: the so called “subject approach”, and the “object approach”. In the latter approach, a single innovation and its sources and results are studied. In the subject approach, each single firm is studied, including any innovative project it might have. The last approach is chosen for CIS, as recommended in the Oslo manual. The method allows aggregation of activity across industries and countries, and allows international comparison if sampling is done properly. Another advantage is that all innovative activity is included, successes as well as failures. As pointed out above, failures are unavoidable in the innovative process. And lastly, firms without innovative activity are included, allowing for comparisons between those active and those inactive in innovation - a matter of great importance for policy making.

There is a general problem of accuracy and reliability when collecting data through survey questionnaires, in particular when the questions do not match readily available data in the firms. This is the case with the innovation survey, as most firms do not keep a record of either innovation inputs or outputs. In effect the answers cannot be treated as accurate measures, but rather as well-informed estimates by the people responsible in the firms. Or, as one might put it, as *indicators* of the activity going on. In addition, there are several questions which ask for opinions or more qualitative information about the firm and its activities. Such information is highly dependent upon who the respondent is, and what function he or she has in the organisation. On the other hand, many issues relating to innovation are not available as “hard data” and surveying or interviewing, collecting more or less qualitative information, are the only possible sources. As the same technique has been applied in a series of countries, and most results seem to be relatively consistent across both countries and industries, we believe that the results give a reasonable picture of reality.[23]

The data collected through CIS can be divided into these categories: general background information, innovation inputs and innovation outputs, along with more

[23] For an evaluation of the CIS approach, see Archibugi, Daniele, P. Cohendet, A. Kristensen and K.-A. Schäffer: Evaluation of the Community Innovation Survey (CIS) - Phase I. EIMS publication No. 11, Luxembourg 1994.

qualitative information on sources of information and obstacles to innovation. A new feature of the Oslo manual was the attempt to measure the output of innovative activity directly. As this was the first version of a manual for collection of innovation data, the Oslo manual concentrated on what is thought to be most easily measured, namely product innovations. Even if the manual generally covers all kinds of innovation except organisational change, it is limited to products or processes on the result side. In concrete terms, companies were asked to estimate the share of total sales stemming from products that had been changed over the last few years (in CIS, limited to the last three years). A distinction was also made between major innovations and incremental innovations, by the degree of change in the product.

The focus of the innovation survey is the to understand the innovation behaviour of the firms, and the questionnaire is concerned with technological innovations as defined below;

Technological innovations

comprise implemented technologically new products and processes and significant technological improvements in products and processes. It requires an objective improvement in the performance of a product or in the way in which it is produced or delivered. An innovation has been **implemented,** if it has been introduced on the market (product innovation) or used within a production process (process innovation). The product or process should be **new (or significantly improved) to the enterprise** but does not necessarily have to be new to the enterprise's market.

Innovation activities is here limited to innovation activities related to product and process innovations, giving the risk that fewer firms than what is actually the case will declare themselves innovative (i.e. firms that have innovations related to organisations, design, packaging etc.). The distinction between what is a 'new' or 'old' product or process is perceived by the respondents himself. This will have the implication that an individual could have a perception of achieving a significant

innovation which is only incremental for the economy. For complex products, respondents could have difficulties in defining what is 'new' or 'old', making differences in the share innovative of firms between industries.

A firm is perceived to be innovative by this definition;

Innovating enterprise
is an enterprise who has introduced new or improved products on the market or new or improved processes. Enterprises can have innovation activity without introducing an innovation on the market (it has either unsuccessful or not yet completed projects to develop or introduce).

When interpreting the results of the Norwegian innovation survey one must have in mind that it is exceedingly difficult to develop a questionnaire that can address many of the important issues of innovation. Technological innovation is probably the single most heterogeneous economic activity. Even though the CIS questionnaire has not been able to solve all these problems, the CIS does improve on the R&D-based definitions of who innovates, which do not take into account that firms can use many other ways to innovate.

The sample

The 1997 Norwegian Community Innovation survey gathered information from 3263 enterprises in Norway. It was based on a stratified random sample. It was stratified by enterprise size as measured by number of employees. A sample of enterprises between 10 and 99 employees was drawn, and there is a full count of enterprises with more than 100 employees. Enterprises with less than 10 employees are excluded altogether. In addition to size groups, strata have been defined by two-digit NACE codes. Random drawing has not been initiated unless there has been at least 15 observations in a cell (stratum) defined by size group and NACE code.

The sample of firms in the Norwegian innovation survey consists of firms from primary industry, from the manufacturing sector and from the service sector. Out of a

total sample of 3263 firms[24] for the whole of Norway, 1976 are classified as belonging to the manufacturing sector (NACE codes 15-37), 1253 in services (NACE code 51-74,2)[25], and 134 in fishing and petroleum (NACE 05-14). We have placed NACE code 40 and 45 in the category 'Other', which has a total of 181 enterprises.

In this report we will mainly be interested in enterprises (hereafter referred to as firms) located in Oslo and Akershus (hereafter referred to as the Oslo-region). The sample is not stratified by region; this opens questions about the representativity of the firms in the sample for the selected region. In this chapter we will compare relative numbers (i.e. of innovative firms) from the region, with relative numbers for the country as a whole, this will reduce some of the problem, but will not eliminate it. To further investigate the question of representativity of the survey for the Oslo-region, we have looked at the gross population of firms in the region from which the sample has been drawn, and from this the coverage (share of firms that answered the questionnaire) has been deducted. We have looked at the coverage for the Oslo-region, the coverage of different firms sizes, and the coverage for different industries in the region compared to the Norwegian average. This is done to see if there are systematic differences in the coverage of firms sizes or industries in the Oslo-region compared to national averages. If the sample is biased in some ways, it could in a systematic way affect the result found for the region.

The different tables showing coverage for the region, firms sizes and industries are presented below.

Table 1. Gross population, the sample and coverage of firms in the Oslo-region and the whole of Norway.

	Gross population	The sample	Coverage
The Oslo-region	2564	836	32,60%
Norway	9097	3261	35,85%

[24] Two entities are taken out of the sample.

[25] There are alternative ways to define the 'service sector'. In this report we have chosen to keep Nace code 40 "Energy supply" and Nace code 45 "Construction" out of the definition of the 'service sector'. Researchers in this field seem to have reached a consensus on leaving these sectors out of the definition of the service sector (Hauknes, Johan. 1996. "Innovation in the Service Economy". Step-report 7/96.)

Table 2. Coverage by size groups in the Oslo-region and in Norway.

Size of firms	Coverage in the Oslo-region	Coverage in Norway.
10-19	19.01%	23,38%
20-49	24.64%	30,50%
50-99	37.94%	48,96%
100-249	91.15%	87,92%
250-499	87.32%	86,79%
499+	91.21%	87,77%

Table 3. Coverage by industry in the Oslo-region and in Norway.

Nace	Coverage in the Oslo-region	Coverage in Norway
15-16	51.80%	42.09%
17-20	50.00%	49.42%
21+27	93.33%	90.90%
22	29.49%	42.67%
23-24	81.48%	88.46%
25-26	57.57%	48.08%
28	53.85%	41.47%
29	45.45%	44.66%
30-33	61.01%	61.34%
34-37	50.79%	50.31%
51	14.49%	12.67%
60-63	28.52%	19.08%
64	78.57%	81.08%
65-67	55.37%	49.83%
72	41.18%	42.40%
74	35.15%	33.89%

The tables show that the coverage for the Oslo-region is quite similar to the coverage for the country as a whole. The aggregate numbers are 32,60% and 35,85% respectively. This means that the share of firms not included in the survey are quite similar. When looking at size-groups the greatest difference is found in the groups of firms with 50-99 employees, where the Oslo-region has a 11 percentage point lower coverage than the average for the country. Looking at different industries, the greatest difference in coverage is found in Nace 22 (‘Publishing and printing’) the coverage for the Oslo-region being 29,5%, the share for Norway being 43%. The share for the Oslo-region is however close to the average coverage, being 32,6%. This particular industry is also well represented in the sample, as much as 30% of the manufacturing firms in the sample for the Oslo-region belong to this industry.

Overall the coverage of firms representing the Oslo-region, do not differ much from the coverage for the whole of Norway, suggesting that the sample is not biased for this region.

The table below gives the distribution of firms in the sample according to defined industry groups for Norway and the Oslo-region.[26]

[26] The enterprises in the sample have been grouped according to NACE-codes. The groupings have been made on the ground of similarity in firm's business activity.

Table 4. The sample grouped by industry and NACE codes, for the Oslo-region and for Norway.

Main group	Sub groups	Nace	Number of firms Oslo-region	Percentage in the Oslo-region	Number of firms Norway	Percentage in Norway
Selected primary industry	Fishing, mining, oil and gas	05-14	18	100%	134	100%
	SUM		18	100%	134	100%
Manufacturing	Food and beverages, tobacco	15-16	43	14%	338	17%
	Textiles, wearing apparel, wood and wood	17-20	19	6%	258	13%
	Pulp and paper, basic metal	21+27	14	4%	120	6%
	Publishing and printing	22	94	30%	230	12%
	Petroleum refining, chemicals	23-24	22	7%	69	3%
	Rubber-, plastic-, other non-metallic min. prods	25-26	19	6%	138	7%
	Fabricated metals prod exc. machinery and equip.	28	18	6%	192	10%
	Machinery and equipment	29	15	5%	163	8%
	Office machinery, computers, electrical machinery and app., radio, Tele & communication, medical instruments	30-33	36	12%	146	7%
	Other manufacturing	34-37	32	10%	322	16%
	SUM		312	100%	1976	100%
Services	Wholesale trade	51	151	33%	265	27%
	Transport and storage	60-63	89	19%	243	25%
	Communication	64	22	5%	30	3%
	Bank, insurance and other financial services	65-67	67	14%	145	15%
	Computer and related activi-ties	72	63	14%	106	11%
	Other business activities	74	71	15%	183	19%
	SUM		463	100%	972	100%
Other	Energy supply	40	10	23%	119	66%
	Collection, purification of wa-ter	41	-	-	2	1%
	Construction	45	33	77%	60	33%
	SUM		43	100%	181	100%
N			836		3263	

The Oslo-region has a sample of 836 firms, more than 25% of the total sample.

When the sample of Oslo-firms is broken down by industry, some industries have low numbers. This is especially true for 'Pulp and paper, basic metal' and 'Machinery and equipment', making it hard to draw firms conclusions in relation to these industries.

In the following analysis we exclude firms representing parts of the primary industry and firms categorised as 'Other'. The reason for this is that we focus on manufacturing industry and the service industry in the Oslo-region. This reduces the sample size for the Oslo-region to 775 firms (minus 18+43 firms) and for the whole of Norway to 2948 firms (minus134 +181). This report will look separately at the manufacturing sector and the service sector since these sectors differ in many ways.

The next section presents our first findings on the extent of innovative activity in the Oslo-region.

The extent of innovative activity

In this section we are interested in the extent of innovative activity of firms in the Oslo-region. We use two measures to highlight this; firstly, we look at the share of firms that have innovation activity. Secondly, we consider innovate firms alone and measure their innovation performance. The results are presented for the manufacturing industry and then for the service industry.

We expect to find that firms in the Oslo-region are more innovative than the average Norwegian firms. The reason for this is the concentration of firms in the region, which could lead to sharp competitions between firms and again could motivate innovation. Secondly, there is a vast amount of suppliers of knowledge and expertise located in this region, such as institutions offering business-oriented guidance and counselling, technology and knowledge brokering, that could supply firms with the innovation support they need. Spillovers from these knowledge institutions could advance economic knowledge in the business sector. Thirdly, the region also has the largest share of financial institutions that can offer risk capital for innovation

purposes. The region has within its borders all the institutions in the private and public sector that are important for innovation.

Innovation activity by industry

Manufacturing firms were firstly asked if they had, during the period 1995-97, introduced technologically new or improved[27] *products* and/or *processes.* In addition, they were asked if they had, during the period 1995-97, undertaken activity to develop or introduce technologically new or improved products or processes, but which had not produced any results in this period, either because the results were yet to come or because the attempts had failed. If the firms answered positively to any of these three cases, it was classified as innovative[28]. Firms in the service sector were asked if they had, during the period 1995-97, introduced any new services or methods to produce or deliver services. They were also asked if they had, during the period 1995-97, undertaken activity that had not produced any results in this period, either because the results were yet to come or because the attempt had failed. If a service firm answered yes to any of the two, it was classified as innovative.

The firm were themselves to define their innovation activity in a three-year period. This choice will have implications for the measure of innovation behaviour for firms in different size classes and in different industries. Large firms are likely to introduce more products/services into the market than smaller firms due to a larger product range. Smaller firms will also introduce new products/services, but may fail to have introduced these in the defined time frame, and may be registered as not innovative. Larger firms will therefore be recorded as more innovative than smaller firms. The problem with defining the period for introduction of an innovation also applies to different industries. Some industries have shorter 'product cycles' than other industries, making them more likely to have introduced new products or services in a three year period. Other industries, e.g., industries heavily based on R&D performance like pharmaceuticals, have products with much longer life spans.

[27] The terms 'new' and 'improved' refer to products and processes which are new or improved from the point of view of the enterprise, but not necessarily from the point of view of the market in which the enterprise operates

[28] We have chosen to include firms (both manufacturing and service firms) which have had innovation activities without any results in the form of actual innovations in the period since a large share of these firms report innovation and R&D expenditures during the period.

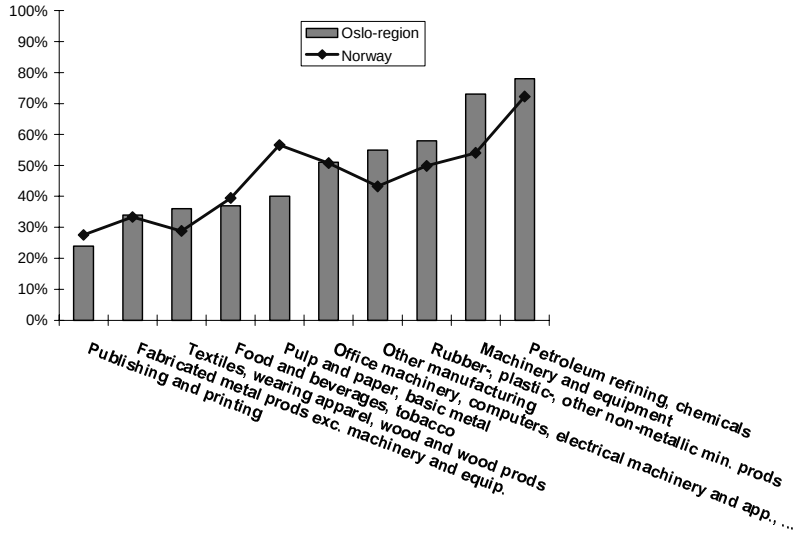
These differences between firm size and industries in innovation performance imply that the measure is not the best for comparisons across sizes of firms or different industries. It will be relevant however to compare the same industries in different regions. The innovation indicator used may also be better 'suited' for some industries than for others, implying that some industries get a higher innovation score than other. One must have in mind that this innovation indicator is only one measure of innovative activity in the firm, and firms which have a low share can do better on other types of innovation and performance indicators.

The table and figures below presents the proportion of firms that are innovative, by industry.

Table 5. Proportion of innovative firms in the Oslo-region and in Norway. Manufacturing industry. Weighted numbers. (N=312, 1976).

Sub groups	Nace	Proportions of innovative firms. The Oslo-region. Weighted	Proportions of innovative firms. Norway-Weighted
Food and beverages, tobacco	15-16	39%	40%
Textiles, wearing apparel, wood and wood prods	17-20	36%	29%
Pulp and paper, basic metal	21+27	40%	57%
Publishing and printing	22	24%	28%
Petroleum refining, chemicals	23-24	78%	72%
Rubber-, plastic-, other non-metallic min. prods	25-26	58%	50%
Fabricated metal prods exc. machinery and equip.	28	34%	33%
Machinery and equipment	29	73%	54%
Office machinery, computers, electrical machinery and app., radio, Tele & communication, medical instruments	30-33	51%	51%
Other manufacturing	34-37	55%	43%
Total		40%	40%

Figure 1. Proportion of innovative firms in the manufacturing sector for the Oslo-region and for Norway as a whole. Weighted proportions. (N^{29}=312, N=1976).



The weighted[30] proportion of innovative manufacturing firms in the Oslo-region is 40%, the same as the average for Norway. 'Publishing and printing' has a particularly low share of innovative firms, and accounts for close to one third of the sample for the Oslo-region. When excluding this industry, the average share of innovative firms in the Oslo-region rises with approximately 10 percentage points. This indicates that a regions innovation intensity to a large degree is reflected by the industry structure in the region.

There are great differences in the proportion of innovative firms in the manufacturing sector. 'Petroleum refining and chemical industry' has the highest proportion of innovative firms, followed by 'Machinery and equipment' and 'Rubber, plastics,

[29] N is here the numbers of firms in the sample. The results given is for the population of firms (weighted sample), making the numbers of firms higher than for the sample.

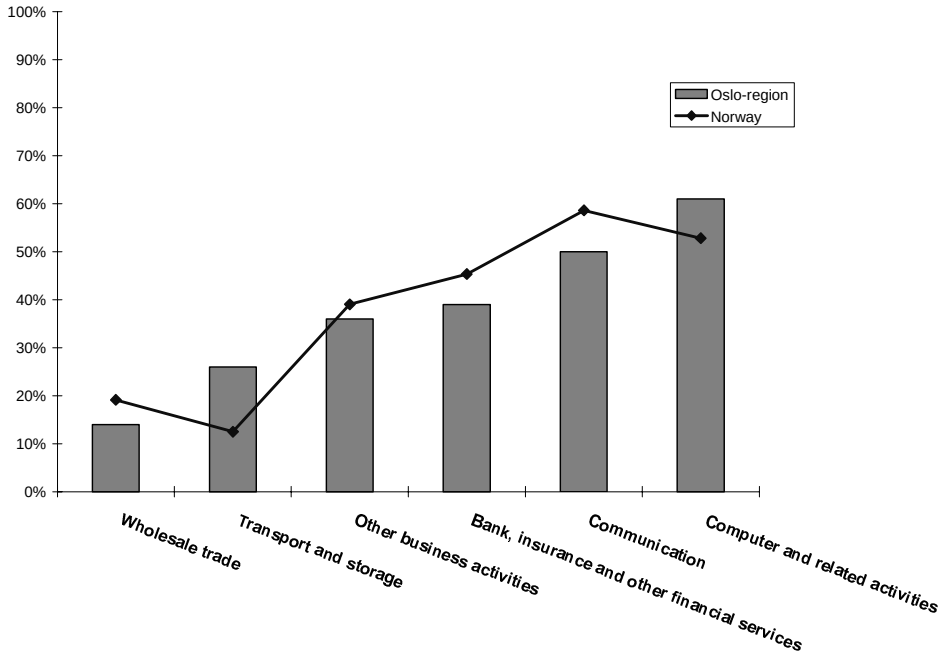
[30] Our sample is a stratified sample where strata have been defined by size groups and two-digit NACE codes. It is therefore necessary to use weighting procedures to recreate the proportions of the population when we have a disproportionate stratified sample. That this will make a difference in our case should be evident from the fact that the main stratification variable, namely firm size (number of employees), also has a substantial effect on the probability of being innovative. Since the large firms are better represented in the sample than the small firms, the proportion of innovative firms will be higher in the sample than in the population. In the following we will therefore use the weighting

other non-metallic min. products' (78%, 73% and 58%). For these three industries the Oslo-region has a larger proportion of innovative firms than the average for Norway. Industries with low proportions of innovative firms are 'Publishing and printing' and 'Fabricated metal products' and 'Food and beverages, tobacco' (24%, 34% and 39%)

Table 6. Innovative firms in the Oslo-region and in Norway. Service industry. Weighted numbers. (N=463, 972).

Sub groups	Nace	Share of firms being innovative in the Oslo-region-Weighted	Share of firms being innovative in Norway-Weighted
Wholesale trade	51	14%	19%
Transport and storage	60-63	26%	13%
Communication	64	50%	59%
Bank, insurance and other financial services	65-67	39%	45%
Computer and related activities	72	61%	53%
Other business activities	74	36%	39%
Total		24%	23%

Figure 2. Proportions of innovative firms in the service sector for the Oslo-region and for Norway as a whole. Weighted proportions. (N=463, N=972).



procedures to be able to recreate the proportions of a given variable for the population. For the Oslo-region regional weights are used, for Norway national weights are used.

For the service industry the weighted proportion of innovative firms is 24% in the Oslo-region, the average for Norway being 23%. When it comes to the service sector, the share of innovative firms is lower than in manufacturing. 'Computer related services' and 'Communication' have the highest share of innovative firms, with a proportion of 61% and 50% innovative firms. In 'Computer related services' the share of innovators is a bit higher in the Oslo-region than the average for the country. The opposite is true for 'communication', 'Banking, insurance and financial services' and 'Other business activities'. Industries that report a relatively low proportion of innovative firms are 'Wholesale trade' (14%).

The following section will look at the difference in the share of innovative firms between size-groups of firms.

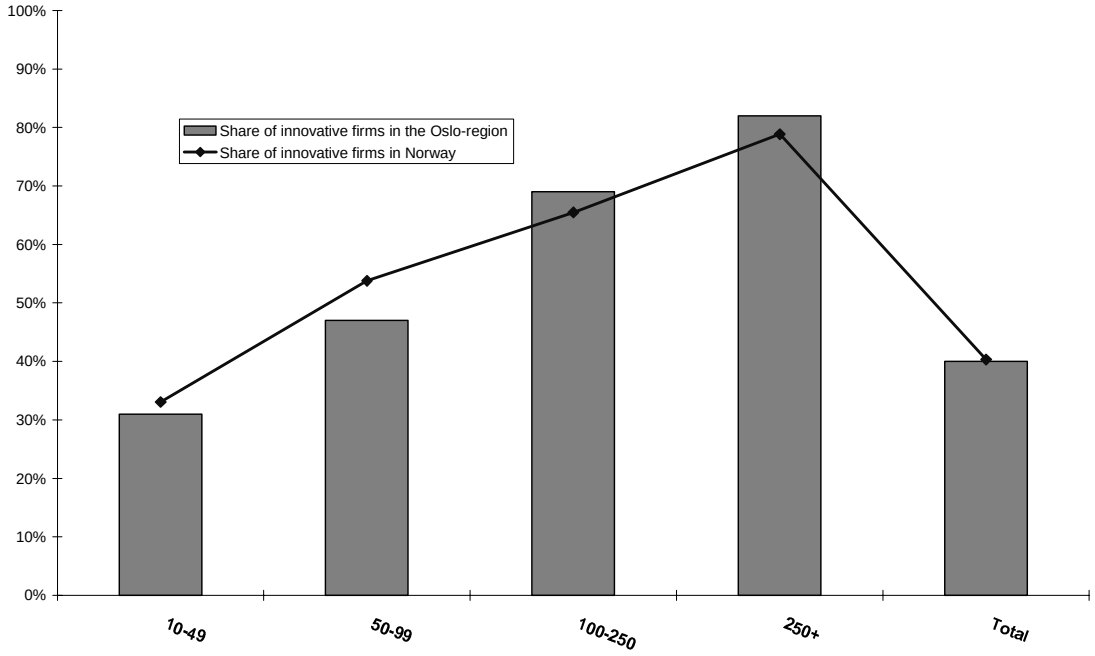
Innovation activity by firm size

This section considers the relationship between proportion of innovative firms and firm size. We use number of employees as a measure of firm size and have categorised the sample in 4 size groups; 10-49 employees, 50-99 employees, 100-249 employees, and more than 250 employees. The figures will firstly be presented in a table, giving the sample numbers and the shares of innovators; the figures will present the share of innovators. This will be done firstly for manufacturing industry, then for services.

Table 7. Proportion of innovative firms by size. Manufacturing sector in the Oslo-region and in Norway. Weighted proportions. (N=312, 1976).

Size groups	Number of firms in the sample. Oslo-region	Share of innovative firms in the Oslo-region. Weighted	Number of firms in the sample. Norway	Share of innovative firms in Norway. Weighted
10-49	175	31%	1188	33%
50-99	41	47%	317	54%
100-249	52	69%	306	65%
250+	44	82%	165	79%
Total	312	40%	1976	40%

Figure 3 . Proportion of innovative firms by size. Manufacturing sector in the Oslo-region and in Norway. Weighted proportions. (N=312, 1976).

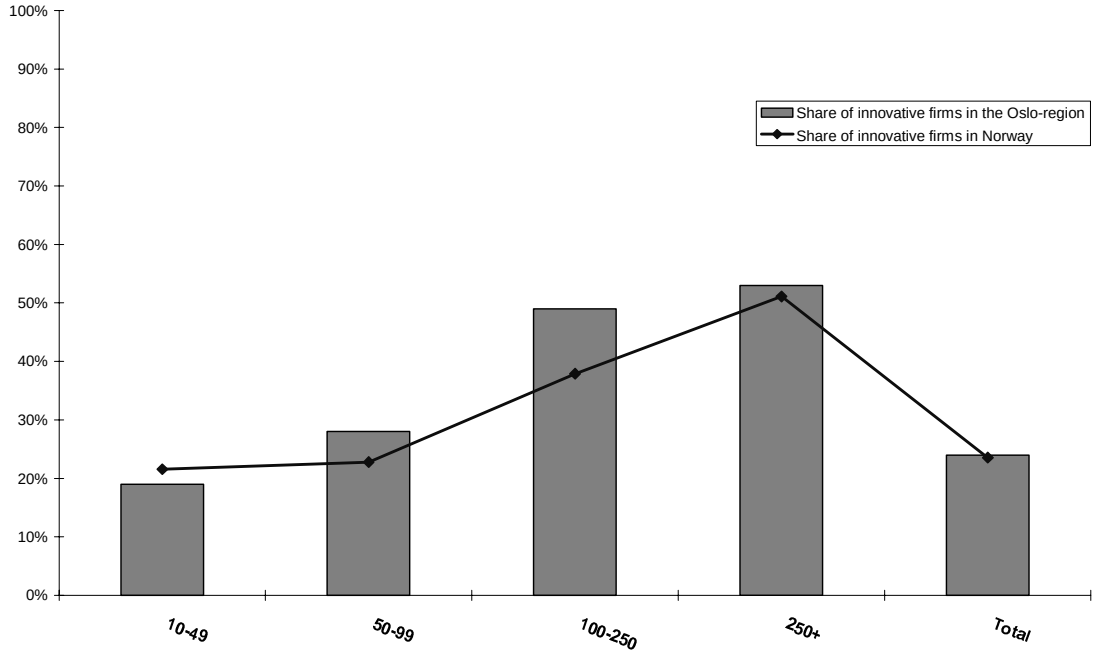


In the manufacturing sector there is a clear relationship between firm size and the number of firms that report having innovation activity in the defined three-year period. In the largest size group (250+) 82% of the firms in the Oslo-region report innovation activity, while in the smallest size group (10-49) the share is only 31%. In other words there are significant differences between the size groups. The Oslo-region has a lower share of innovative firms in firms with less than 100 employees than the average for Norway as a whole. In firms with more than 100 employees the share of innovators is slightly higher for the Oslo-region than average.

Table 8. Proportion of innovative firms by size. The service sector in the Oslo-region and in Norway. Weighted proportions. (N=463, 972).

Size groups	Number of firms in the Oslo-region	Share of innovative firms in the Oslo-region-weighted	Number of firms in Norway	Share of innovative firms in Norway-weighted
10-49	223	19%	526	22%
50-99	59	28%	129	23%
100-249	101	49%	187	38%
250+	80	53%	130	51%
Total	463	24%	972	23%

Figure 4. Proportion of innovative firms by size. The service sector in the Oslo-region and in Norway. Weighted proportions. (N=463, 972).



Also within the service sector there is a clear positive relationship between firm size and the proportion of innovators. While small firms (10-49) in the Oslo-region have a slightly lower proportion of innovators than the average for Norway, the opposite appears to be the case for firms with more than 50 employees. In the size groups with more than 50 employees, the proportion of innovative firms in the Oslo-region increasing with firm size.

In the remainder of this chapter we will only follow firms that had innovation activity in the three-year period of 1995-97.

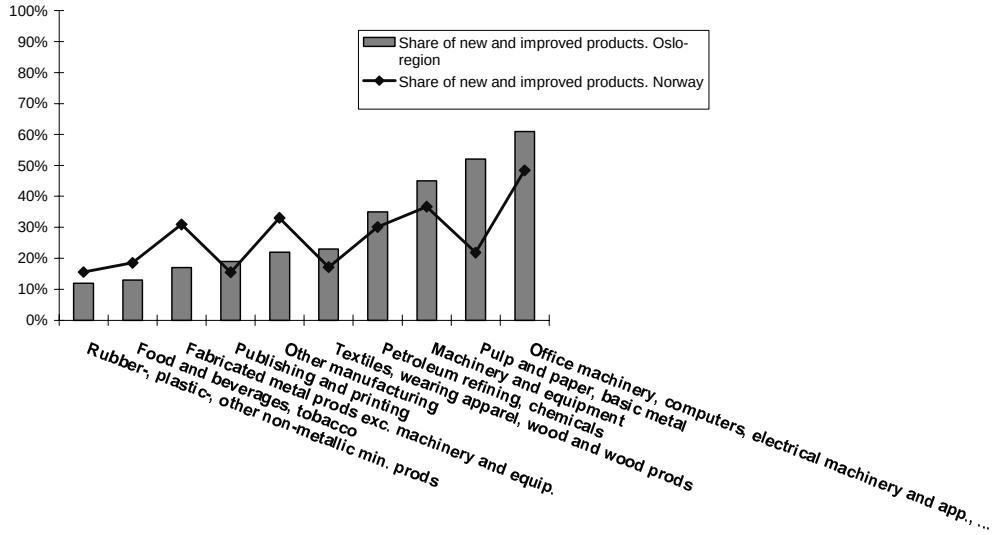
Innovation performance

Innovation activities can be more or less successful, and it would be of interest to see if there are differences in innovation performance between industries in the Oslo-region and the average for Norway. The result of innovation activity will be measured as the share of sales in 1997 which was accounted for by products which were new, improved or modified during the three year period 1995-1997. Only new or improved products or services will be regarded as innovations.

This indicator is a measure of only one aspect of innovation, leaving many other aspects of innovation outside the analysis (process innovations, organisational innovation etc.). The reason for this is simply the difficulties in measuring other aspects of innovation. Product and service innovations are easier to measure and have therefore become an indicator for firms' innovation performance. There will also be problems relating to the time period when looking at innovation performance. In some industries it takes a much longer time to be able to introduce new products to the market, than in other industries. This will have implications for the share of sales that derive from new products. The same problems apply for small firms; they will in general introduce fewer products or services onto the market since they have a smaller portfolio than larger firms do.

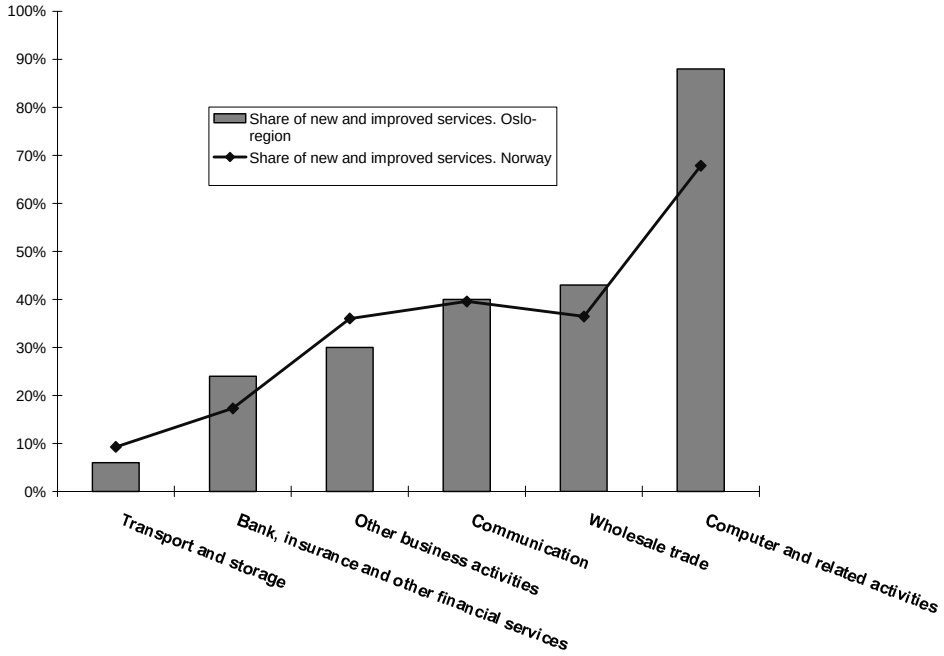
The figures below present the weighted proportions of turnover in 1997 that consist of both innovative products or services (new or improved products) and non-innovative products or services (marginally modified products or services). In the following two figures we will only look at the share of turnover that consists of new or improved products, and refer to this as 'innovative products or services'.

Figure 5. Shares of new and improved products in turnover. Manufacturing industry. Innovative firms. Weighted shares. (N=150, 911).



Manufacturing industries that have the highest share of innovations in turnover are 'Office machinery, computers, electrical machinery', 'Pulp and paper, basic metal' and 'Machinery and equipment', with a percentage of innovation in turnover ranging from 45%-61%. The Oslo-region performs better in these industries than the average for Norway. Industries where innovation in turnover is low, are 'Rubber, plastic-, other non-metallic min. products', 'Food, beverages, tobacco' and 'Fabricated metal products'. In these industries the Oslo-region has a lower share of innovation in turnover than the rest of the country. It seems then that in the Oslo-region there is a group of industries that are highly innovative, and perform better than the average. On the other hand, within industries that have low shares of innovation in turnover, firms in Oslo under-perform.

Figure 6. Shares of new and improved services in turnover in 1995-1997. Service industry. Innovative firms. Weighted shares. (N=108, 204).



In the service sector 'Computer and related activities' has the highest share of innovative services as part of turnover. As much as 88% of turnover derives from new or improved services, clearly outperforming the national average which is 68%, suggesting an innovative cluster in the Oslo-region. In services like 'Wholesale trade' and 'Bank, insurance and other financial services' firms in the Oslo-region report higher shares of new or improved services in turnover than the average. 'Transport and storage' have low shares of innovation in turnover at only 6%, with the average for Norway at 9%.

We will in the next section look more closely at the innovators and try to understand how innovation takes place in manufacturing and in services.

How innovation takes place

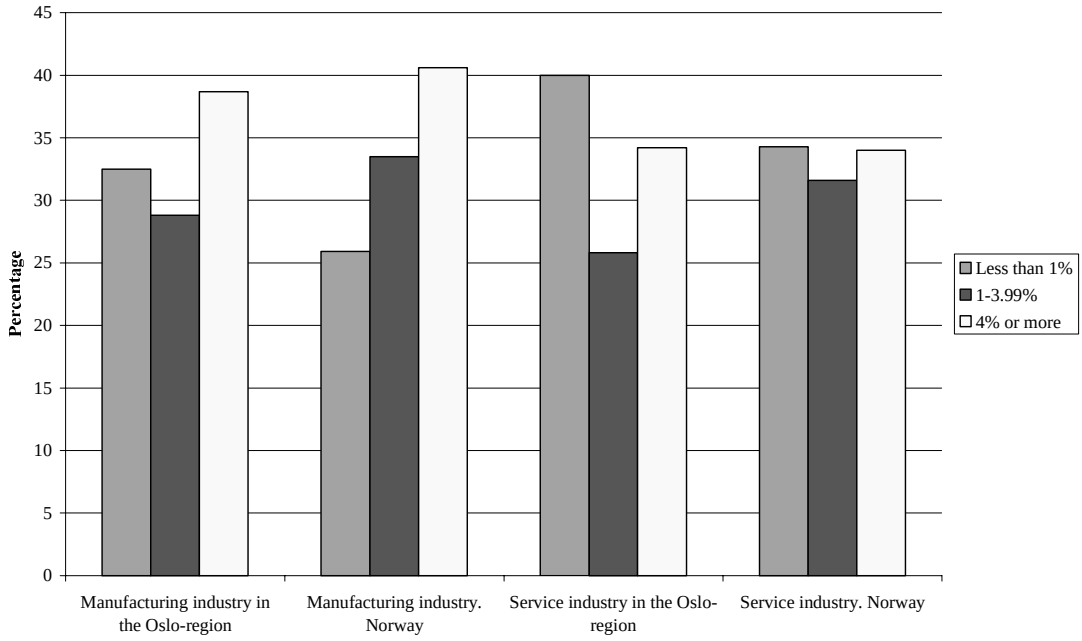
We will investigate how innovation takes place among firms in the Oslo-region and for the average Norwegian firm. Firstly we will look at how much firms spend on innovation by calculating firms' innovation cost intensity. Secondly we will map

what kind of innovation activity firms spend most of their innovation costs on. We will also look at the types of innovation activity the largest share of firms takes part in; the most commonly used 'inputs' into the innovation process. Thirdly we will look at firms reasons for engaging in innovation activity, and their main sources for information on innovation. Lastly we will present firms innovation collaboration partners. These different elements will give us an idea of how innovation takes place in the firms, and the kinds of actors they relate to in the innovation process. This will be done for both the manufacturing sector and for services.

Innovation cost intensity

In our search for explaining innovation activity in the Oslo-region we will highlight the amount of turnover firms use on innovation activity – the innovation 'input' – such as research and development, acquisition of machinery etc. Innovation cost intensity is defined as innovation costs as a percentage of turnover. We approach the problem by constructing classes of firms, depending upon how much they spend on innovation inputs. We have constructed three classes, with innovation intensities 'less than 1 including 0', '1-3.99' and '4 or above'. These classes are somewhat arbitrary, and the choice of boundary will affect the differences between the classes. The classes do, however, apply the same borderlines as used by the OECD to classify low, medium and high tech industries based on R&D expenses.

Figure 7. Proportion of firms with different classes of innovation cost intensity. Manufacturing industry and services in the Oslo-region and for Norway. Innovative firms. Weighted shares.



Manufacturing firms in the Oslo-region have the highest proportion of firms belonging to the 'high-tech' sector, using 4% or more of turnover on innovation expenditure, followed by the 'low-tech' sector using less than 1% on innovation expenditure. The innovative manufacturing firms in the region are divided into one set of firms highly engaged in the innovation process and another that uses very low expenditure on innovation. The region has a lower share of firms using more than 4% of turnover on innovation, than the national average. The region also has a much higher share of firms using less than 1% of turnover on innovation, than the average for Norway. innovation.

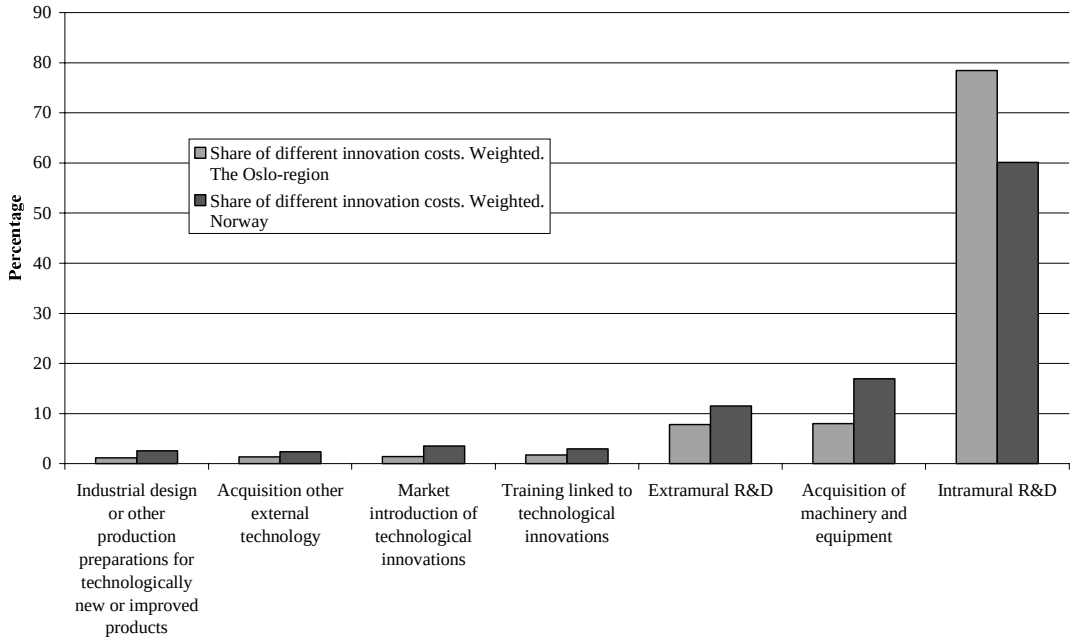
When it comes to the service sector, the share of 'high-tech' in the Oslo-region is much on the average for Norway. The differences lie especially in the proportions of firms belonging to 'low-tech' sector, where the region has close to 40% of the innovative firms. The average for Norway is 34%, in other word the share of firms that spend low shares of turnover on innovation is higher in the capital region.

Innovation activities

We will in this section calculate the share of innovation costs used on different innovation activities. Besides looking at differences between industries, we will be interested in looking at differences between the Oslo-region and the average for Norway to see whether firms in the Oslo-region use other inputs into the innovation process than the average for Norway.

By 'innovation activities' are meant research and development (both intramural and extramural), acquisition of machinery, equipment and other external technology, industrial design, training and marketing linked to technological innovations.

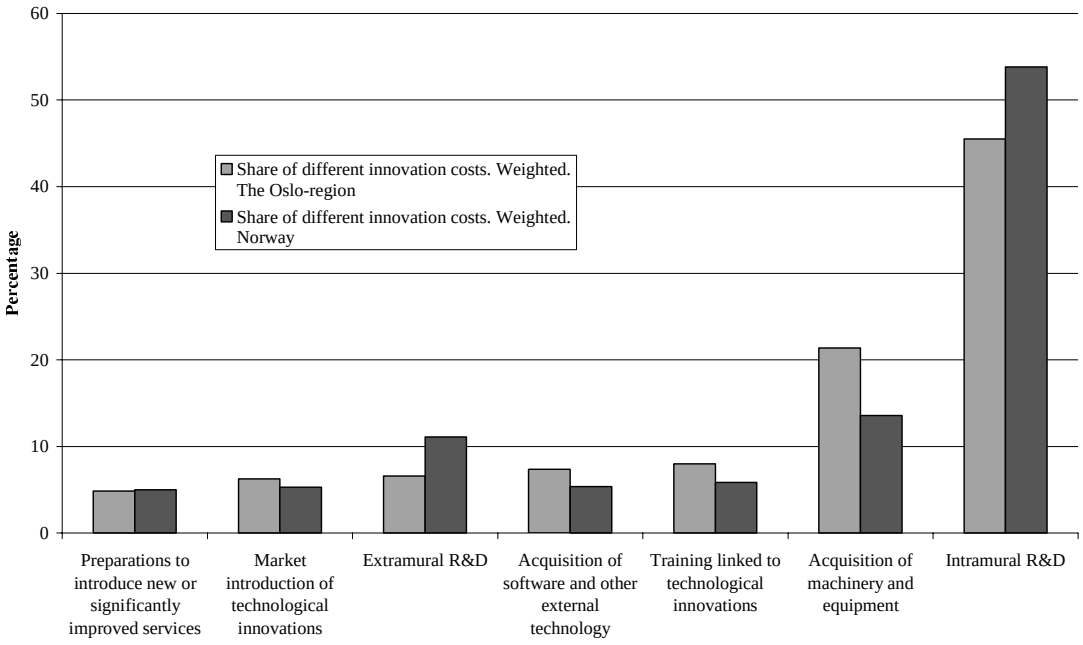
Figure 8. Distribution of innovation costs on different innovation activities. Manufacturing industry in the Oslo-region and in Norway. Innovative firms. Weighted shares. 1997. (N=133, 777).



The figure reveals that 'Research and experimental development within the firm' is by far the most important innovation input into the manufacturing industry, especially for firms located in the Oslo-region. This might suggest an innovation strategy with a long term perspective. The R&D share amounts to 78% of innovation

costs for firms in the Oslo-region, and 60% in average for Norway. The large share used on R&D by Oslo-firms can be explained by them often having the function of head offices, and thus being the unit where R&D activity is performed and/or registered. 'Acquisitions of machinery and equipment' and 'Acquisition of R&D services (extramural R&D)' are the second and third most important innovation activity, and seems to be more important for the average Norwegian firms than for firms located in the Oslo-region.

Figure 9. Distribution of innovation costs on different innovation activities. Service industry in the Oslo-region and in Norway. Weighted shares. (N=159, 311).

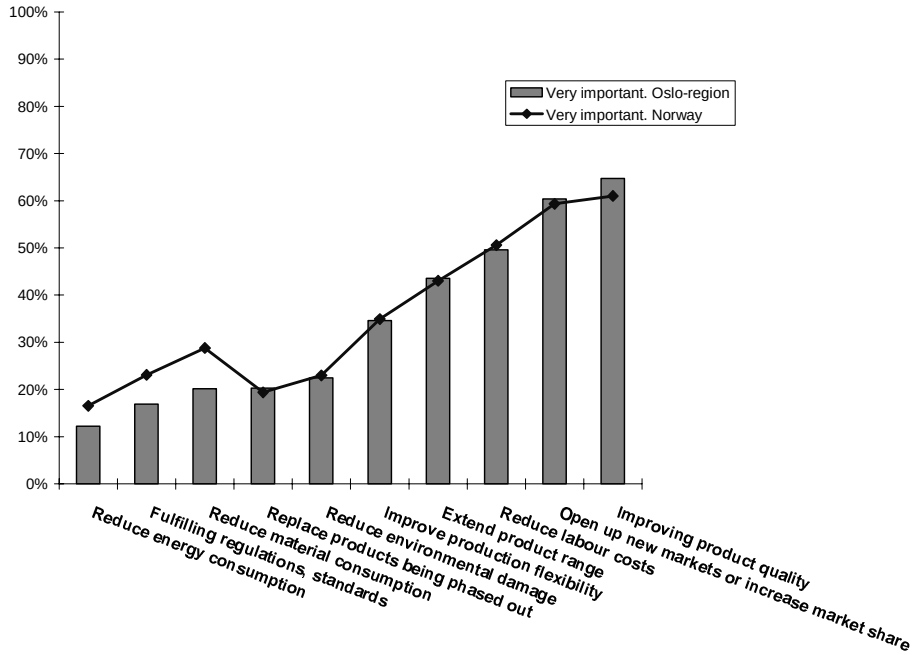


In the service sector in the Oslo-region, 'Research and experimental development within the firm' is the dominant innovation activity, however being a much lower share than for the manufacturing industry. 'Acquisition of machinery and equipment' and 'Training linked to technological innovations' are the second and third largest innovation activity for Oslo-based firms. There are differences in how firms in the Oslo-region innovates compared to the national average. Firms in the Oslo-region use less on R&D (both intramural and extramural) than the average, and Oslo-based firms uses more on 'Acquisition of machinery and equipment'.

Factors influencing innovation activity between 1995-1997

Firms that responded positively to having innovation activity were asked to answer questions related to 'reasons for engaging in innovation activity'. Firms were given 10 different reasons, and were asked to rate the question according to importance. Even though some of the reasons are quite general, they give some indication of the kind of factors firms consider to be important for innovation. The figures below show the share of firms that have answered that the following factors are very important reasons for engaging in innovation. The figures are scaled by the factors most firms in the Oslo-region perceived as being 'very important'.

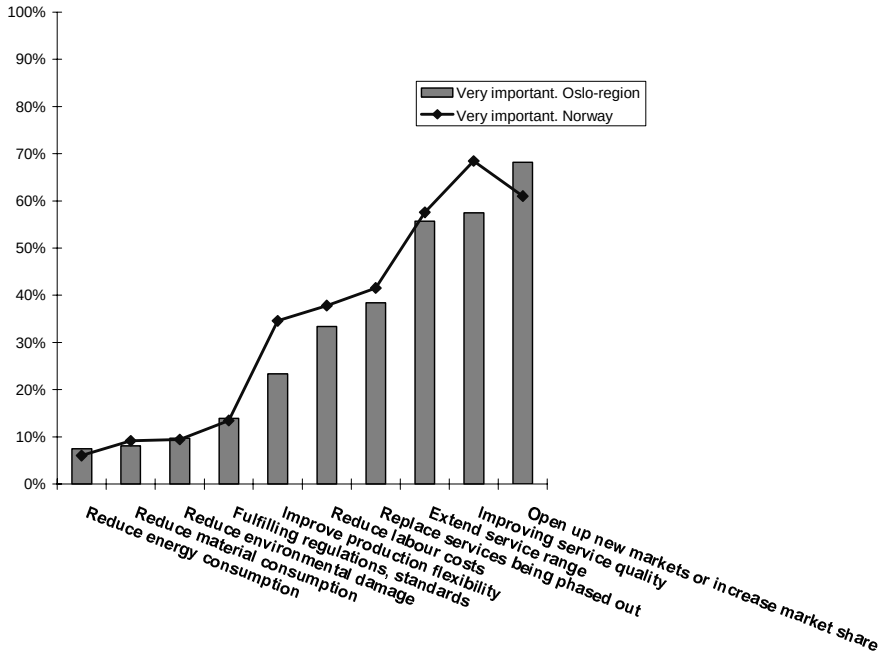
Figure 10. Share of firms that have answered that the following factors are very important reasons for engaging in innovation. Manufacturing industry. Innovative firms. Weighted shares. (N=151, 913).



For the manufacturing industry there are two reasons that stands out as being the most important for engaging in innovation activity, and those are 'Improving product quality' and 'Open up new markets or increase market shares'. More than 60% of the firms in the survey responded that these factors were very important reasons for engaging in innovation activity. Other important reasons where 'Reduce labour costs' 'Extend product range' and 'Reduce material consumption'. A low share of firms have emphasised 'Reduce energy consumption' and 'Fulfilling regulations' as

being reasons for engaging in innovation, these shares is lower in the Oslo-region than the average for Norway.

Figure 11. Share of firms that have answered that the following factors are very important reasons for engaging in innovation. Service industry. Innovative firms. Weighted shares. (N=178, 349).



The largest share of firms in the service industry in the Oslo-region emphasise the importance of 'Open up new markets' as reason for engaging in innovation. A larger share of firms in the Oslo-region emphasises this reason than the average for Norway. 'Improving service quality' is also highly rated by a large share of firms, followed by 'Extend service range'.

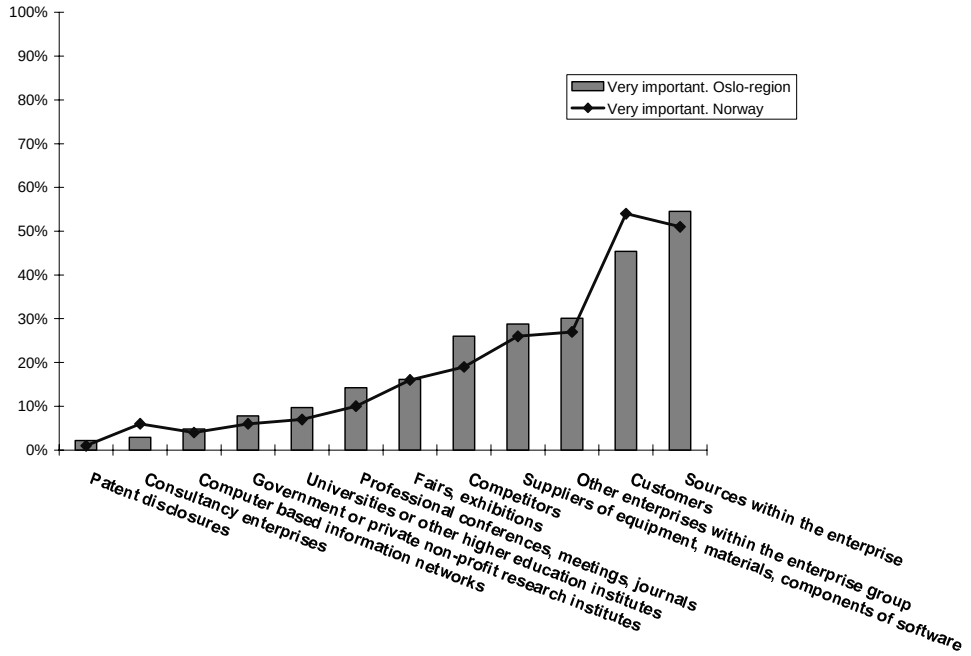
Aspects of the product or service that firms provide are highly valued as factors for engaging in innovation. This implies that factors linked to cost of production are not necessarily most decisive for engaging in innovation. This is true both for the manufacturing industry and for services.

Sources of information for innovation between 1995-1997

Innovation and knowledge creation are a result of firms' interactions with their environment. Innovation is an interactive learning process, and knowledge creation implies collaboration, exchange and trade between firms and institutions. This implies that firms seldom innovate alone, but always in relationship (formal or informal) with other firms, the institutional infrastructure, networks, scientific infrastructure, regulations and laws etc. Innovation therefore has a systemic character.

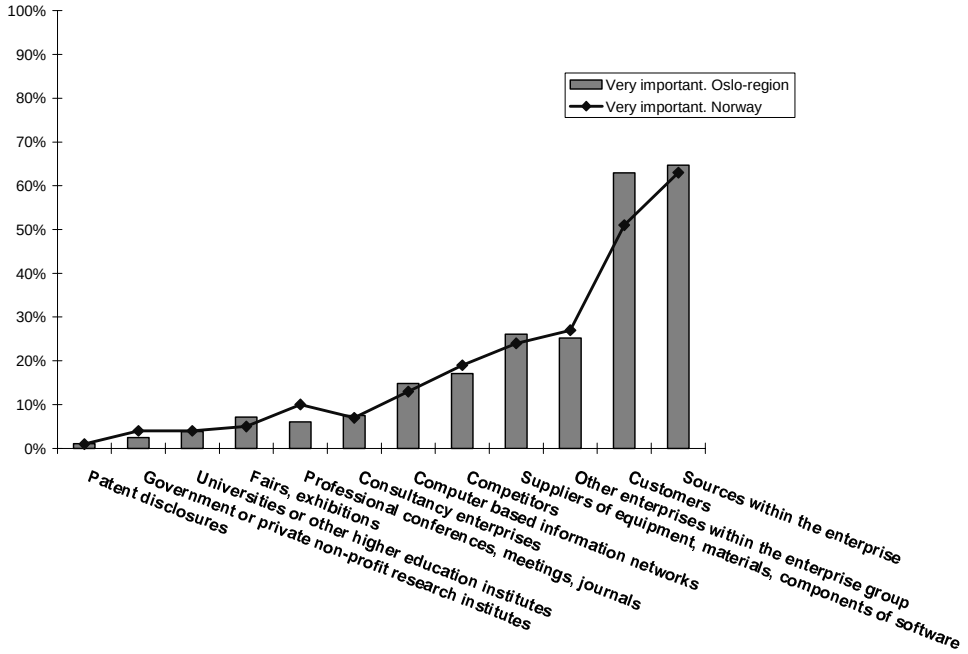
By looking at sources of information that are important for innovation, we can gain an insight into the operative system of innovation that firms act within. We asked firms to rate 12 different factors that might be influential to innovation. The figures below register the share of firms that perceive the given factors as 'very important'. The figures have been scaled by the factor most firms in the Oslo-region rated 'very important'.

Figure 12. Share of firms that have answered that the following sources are very important information sources for innovation. Manufacturing industry. Innovative firms. Weighted shares. (N=151, 913).



For the manufacturing industry in the Oslo-region, 'Sources within the enterprise' 'Customers' and 'Other enterprises within the enterprise group' are rated as very important information sources for the largest share of service firms. Human information and knowledge bases within firms stand out as the most important source of information for innovation. A smaller share of firms in the region value 'Customers' as information source than the average for the country, however the patterns of important sources for innovation are quite similar. The scientific infrastructure (universities, HEI, research institutions) is rated as very important by a small share of manufacturing firms, with this share of firms being slightly higher in the Oslo-region than the average for the country.

Figure 13. Share of firms that have answered that the following sources are very important information sources for innovation. Service industry. Innovative firms. Weighted shares. (N=178, 349).



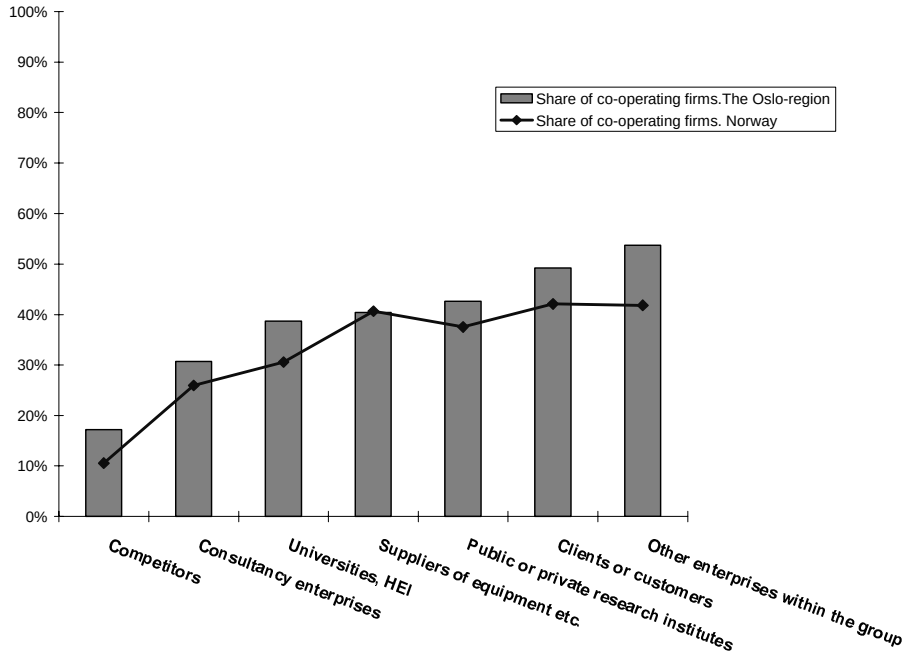
As for the manufacturing industry, 'Sources within the enterprise' and 'Customers' are the information sources that the largest share of firms rates as very important for innovation. These two sources of information stand out as being much more important than other factors. The scientific infrastructure is not perceived as an important source of information for innovation for the service industry; hardly any firms in this sector value them as being very important. It seems that human capital within firms and customers are the most relevant sources of information, and there

are hardly any differences in the levels of importance attached to the different factors in the Oslo-region compared to the average for the country.

Collaboration for innovation

In this section we will look more closely at firms' collaborative behaviour, in order to get an insight into which actors in the innovation system firms have formal contact with. The measure is simply a 'yes' or 'no' question of whether firms have engaged in innovation collaboration with any of the mentioned partners and will not take into account the number of co-operative actions. Further, we have no indication of how the firms value their collaborative partners, or of how successful the innovation collaboration project is.

*Figure 14. Share of firms with different **domestic** collaboration partners in the Oslo-region and in Norway. Manufacturing industry. Weighted shares. (N=82, 473).*

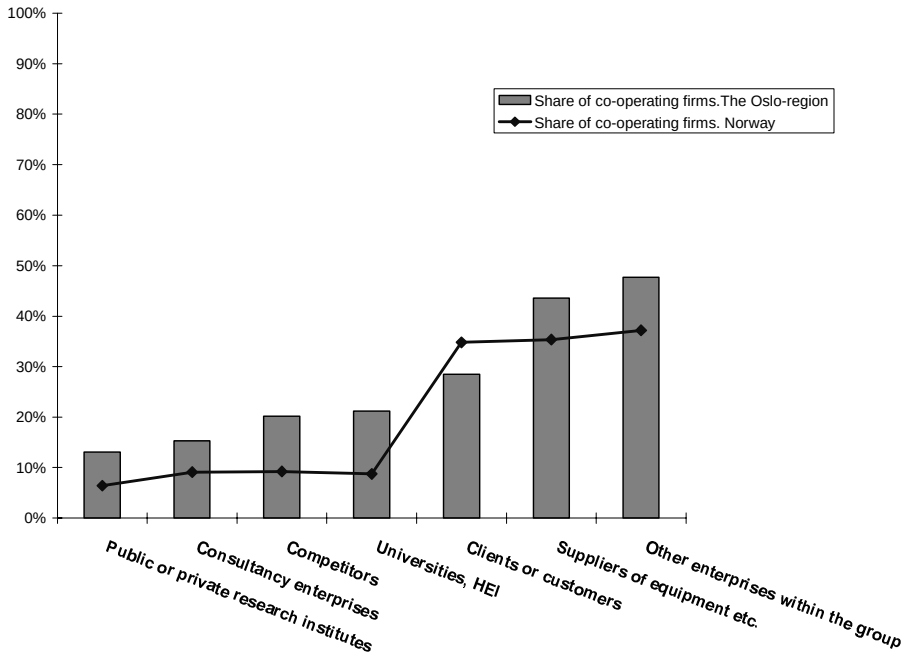


Innovating firms in the Oslo-region have a higher share of firms co-operating with all types of private partners than the average for Norway. Of firms in the Oslo-region that belong to an enterprise group, 10% more co-operated with other enterprises within the group than the average for the country. The reason is that these entities are

probably located in this region. For the Oslo-region, 'Clients or customers' constitute partners for 49% of the innovative firms.

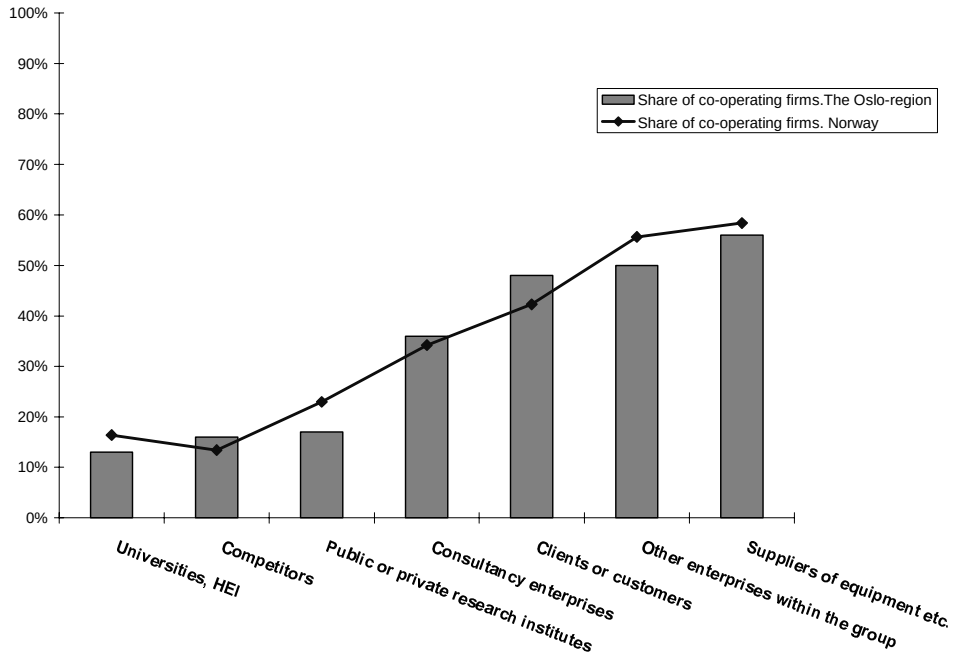
A high share of firms co-operate with the scientific infrastructure, with as many as 43% having co-operated with research institutes and 39% with universities or higher education institutions (HEI). This seems reasonable since such a large share of firms' innovation activities is directed towards R&D. What is surprising is that such a large share of firms in the country as a whole use the scientific infrastructure when innovating. However, the average shares of firms in Norway using these milieus are, despite being reasonably high, still lower than the share for the Oslo-region. There are great differences between size of firms in the use of the scientific milieus, the smaller the firm the less they use these milieus.

*Figure 15. Share of firms with different **foreign** collaboration partners in the Oslo-region and in Norway. Manufacturing industry. Weighted shares. (N=82, 473).*



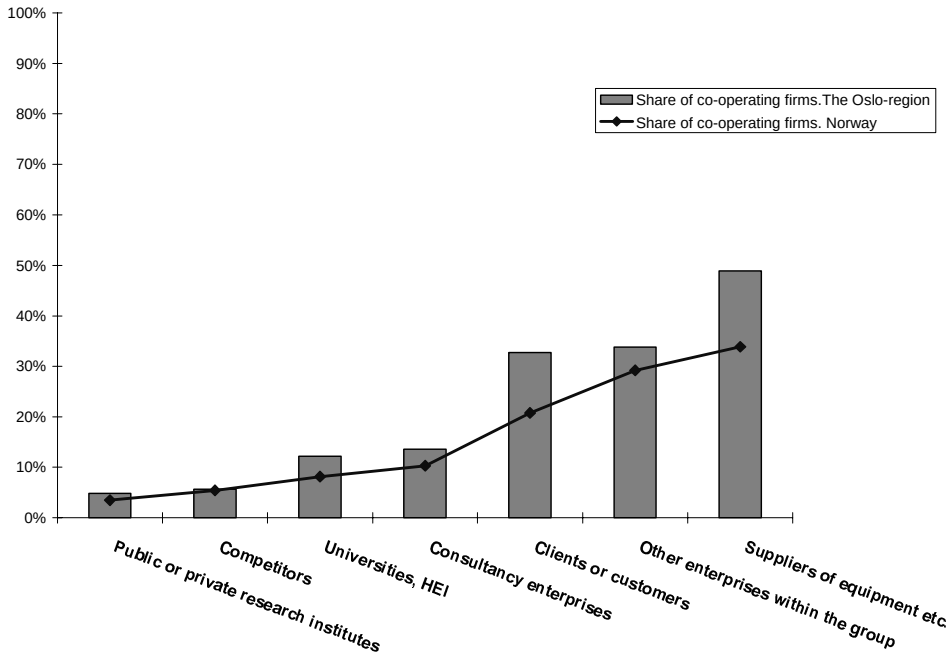
The figure shows that firms in the Oslo-region collaborates more with foreign partners than the average Norwegian firm, especially with universities and higher education institutions. This suggest that some firms need to look abroad to find relevant R&D competence. The figure also suggests that firms located in the Oslo-region can act as bridge builders to actors abroad.

*Figure 16. Share of firms with different **domestic** collaboration partners in the Oslo-region and in Norway. Service industry. Weighted shares. (N=94, 213).*



The service industry has a different structure of collaboration than the manufacturing industry. The most cited collaboration partners are ‘Suppliers of equipment etc.’, ‘Other enterprises within the group’ and ‘Clients and customers’. Firms in the service industry have lower shares of firms co-operating with domestic research institutions, universities and HEIs than the manufacturing industry. The reason for this may lie in the difficulties firms experience finding relevant competencies in the region or in the country.

*Figure 17. Share of firms with different **foreign** collaboration partners in the Oslo-region and in Norway. Service industry. Weighted shares. (N=94, 213).*



The figure shows that firms based in the Oslo-region collaborate with foreign actors to a larger degree than the average service firm. Oslo-based firms seems to collaborate to a much larger degree with suppliers of equipment. and other enterprises within the group and customers.

Our findings are that firms in the Oslo-region has a slightly higher share of firms reporting collaboration than average. Almost all innovative firms have engaged in collaboration activity with domestic private partners. There are significant differences between innovators in the Oslo-region and the average for the country in use of foreign partners.

We have in this final section of the chapter gained an insight into how the manufacturing and service industries innovate; we have looked at differences between the sectors and differences between industries. We have also emphasised the difference between firms located in the Oslo-region and the average for Norway. The next section summarises our findings on the extent of innovation and on how firms innovate.

Summing up findings on innovation

In general, manufacturing and service firms in the Oslo-region do not differ much from the average Norwegian firm with regard to either the 'extent of innovation' or 'how' they innovate. Investigating the material by industries and size classes, some differences do however emerge between firms in the Oslo-region and the average Norwegian firm.

Firms in the Oslo-region differ from the average Norwegian firm in that they;

1. – perform better in manufacturing industries with the highest share of innovative firms and among firms with the highest share of new products or processes in sales. Large firms also perform better in the Oslo-region than average, the smallest firms however, underperform in this region.
2. – spend more on R&D activity.
3. – have a higher share of firms co-operating, especially with foreign partners.

Below we will further explore these main findings, we will also give some international comparisons.

In the Oslo-region industries like 'Petroleum refining, chemicals', 'Machinery and equipment' and ' Rubber, plastics etc.' has a slightly higher share of firms with innovation activity than the rest of the country. When looking at manufacturing industries' innovation performance (measured as share of turnover that was accounted for by new or improved products), the Oslo-region also stands out as performing better in some industries than the average for the country in 'Office machinery, computers, electrical machinery', 'Pulp and paper, basic metal' and 'Machinery and equipment'. In manufacturing the Oslo-region also has a higher share of innovators than the average for the country among firms with more than 100 employees. This could mean that these particular industries or groups of firms are linked to networks that are well functioning in terms of flows of innovation relevant knowledge and information, and that they have the ability to absorb this information.

The opposite seems to be the case for small firms and industries like 'food, beverages and tobacco', and 'Other business activities', where we find that Oslo-based firms perform worse than the average. In order to turn this trend one may have to link these firms to relevant regional actors and strengthen network relationships between firms and the regional system of innovation.

On average 53% of all enterprises in manufacturing sector in 12 EEA[31] Member States[32] were innovative[33] in the period 1994-96 (1995-97). The figures are preliminary results[34] from the second Community Innovation Survey (CIS2). When looking at Norway in this particular study, the shares of innovative manufacturing are slightly lower and for service the shares are particularly lower[35].

[31] European Economic Area (EU and EFTA)

[32] The second Community Innovation Survey (CIS2) was launched in the EEA Member States in 1997/1998. The first Community Innovation Survey was done for 1992. In general, the results from the two surveys are not directly comparable. All the participating countries have agreed on a common set of methodology and a core questionnaire aimed at providing comparable, harmonised and representative data on a pan-European scale. The survey is based on the Oslo-manual. In general, it is either the National Statistical Institute or a Ministry that is directly responsible for the survey at the national level. This Statistics in Focus presents preliminary results for Belgium, Germany, Spain, France, Ireland, Luxembourg, Netherlands, Austria, Finland, Sweden, United Kingdom and Norway. The data for Norway refers to 1997, for the other countries the reference year is 1996. Final results for all participating countries are planned to be published in 3rd quarter 1999. The results can deviate from national published results, mainly due to different target population.

[33] Innovating enterprise; is an enterprise that has introduced new or improved products on the market or new or improved processes. Enterprises can have innovation activity without introducing an innovation on the market (it has either unsuccessful or not yet completed projects to develop or introduce).

[34] The results are based on answers from 33 700 enterprises, thus yielding a response rate of about 57%. Nationally the response rate varies from 24% to over 90%. The results presented are grossed-up figures for the whole population. The weighting factors are based on shares between the numbers of enterprises in the realised sample and total number of enterprises in each stratum of the frame population (combined non response correction and weighting). A non-response analysis has been carried out whenever the national response rate is below 70%. In these cases the results of the non-response analysis is used in the calculation of weighting factors.

[35] The results deviates from the national published results, mainly due to different target population and weighting procedures; In the European study of the manufacturing industry the cut off point for inclusion in the target population is 20 employees, in the Norwegian CIS the cut off point is 10 employees. This will have implications for the share of innovative firms, since large firms often have higher shares of innovation than smaller firms.

Table 9. Share of innovating manufacturing and service firms. Eurostat. CIS2. 1997/1998.*

	In Norway Weighted shares**	In Europe Weighted shares (Norway included)
Share of innovative manufacturing firms.	48%	53%
Share of innovative service firms.	22%	41%

*An innovating enterprise is an enterprise which has introduced new or improved products on the market or new or improved processes.
**Grossed up figures for the whole population. The results are based on answers from 33 700 enterprises, thus yielding a response rate of about 57%. Nationally the response rate varies from 24% to over 90%

Table 10. Share of innovative firms, by size-groups. Manufacturing industry. Eurostat. CIS2. 1997/1998.

Size class		In Norway Weighted shares**	In Europe Weighted shares (Norway included)
20-49	Small	39%	44%
50-249	Medium-sized	56%	59%
250 +	Large	77%	81%

*An innovating enterprise is an enterprise which has introduced new or improved products on the market or new or improved processes.
**Grossed up figures for the whole population. The results are based on answers from 33 700 enterprises, thus yielding a response rate of about 57%. Nationally the response rate varies from 24% to over 90%.

Table 11. Share of innovative firms, by size-groups. Service industry. Eurostat. CIS2. 1997/1998.*

		In Norway Weighted shares**	In Europe Weighted shares (Norway included)
10-49	Small	20%	37%
50-249	Medium-sized	26%	49%
250 +	Large	50%	73%

*An innovating enterprise is an enterprise which has introduced new or improved products on the market or new or improved processes.
**Grossed up figures for the whole population. The results are based on answers from 33 700 enterprises, thus yielding a response rate of about 57%. Nationally the response rate varies from 24% to over 90%.

Furthermore, the European study found that large enterprises are definitely more innovative than small and medium-sized enterprises. As much as 81% of manufacturing enterprises with more than 250 employees were innovative, while the corresponding share for Norway in Eurostats study is 77%. In the service sectors[36] covered by the European survey, 41% of enterprises were innovative, while for Norway the share was 22% (Eurostat). The same structure by size-class appears in the service sector; 73% of large enterprises were innovative compared to 37% of the small ones. The numbers for Norway are 50% and 20% respectively.

When focusing on innovation performance (measured as share of sales deriving from new or changed products) we found that the average share of turnover constituted by innovation was slightly higher in the Oslo-region than for the country as a whole. In manufacturing industry, firms in the Oslo-region appear to perform better than the average for Norway in those industries where innovation activity is high. However, the Oslo-region has lower shares of innovation in sales in some of the industries that have the lowest share of innovation in sales, both in manufacturing and services. When compared to results from the European innovation study the share of innovation in sales for the manufacturing industry in Norway seems reasonably comparable to the average for other EU-member countries (31%).

'How' then do firms in the Oslo-region innovate, compared to the average Norwegian firm? This question was approached by examining firms innovation intensity. We found that the largest share of innovative firms in the Oslo-region use more than 4% of turnover on innovation activities, which is also true for the country as a whole, however the share for the Oslo-region being slightly lower. The Oslo-region does have a larger proportion of firms that use less than 1% of turnover on innovation activity. This means that innovative manufacturing firms in the region seem to be divided into one group of firms heavily involved in innovation activities and one group that has little ongoing innovation activity. In the service industry the

[36] The service sector do consists of these Nace codes 51,60-62, 64.2, 65-67,72, 74.2 and therefor differs a bit from the Norwegian Community Innovation survey that also includes Nace 63, whole of 64 and 74, so the numbers are not fully comparable to the national study.

highest proportion of firms using less than 1% of turnover on innovation, this share of firms being slightly higher in the Oslo-region than in Norway as a whole.

Innovation patterns differ between firms in the Oslo-region and firms in Norway as a whole; manufacturing firms in the Oslo-region use a larger share of innovation costs on R&D. This may be accounted for by the large share of headquarters located in the region, registering large amounts of R&D expenditure. For the service industry the structure of amount spent on innovation activity do not differ much between the Oslo-region and the average for Norway. The pattern, however, differs from the manufacturing industry in that service firms use less money on R&D, indicating another approach to acquiring technology; namely by acquisition of machinery and equipment.

What, then, are the most important objectives for innovation? For both manufacturing and for services, the largest share of firms answered that ‘Improving product/service quality’ and ‘Open up new markets or increase market share’ are the most important reasons to engage in innovation. In the service industry the share of firms that emphasise the latter is especially high in the Oslo-region, suggesting an offensive strategy among these firms. In comparison, the European innovation study shows ‘Improving product or service quality’ to be the most important objective for innovation activity among firms in other EU-member countries. Innovation activity to ‘Fulfil regulations and standards’ or to ‘Reduce material and energy consumption or environmental damage’ was of minor importance, as well as to ‘Replace products being phased out’. Again, much the same patterns were found in the survey of the Oslo-region and Norway as a whole.

The two most important sources of information for innovation are ‘Sources within the enterprise’ and ’Customers’. However, these sources seem more dominant in the service sector than in manufacturing. Competencies that lie in the workforce are, naturally enough, a very important source of information for innovation, and as we have seen a large share of firms engage in training the workforce. Furthermore, customers are perceived to be very important by a smaller share of firms in the Oslo-region than the average for Norway. This can be due to the large supply of other

relevant knowledge providers. It is worth noting that the scientific infrastructure is perceived as a 'very important information source for innovation' by a low share of firms, the share however being larger for the manufacturing industry than for services. The reason for this can be found in different types of innovation activity being used in the manufacturing compared to the service sector. The European study found that dominant sources of information for innovation in the manufacturing sector were 'Clients or customers' and 'Sources within the enterprise or within the enterprise group'. In the service sector the picture is much the same, but the importance of 'Clients or customers' seems less pronounced; this is the opposite of what we found in our Norwegian study.

Innovative firms in the Oslo-region have higher shares of firms taking part in collaboration activities compared to the average for Norway. The difference is particularly pronounced for collaboration activities with foreign public partners.

5. Innovation and collaboration - in the Oslo-region and in Norway

By Finn Ørstavik

Introduction

In this section, the Cotech database compiled by the STEP group during 1998 is used to investigate facts on innovation-collaboration in Norway and in the Oslo-region.

The Cotech database

The Cotech dataset was developed with the intention of improving the empirical basis for answering questions such as:

- To what extent is innovation an interactive process?
- What kinds of partners work together in successful innovation projects?
- What is the nature of interaction between partners who collaborate on innovation?

A specific methodology was employed to gather the data, and to make sure they would confirm to strict quality standards. We used computer-aided telephone interviewing, and the group's own researcher engaged in the interview work. This significantly increased the response rates, and made sure we managed to build a large and high-quality dataset at relatively low cost. Our experience was that skilled interviewers in a structured dialogue resolved conceptual issues and coding problems, and also that the fact that we sought out the person with the best knowledge of innovation efforts in the firm contributed positively.

Cotech contains data on manufacturing firms with 10 or more employees. A 20% sample was drawn of firms with less than 100 employees, while all firms with 100+ employees were selected.

The sampling in the survey was done to make our firms a representative sample with respect to industry and firm size. *They were not drawn to make possible accurate regional comparisons.* This makes our task in this section more difficult: The

observations of innovative and collaborating firms in the Oslo-region are few, only 65 in all.

In general, however, it appears that data for Oslo in most respects are relatively similar for the Oslo-region and the rest of Norway. In the following, we will point out specific cases where the figures seem to indicate that there are real differences.

The definition of innovation and collaboration in Cotech

In order to make data more comparable to CIS data, some of our definitions and so-called filter questions were conforming with the standard set by the Community Innovation Survey. That is, we have *innovation* in a company (1) if the company has introduced a *new product* during the last three years, and we explained that the change should have a technological content: A simple design change, such as a new colour, would not be considered an innovation. Also, to mention another example, even a radical change of a bread recipe for a bakery would not count as an innovation, while the introduction of a new type of packaging (such as protective atmosphere plastic packaging) would count as an innovation. Although all this is in line with the CIS questionnaire, the latter is consistently talking about *technological innovation* and we believe this in reality is interpreted more narrowly by respondents than our question in the Cotech survey.
A firm would also be considered innovative if (2) the firm had worked on product development during the last three years, even if a new product had not been launched. (This is the same as in the CIS.) Finally, a firm would be classified innovative if (3) the firm had developed a new *service* which it sold together with (as an integral part of) its product offering (whether or not the products had been changed in the period). This option is not included in CIS.

As for *collaboration*, we were emphasising that this needed to encompass interacting over a period of time. Merely out-contracting part of the development project; such as buying a component, did not in itself classify as collaboration in the Cotech survey. An interchange back and forth, with mutual adjustments and learning was a precondition for deciding that collaboration had taken place.

Collaboration patterns in different industries

In the table below, we look at the tendency to undertake innovation-collaboration in different industries. The tendencies for firms to innovate and collaborate are discussed in Table 1. This table summarises answers given by innovating and collaborating firms which we asked: "What share of the innovation projects in your firm involve collaboration with external partners?" The table displays scaled numbers, for the Oslo-region and for the rest of Norway. The figures build on observation of 383 companies; thus the N referred is the number of observation with weights applied to the data set. Given the limited number of observations for the Oslo-region, we must be careful not to draw unwarranted conclusions about what the figures actually say.

Table 1: Share of a firms innovation projects involving collaboration with external partners. Manufacturing firms with innovation and collaboration. Norway 1998. Scaled.

		Oslo-region			**Elsewhere**		
Industry	NACE	Percent of firms collaborating in more than half of its innovation projects	Percent of firms collaborating in 9 or 10 of 10 innovation projects	(N-scaled)	Percent of firms collaborating in more than half of its innovation projects	Percent of firms collaborating in 9 or 10 of 10 innovation projects	(N-scaled)
Food, beverages, tobacco	15+16	82.1	50	28	44.8	29.9	261
Textile and clothing	17+18+19	Na	Na	0	35.7	32.9	70
Wood products	20	0	0	8	47.8	21.1	90
Paper products and pulp	21	100	0	10	40	20	35
Publishing and printing	22	73.6	66.7	72	42.4	4.0	99
Chemicals and chem. prod.	23+24	80	70	20	74.6	36.6	71
Rubber and plastic prod.	25	100	66.7	3	78.3	43.4	106
Non-metallic mineral prod.	26	100	100	2	65	31.7	60
Prod. of metals	27	100	0	2	69.6	60.9	23
Metal products	28	0	0	8	46.2	31.9	182
Machinery and equipment	29	100	50	4	52.7	23.6	203
Electronics optical products	30+31+32	43.3	10	30	42.1	19.8	126
Transport equipment	34+35	100	100	8	55.6	33.8	151
Furniture and other industry	36-37	95.7	69.6	23	72.4	50.9	116
Manufacturing industry	15-37	71.6	50	218	53.0	29.9	1593

As has been shown elsewhere, the tendency for firms to collaborate with external partners in order to promote innovation is considerable in all industries. In Norway outside the Oslo-region, we see that the industries that are most eager to collaborate when they embark on innovation ventures are chemical, rubber and plastic and metal production – that is chemical process industries. About ¾ of the firms in these industries that do have collaboration, collaborate in more than half of the innovation projects that they engage in. Also "furniture, sport products, toys and other" industries rank high on this scale, both when we look at how many collaborate in more than half of their innovation projects and how many always – or nearly always – collaborate.

For the Oslo-region, the general tendency is that innovating and collaborating firms in the manufacturing industry collaborate *more* than similar firms in the rest of Norway. *The average rates for the Oslo-region are similar to the highest industry rates elsewhere in Norway.*

Many industries here appear as small in the Oslo-region, which means that there aren't many innovating and collaborating firms from these firms in the region. These industries are not represented with enough observations in the data to say anything specific here. However, one major industry in the Oslo-region, publishing and printing, is well represented in the data. We can see that innovating and collaborating firms in this industry collaborate significantly more than comparable firms in this industry elsewhere in Norway: 2/3 of the firms in Oslo collaborate always or nearly always, while this holds for only 4 percent of firms outside the region. In the case of the food industry, the chemical industry and the electronics industry the figures for collaboration are also clearly *higher* than the figures for the other parts of the country.

For the manufacturing industry as a whole, figures indicate that the overall tendency to collaborate is significantly higher in the Oslo-region than elsewhere in Norway. The share of innovative and collaborating firms that collaborate in more than half of their innovation projects is 72% for the Oslo-region, but only 53% in industry

elsewhere. 50% of firms in the Oslo-region virtually always collaborate, while this applies to 30% of manufacturing industry in the rest of Norway.

Patterns of public support

In the table below we report the share of key innovation projects reported by innovating and collaborating firms that have received support in the form of public funding.

The figures for the Oslo-region are based on a very limited set of observations. However, we see that the overall share of projects reported to have received public funding is half the rate reported in the country as a whole; 16% of reported projects in Oslo received support, while 30% of the projects reported for the rest of the country benefited from subsidies. The numbers are not surprising, given the consistent orientation of policies to support peripheral regions.

There are also other signs confirming that the Oslo-region receiving a disproportionate share of public financial support. In the food industry, which is important in this region, none of the projects reported have received public support (while the rate for projects in this country in Norway as whole is 28%). A similar fact can be noted for another important industry in this region: of the projects reported in the Oslo-region printing and publishing industry, none received support (in this case though, the share for the rest of the country is as low as 6 percent.)

On the other hand, the electronics industry and chemicals industry display a higher probability of receiving public support than these industries elsewhere in Norway.

Table 2: Share of key projects receiving support in the form of public funding. Manufacturing industry Oslo-region and elsewhere in Norway 1998. Scaled.

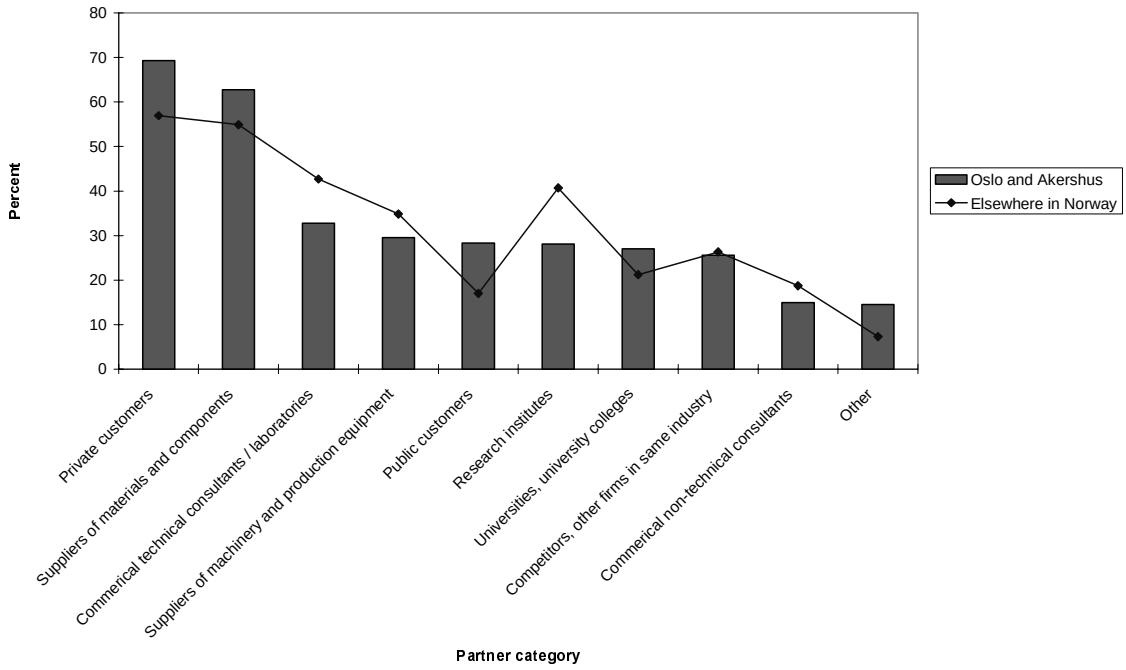
		Oslo-region		Elsewhere	
Industry	NACE	Percent received public support	(N-scaled)	Percent received public support	(N-scaled)
Food, beverages, tobacco	15-16	0	29	27.5	51
Textile and clothing	17-19	na		18.8	16
Wood products	20	100	8	40	15
Paper products and pulp	21	0	10	14.3	14
Publishing and printing	22	0	80	5.6	18
Chemicals and chem. prod.	23-24	52.6	19	31.3	18
Rubber and plastic prod.	25	0	3	42.1	20
Non-metallic mineral prod.	26	100	2	38.5	14
Prod. of metals	27	0	2	53.8	14
Metal products	28	0	8	42.3	27
Machinery and equipment	29	0	3	39.5	38
Electronics optical products	30-33	52.2	30	34.4	33
Transport equipment	34-35	0	8	17.5	41
Furniture and other industry	36-37	0	24	26.9	27
Manufacturing industry	15-37	16.1	226	30.3	346

As a final point, it should be noted that the Oslo-region appears to have an industry structure where the large industries are those that traditionally receive little support. Printing and publishing is one such industry. The actual cause and effect, whether it is the location or the industry that matters, cannot be established here.

Which partners are involved in collaborative innovation efforts?

We have looked into the percentage of collaborating firms that report relationships to specific partner categories. The figure below summarises the main findings.

Figure 1: Share of innovative and collaborating firms reporting collaboration with partner category. The Oslo-region and elsewhere in Norway. Percent. 1998. Numbers are scaled.



The general pattern is relatively similar in the Oslo-region to the pattern for other parts of the country. The most frequently used partners are private customers and suppliers of materials and components. The least frequently used partner type is "other", which usually means corporate research- or competence centres. But there are also some notable differences: Collaborating firms in the Oslo-region more frequently collaborate with suppliers of materials and components and with private customers. Firms here collaborate much more frequently with public customers, significantly less so with research institutes, and only slightly more with entities in the university/university colleges category than firms elsewhere in the country. Since Oslo is the administrative centre of Norway, the former fact is not surprising. That firms here collaborate less with research institutes is quite remarkable, as is the fact that the rate of collaboration with institutions in higher education is no higher than the rate for other parts of Norway in spite of the fact that the University of Oslo and other several important institutions are located in the region.

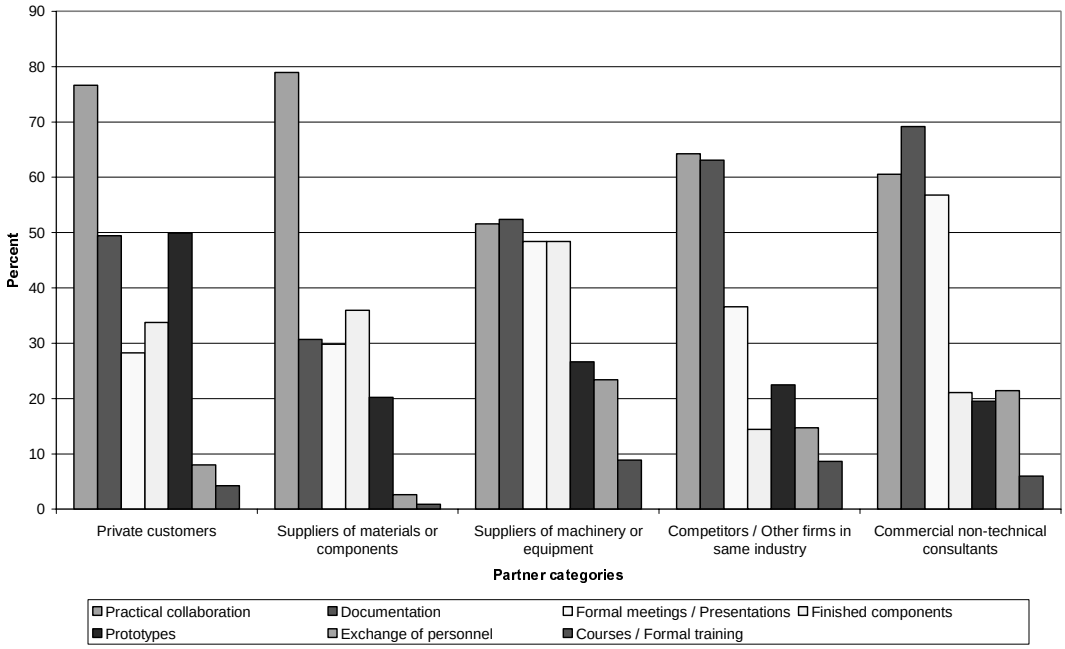
A final notable difference between the Oslo-region and the rest of the country with respect to partner portfolio, is the fact that companies in the region much more often

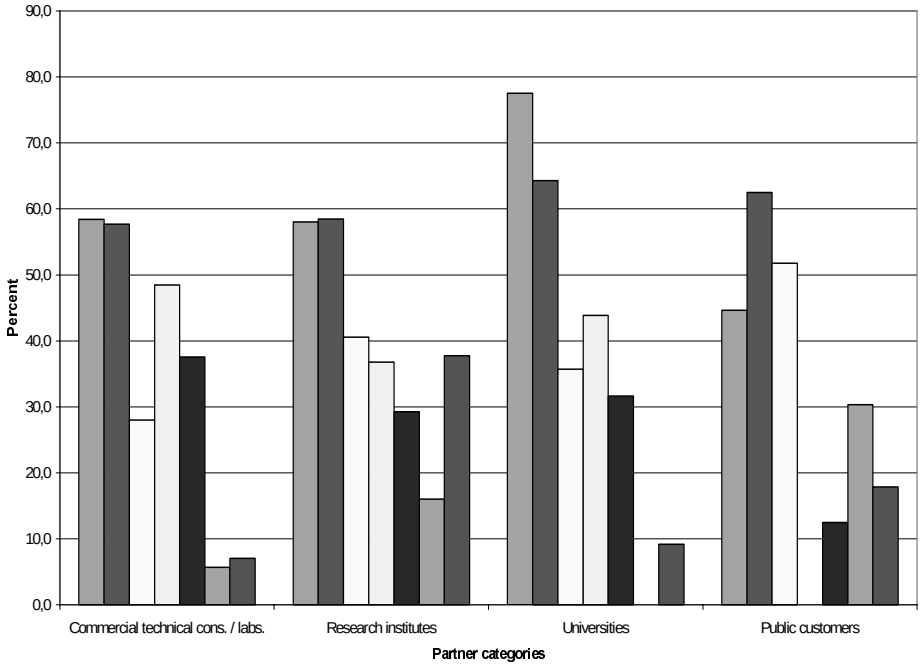
collaborate with partners in the category “others”. Looking into the data, one can see that “other” partners tend to be research centres inside larger companies. Our hypothesis therefore, is that there are more companies in the Akershus and Oslo-region that are part of large corporations with access to such internal competence units.

How does collaboration happen?

During the Cotech interview, respondents were asked to pick the single most collaborative innovation project for the firm over a three-year period. We asked several questions about this project; some focusing on the importance attributed to various dimensions of the actual collaborations. In the following figure, we show the share of firms reporting having used a specific collaboration method which judged this method to have been very important (4 on a scale from 1 to 4) for the innovation project.

Figure 2: The important dimensions of collaborative relationships. Share of firms using collaboration method reporting method to be "very important". Norway, 1998. Scaled numbers.





With only a couple of exceptions, it is practical, face-to-face co-operation and documentation that are the most important dimensions of collaborative relationships. Documentation is less important in collaborations involving private customers and, in an even higher extent, in collaborations involving suppliers of materials and

components. But documentation is rated as slightly more important in collaborations with public customers and with commercial non-technical consultants.

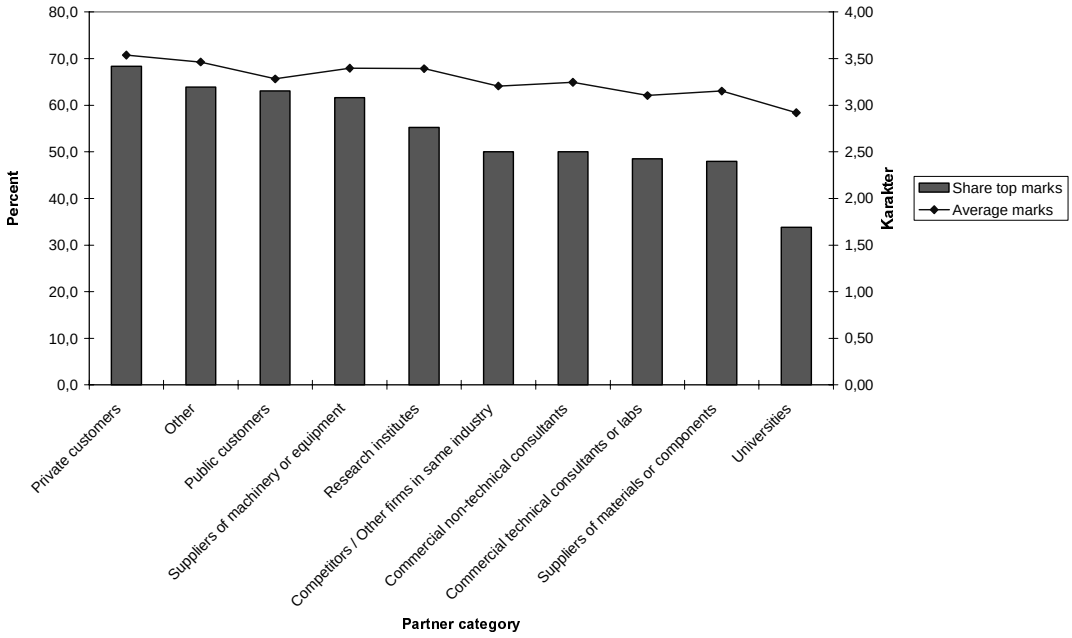
The least well considered collaboration method is *courses and training*. The exception here is collaboration with research institutes, where courses and organised training is considered an important aspect of interaction.

The data on perception of significance of collaboration methods do not allow a breakdown on the Oslo-region and the rest of the country. The number of observations is insufficient. However, we have repeatedly seen that Oslo does not appear dramatically different from the rest of the country. Thus, the industry breakdown above is quite sufficient for some types of evaluations of the situations in Oslo. The crucial point is to look into the industry structure of the Oslo-region. The situation in these industries nationally will very probably give a good indication of the situation for these industries in Oslo, and thus in the Oslo-region as a whole.

The significance of partners

How do innovating firms perceive their partners' contributions? What is the perceived significance of the contributions of partners for the innovation effort as a whole? We have investigated this by looking at what share of firms rate their partners' contribution to be "very important" (4 on a scale from 1 to 4). The results are presented in the figure below, where also another measure of perceived significance is presented: The average mark given to the partners.

Figure 3: Significance of collaborating partners overall contribution to innovation project. Norway, 1998. Scaled.



It appears that the first measure, 'share granting top marks', is the most sensitive to differences, and we concentrate on this indicator here. The partner categories that are most often considered very important contributors also tend to be the partner categories which are used frequently in collaborative innovation efforts. Private customers, for instance, are used extensively as partners and get the highest share of top marks for significance

Research institutes come fifth in this ranking, a position that matches well the frequency with which they are used as partners in innovation. The same holds for partners in the university and higher education sector who are also at the bottom of this ranking. They are relatively rarely involved in collaborative relationships, and even when they are involved, they do not get very high marks for their contributions. Around 1/3 of the firms collaborating with partners in this sector say that their partners' contribution is "very important". Twice as many, that is, 2/3 of firms, give their collaborating customers top marks for their contribution.

There are several examples of little or no match between frequency of use and attributed significance. One example is the category “Other” which is rarely used but highly rated. As mentioned earlier, many of the “Other” observations were of corporate research and competence groups which did not fit well into the pre-selected partner categories. We would interpret the numbers, therefore, to indicate that not many firms have access to such partners, but those who do have them rate them very highly. (We do not know to what extent this positive evaluation is an expression of opportunism or corporate loyalty. In spite of the fact that we guaranteed respondents anonymity both for themselves and their firm, background data indicate that answers have a certain bias in a positive direction.)

A final note concerns public customers, who, much like “others” are rarely used but highly rated. This may indicate that the number of public customers available for innovation collaboration is limited, but that those that are available are important for the innovating firms. It would be interesting to know more about why these partners are considered important, for instance to what extent they are sources of competence and to what extent they simply give access to financial resources, or to big market opportunities.

Perception of partners in Oslo and in the rest of Norway

The data on significance of partners are too limited to allow proper statistical analysis based on a breakdown with respect to both partner category and location. The overall numbers show that 63% of collaborating firms in the Oslo-region give their partners top marks for importance, while 57% do the same elsewhere in Norway. (If we look at *average marks* scored, the numbers show no difference.) For illustration purposes we have also analysed the “satisfaction rate” with respect to partner categories, in spite of the weakness of the data for the Oslo-region. The data are placed in Appendix 1.

Conclusion.

This section has reported results from the innovation-collaboration survey carried out by the STEP group in 1998. We have noted that sampling methods have not made it

possible to carry out a thorough statistical analysis of the Oslo-region, but we have nevertheless been able to draw a number of conclusions.

The data indicate that innovation related collaboration is at least as common in Oslo as in the rest of the country, and it is quite probable that **the tendency to collaborate is actually markedly higher in the Oslo-region than the average for the rest of the country**.

Public sector support is less frequent in the Oslo-region, both because of an "unfavourable" industry structure in this respect, and because industries for policy reasons have lower chances of receiving support in this central region.

In terms of collaboration partners, **firms in the Oslo-region work most frequently with suppliers of materials and components and with private customers**. This is a general tendency in innovation related collaboration, and shows that innovation is an *interactive process*, in which successful mutual learning and influencing among significant partners is a crucial factor. Firms in Oslo and Akershus collaborate **much more frequently with public customers**, markedly **less with research institutes**, and only **slightly more with entities in the university and higher education category** than firms elsewhere in the country. Given the status of Oslo as the administrative centre of Norway, the first fact appears not to be surprising. The fact that the University of Oslo and other institutions in higher education does not play a more prominent role might be more surprising.
We have also looked into how collaboration happens, but the data here do not allow specific analyses of the situation in the Oslo-region. In general, with only a couple of exceptions, it is ***informal face-to-face collaboration*****, and the use of reports and other *documentation* that are the most important dimensions of collaborative relationships**. Documentation is less important in collaborations involving private customers and, to an even lesser extent, in collaborations involving suppliers of materials and components. But documentation is rated as slightly more important in collaborations with public customers and with commercial non-technical consultants.

The collaboration method given less consideration is *courses and training*. The exception here is in collaborations with research institutes, where courses and organised training are considered an important aspect of interaction.

As for perception of how important *partners* are, the partner categories that are most often considered very important contributors to key innovation projects also tend to be the partner categories which are used frequently in collaborative innovation efforts. Private customers, for instance, are used extensively as partners, and get the highest share of top marks for significance.

Research institutes come fifth in this ranking, a position that matches well the frequency with which they are used as partners in innovation. The same holds for partners in the university and higher education sector: They score low also on this ranking. They are relatively rarely involved in collaborative relationships, and **even when they are involved, they do not get very high marks for their contributions**.

Finally, we find that innovating and collaborating firms in the Oslo-region on average are more satisfied with the contributions of their partners than firms are elsewhere in Norway, both in terms of the rate of firms awarding top marks and in terms of average marks awarded. These differences are not very large, however.

We wish to make a final note on the figures concerning the role of the University and other institutions' level of involvement in innovation collaboration. The numbers in themselves are quite clear: The level of direct involvement is modest. In evaluating this fact however, it is important to note that the role of the university is not limited to direct engagement in business innovation. Substantial benefits of the work going on in the university may flow to business and industry by way of diffusion of educated people, and dissemination of results that are available to all, and not limited to particular collaborative relationships.

Appendix 1

Figure A1: Share of collaborating firms saying partner was "very important" for innovation project. Oslo and elsewhere in Norway, 1998. Scaled.

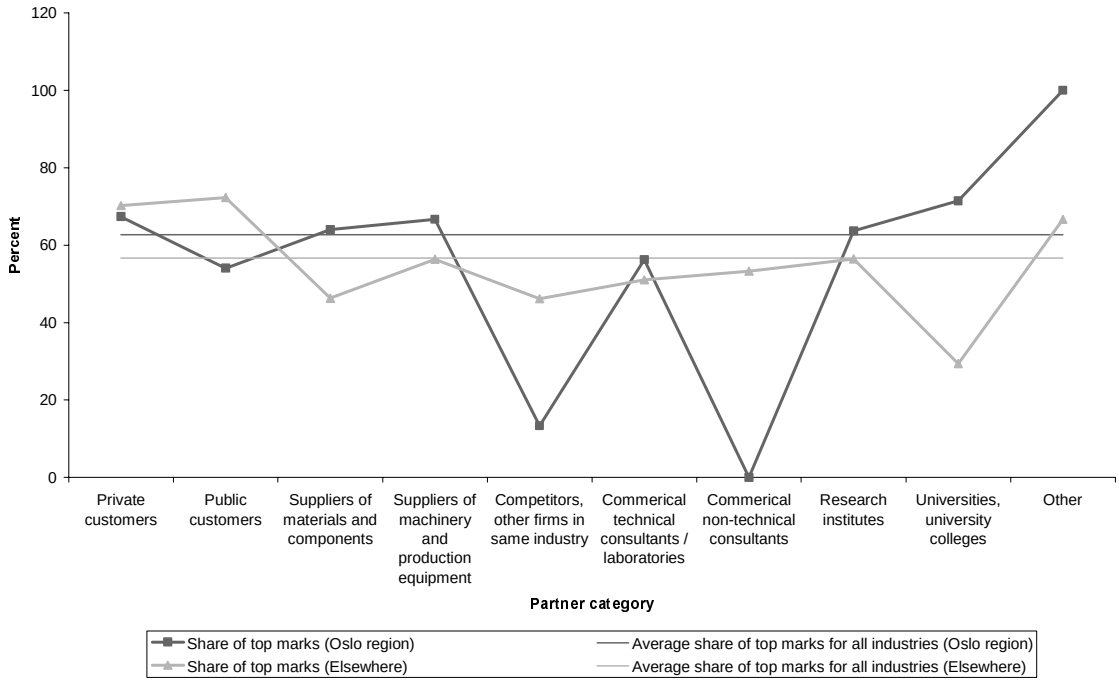


Table A1: Perception of partner's contribution to selected innovation project. Manufacturing firms in the Oslo-region and elsewhere in Norway, Norwegian partners. 1998. Absolute numbers, scaled.

Oslo-region

	Private customers	Public customers	Suppliers of materials and components	Suppliers of machinery and	Competitors, other firms in same industry	Commercial technical consultants/	Commercial non-technical consultants	Research institutes	Universities, university colleges	Other	Aggregate
1. Not important	1	0	0	0	11	8	0	0	0	0	20
2.	11	9	13	9	1	2	0	2	2	0	49
3.	4	8	14	2	1	4	3	2	0	0	38
4. Very important	33	20	48	22	2	18	0	7	5	25	180
No answer	20	2	12	6	0	13	2	0	2	12	69
(N scaled)	69	39	87	39	15	45	5	11	9	37	351

Norway elsewhere

	Private customers	Public customers	Suppliers of materials	Suppliers of machinery	Competi-tors, other	Commer-cial tech-nical	Commer-cial non-	Research institutes	Universi-ties,	Other	Aggregate
1. Not important	2	1	25	11	5	30	2	8	4	0	88
2.	61	21	105	6	15	59	21	33	22	19	362
3.	98	4	102	38	43	77	27	87	22	16	514
4. Very important	380	68	200	71	54	173	57	166	20	70	1259
No answer	38	19	89	65	25	59	61	33	26	43	458
(N scaled)	579	113	521	191	142	398	168	327	94	148	2680

Appendix 2

	2-DIGIT NACE CODES	
NACE	**NORWEGIAN**	**ENGLISH**
01	jordbruk	01 agriculture hunting and related service activities
02	skogbruk og tjenester tilknyttet skogbruk	02 forestry logging and related service activities
05	fiske, fangst og fiskeoppdrett tjenester tilknyttet fiske, fangst og fiskeoppdrett	05 fishing operation of fish hatcheries and fish farms; service activities incidental to fishing
10	bryting av steinkull og brunkull utvinning av torv	10 mining of coal and lignite; extraction of peat
11	utvinning av råolje og naturgass tjenester tilknyttet olje- og gassutvinning	11 extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
12	bryting av uran- og thoriummalm	12 mining of uranium and thorium ores
13	bryting av metallholdig malm	13 mining of metal ores
14	bergverksdrift ellers	14 other mining and quarrying
15	produksjon av næringsmidler og drikkevarer	15 manufacture of food products and beverages
16	produksjon av tobakksvarer	16 manufacture of tobacco products
17	produksjon av tekstiler	17 manufacture of textiles
18	produksjon av klær beredning og farging av pelsskinn	18 manufacture of wearing apparel; dressing and dyeing of fur
19	beredning av lær produksjon av reiseeffekter, salmakerartikler og skotøy	19 tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	produksjon av trelast og varer av tre, kork, strå og flettematerialer, unntatt møbler	20 manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	produksjon av papirmasse, papir og papirvarer	21 manufacture of paper and paper products
22	forlagsvirksomhet, grafisk produksjon og reproduksjon av innspilte opptak	22 publishing, printing and reproduction of recorded media
23	produksjon av kull- og petroleumsprodukter og kjernebrensel	23 manufacture of coke, refined petroleum products and nuclear fuel
24	produksjon av kjemikalier og kjemiske produkter	24 manufacture of chemicals and chemical products
25	produksjon av gummi- og plastprodukter	25 manufacture of rubber and plastics products
26	produksjon av andre ikke-metallholdige mineralprodukter	26 manufacture of other non-metallic mineral products
27	produksjon av metaller	27 manufacture of basic metals
28	produksjon av metallvarer, unntatt maskiner og utstyr	28 manufacture of fabricated metal products, except machinery and equipment
29	produksjon av maskiner og utstyr	29 manufacture of machinery and equipment n.e.c.
30	produksjon av kontor- og datamaskiner	30 manufacture of office, accounting and computing machinery

31	produksjon av andre elektriske maskiner og apparater	31 manufacture of electrical machinery and apparatus n.e.c.
32	produksjon av radio-, fjernsyns- og annet kommunikasjonsutstyr	32 manufacture of radio, television and communication equipment and apparatus
33	produksjon av medisinske instrumenter, presisjonsinstrumenter, optiskeinstrumenter, klokker og ur	33 manufacture of medical, precision and optical instruments, watches and clocks
34	produksjon av motorkjøretøyer, tilhengere og deler	34 manufacture of motor vehicles, trailers and semi-trailers
35	produksjon av transportmidler	35 manufacture of other transport equipment
36	produksjon av møbler annen industriproduksjon	36 manufacture of furniture; manufacturing n.e.c.
37	gjenvinning	37 recycling
40	elektrisitets-, gass-, damp- og varmtvannsforsyning	40 electricity, gas, steam and hot water supply
41	oppsamling, rensing og distribusjon av vann	41 collection, purification and distribution of water
45	bygge- og anleggsvirksomhet	45 construction
50	handel med, vedlikehold og reparasjon av motorkjøretøyer og motorsykler detaljhandel med drivstoff til motorkjøretøyer og motorsykler	50 sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
51	agentur- og engroshandel, unntatt med motorkjøretøyer og motorsykler	51 wholesale trade and commission trade, except of motor vehicles and motorcycles
52	detaljhandel, unntatt med motorkjøretøyer og motorsykler reparasjon av husholdningsvarer og varer til personlig bruk	52 retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
55	hotell- og restaurantvirksomhet	55 hotels and restaurants
60	landtransport og rørtransport	60 land transport; transport via pipelines
61	sjøtransport	61 water transport
62	lufttransport	62 air transport
63	tjenester tilknyttet transport og reisebyråvirksomhet	63 supporting and auxiliary transport activities; activities of travel agencies
64	post og telekommunikasjoner	64 post and telecommunications
65	finansiell tjenesteyting unntatt forsikring og pensjonsfond	65 financial intermediation, except insurance and pension funding
66	forsikring og pensjonsfond, unntatt trygdeordninger underlagt offentlig forvaltning	66 insurance and pension funding, except compulsory social security
67	hjelpevirksomhet for finansiell tjenesteyting	67 activities auxiliary to financial intermediation
70	omsetning og drift av fast eiendom	70 real estate activities
71	utleie av maskiner og utstyr uten personell utleie av husholdningsvarer og varer til personlig bruk	71 renting of machinery and equipment without operator and of personal and household goods
72	databehandlingsvirksomhet	72 computer and related activities
73	forskning og utviklingsarbeid	73 research and development
74	annen forretningsmessig tjenesteyting	74 other business activities
75	offentlig administrasjon, forsvar og trygdeordninger underlagt	75 public administration and defence; compulsory social security

	offentlig forvaltning	
80	undervisning	80 education
85	helse- og sosialtjenester	85 health and social work
90	kloakk- og renovasjonsvirksomhet	90 sewage and refuse disposal, sanitation and similar activities
91	interesseorganisasjoner ikke nevnt annet sted	91 activities of membership organizations n.e.c.
92	fritidsvirksomhet, kulturell tjenesteyting og sport	92 recreational, cultural and sporting activities
93	annen personlig tjenesteyting	93 other service activities
95	lønnet arbeid i private husholdninger	95 private households with employed persons
99	internasjonale organer og organisasjoner	99 extra-territorial organizations and bodies

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STEP group

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.