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Title:

Innovation performance in the capital region of Norway. Potentials for improvement?

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Abstract:

Innovation performance in the capital region of Norway. Potentials for improvement.

The paper presents an analysis of the Oslo-region, which is the capital area of Norway, with respect to innovation activity and the networking of firms in the innovation process. The Oslo-region is the most knowledge-intensive industrial area of Norway. The business activities are marked by relatively high expenditures on 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 companies in other parts of the country.

The main question in the paper is to what extent an innovation system can be found in the Oslo-region. By mapping the existing interactions between business activities and the research and technology environment in the region, and relate these to processes of innovation, one are able to look into the operative innovation system of the region. To further explore this issue, we carried out five qualitative industry studies in the Oslo-region. Our findings showed that the innovation demand of firms differed between industries and between firms of different size. Nevertheless, a general problem was related to collaboration between firms and the scientific community in the region. The problem was rooted in both a competence mismatch and a "cultural" mismatch.

In the paper we discuss further findings that could give insight into the ways in which innovation performance of a region could be improved.

1. Introduction

The aim of this paper is to present some empirical findings on the regional innovation system in the Oslo-region (Oslo and Akershus counties), which is the capital region of Norway. The paper presents an analysis of the Oslo-region with respect to innovation activity and the networking of firms in the innovation process, and explores to what extent firms rely on external partners in the innovation process. The main questions are to what extent an innovation system can be found at the regional level, and if so, how it functions. The paper also looks into possible barriers to the formation of innovation systems. The focus is on small and medium-sized enterprises (SMEs[1]) in the manufacturing industry in the region**.**

The paper uses data from the Norwegian Innovation Survey carried out in 1997[2]. It also uses findings from five qualitative industry studies in the region[3]. The industries studied are graphics (printing and publishing), food, machinery and equipment, electronics and the electrotechnical industry. Two of the industries, graphics and electronics, are defined as 'regional clusters'[4] (Isaksen, A. and O.R. Spilling, 1996).

The paper is based on parts of the RITTS Oslo project (Regional Innovation Infrastructure and Technology Transfer Systems in the Oslo-region, RITTS Oslo, Stage 1 report)[5] (Aslesen et *al*., 1999 a) and Aslesen et *al*., 1999 b)).

2. Regional learning and 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 and industries. Today, innovation is regarded as a bottom up interactive activity, including other elements than formal R&D. 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 (OECD, Paris 1992). Innovation is a process of interactive learning, characterised by continuos internal and external feedback's, which initiate steady changes to products, processes and services. Innovation is a socially and territorially embedded, interactive learning process, which cannot be understood independent of its institutional and cultural context (Lundvall, 1992). Innovation and learning occur in various kinds of networks where different actors become involved, and where different kinds of knowledge are exchanged and exploited. 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, technical institutes, training bodies, etc.) (Cooke, Philip & Kevin Morgan, 1994). These networks may extend from local/regional to international and global space.

The interactive innovation model has been given an explicit geographical context. Attention has been drawn towards *national systems of innovation* (Edquist, C., 1997) and *regional systems of innovation* (Braczyk, H-J, Cooke and Heidenreich eds., 1998). The essential argument of these studies is that innovation is more frequent, and is more apt to be successful, when innovation and learning processes are locally embedded (Asheim, B., 1994, Asheim, B. and Isaksen, A. 1996). "A growing attention has been given to perspectives and strategies that can secure the innovative capability of regions in order to foster regional future of endogenous growth, making the learning capacity of the regional economy of strategic importance to its innovation and competitiveness" (Asheim, 1999). The existence of innovative, learning intensive firms secures and strengthens national competitiveness.

The importance of tacit knowledge is often emphasised when discussing localised learning, "…tacit knowledge is still a key element in the appropriation and effective use of knowledge, especially when the whole innovation process is accelerating" (Lundvall and Borras 1999, 33). Codified knowledge, e.g. embedded in standardised technologies, can be transferred over long distances at low cost; spatial proximity between users and producers is not necessary. Tacit knowledge, however, is only transferable through interpersonal contacts and verbal or non-verbal communication (Arnold & Thuriaux, 1997, 25; Foray & Lundvall 1996, 21). Spatial, social, and cultural proximity is a major precondition for the transfer of tacit knowledge. However, local production systems would face problems if they lack strategic, goal oriented actions and strategies, which, basically, has to be supported by codified knowledge (e.g. formal R&D)(Amin and Cohendet 1999). Localised learning must be build on strategic use of codified, R&D-

based knowledge in addition to tacit knowledge. Firms cannot rely on localised learning in the long run. Since innovation relies strongly on interaction and the ability to interact (Rothwell, 1994), above average innovation activity not only depends on the amount on co-operative relationships and learning capabilities, but is itself an indicator for utilising network interactions. Since the propensity for knowledge-spillovers (Jaffe *et al.*, 1993; Feldman & Florida, 1994) and for finding network partners is higher in central, metropolitan regions, innovative firms are not equally distributed geographically, but expected to be located mostly in urban regions (Isard, 1956; Armstrong & Taylor, 1993). Two reasons why geographic factors might explain differences in innovative behaviour among firms are localisation economies and urbanisation economies (Chinitz, 1961; Hoover, 1971; Isard, Schooler, and Vietorisz, 1959), where localisation economies refer to externalities associated with the presence in a place of a mass of other products in the same sector. Urbanisation economies is found where there is a diverse industrial base, extensive infrastructure and services supporting it, and a concentration of institutions that generate new knowledge. These sources can contribute to innovation in a metropolitan area.

3. The Oslo-region

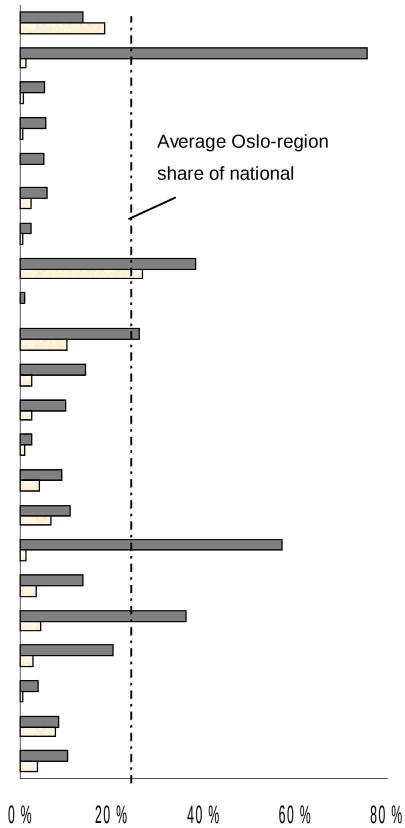
3.1 Employment and business activity

The Oslo-region account for ¼ of all Norwegian employment, in all 440.000 employees. The region is a dominant national service centre. Private services represent almost half of all employment in the region, while almost 1/3 employed in the public sector. Employment in private and public services represented in 1996 as much as 80% of total employment in the region. Large parts of important national manufacturing industries, is however also located in the region.

Figure 1. 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. Source: 'The Norwegian firm and enterprise register'.

Industry	Employment	NACE
Food Products and Beverages	7433	15
Tobacco Products	431	16
Textiles	269	17
Clothing	163	18
Leather; Luggage, Handbags, Saddlers, 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 NEC	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 NEC	1465	36
SUM	40.540	

Share of manufacturing employment in the Oslo-region (bright floaters) and share of national employment in industry (dark floaters), (not comparable sizes)



Employment in manufacturing industry represents about 10 % of all employment in the region. Manufacturing in the Oslo-region represents only 14 % of national employment in manufacturing industries. The largest manufacturing industries are printing and publishing (30 % of all employment in manufacturing industries), food and beverages (20 %) and chemicals (10 %) (bright floaters). The figure 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 % of national employment. The table shows that there are five industries that have a larger share of national employment than this 24 % average. These industries are tobacco (76 %), office machinery and computers (57 %), publishing and printing (38 %), radio and television (36 %) and chemicals (26 %).

There has been a decline in new firm formation[6] the last four years. Despite this decline, the share of new registered firms in 1998 is higher in the Oslo-region than in any other counties in the country. In Oslo there are 14.6 % new registrations pr 100 enterprises, the share for Akershus is 12.5 %, the average is 9.4%. New registrations can present important contributions to innovation in a region; the high numbers for the Oslo-region do suggest a dynamic region. It has been established fewer firms last year compared to earlier years, but at the same time the number of close-ups have decreased. From the early 1990's until 1998, the share of close-ups 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.

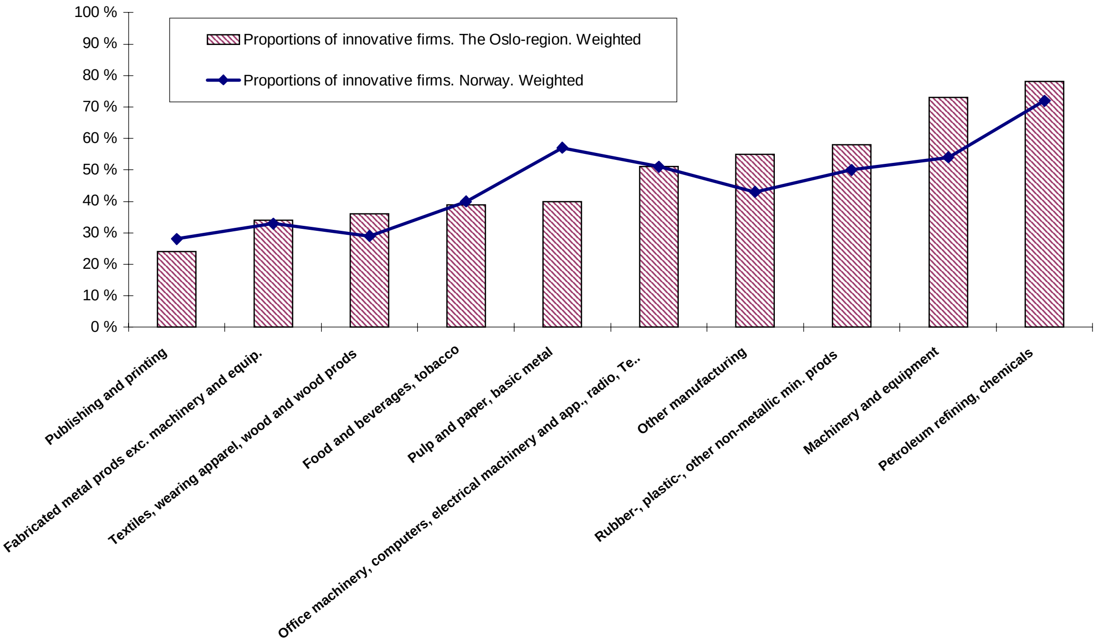
In terms of competence, what mainly characterises Oslo is that the city has a more than proportional share in all higher education groups, with 43% of the persons with the highest level of education (more than four years, ISCED level 7[7]). This is an expected consequence of being the capital, of having both Central government, county and municipal administration. Oslo supports a major 'knowledge infrastructure' in the form of research institutes, universities, science parks and consulting firms. We estimate approximately 75 non-university research institutes in all fields, 3 science parks, and 20 higher education institutions with approximately 60,000 students. The technological and R&D capabilities of the research institute sector cover the whole range of relevant technologies for the region's production structure. Oslo Research Park currently has 49 firms, of which 60% are in the fields of IT and media, with the remainder spread between biotechnology, materials, pharmaceuticals and consultancy. The Science Park at Kjeller has major capabilities in energy and environmental technologies, aerospace, telecommunications and IT (especially satellite communications) and industrial mathematics applications. The Science Park at Ås has specialisation in agriculture, aquaculture, environmental sciences, and forestry and food sciences. Finally the region has a wide range of venture capital institutions, consultancy firms and technology transfer institutions.

4. Innovation activity and innovation collaboration

4.1 Innovation activity

In this chapter we focus on the extent of innovative activity of firms located in the Oslo-region, compared to the average Norwegian firm. We look at the proportion of firms that have innovation activity[8]. Our hypothesis is that firms in the Oslo-region are more innovative than the average Norwegian firms. The reason is the proximity and density of a mass of other producers, and knowledge providers located in the Oslo-region, which we expect would have a positive effect on the circulation of information and relevant knowledge to firms.

Figure 2. Proportion of innovative firms in the Oslo-region and in Norway. Manufacturing industry. Weighted numbers. (N=312, 1976). Source: 'Norwegian Community Innovation Survey'



The weighted[9] proportion of innovative manufacturing firms in the Oslo-region is 40%, the same as the average for Norway. There are large differences between industries concerning the share of firms taking part in innovation activity. 'Petroleum refining and chemical industry' has the highest proportion of innovative firms, followed by 'Machinery and equipment' and 'Rubber, plastics, 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, suggesting these industries to be integrated into systems of innovation. Industries with low proportions of innovative firms are ‘Publishing and printing’, ‘Fabricated metal products’ and ‘Food and beverages, tobacco’ (24%, 34% and 39%). Important to note is that ‘Publishing and printing’ and ‘Food and beverages, tobacco’ are the dominating industries in the region, reducing the average innovation performance of the region. This does underline that the innovation performance of a region is much dependent on the industry structure. ‘Publishing and printing’ is also defined to be a ‘cluster’. Externalities associated to the presence of a mass of other producers in the same sector, seems to have little effect on this industries` innovation performance, suggesting industries with an unused potential.

We use number of employees as a measure of firm size and have categorised the sample into 4 size groups; 10-49 employees, 50-99 employees, 100-249 employees, and more than 250 employees. The table below gives the sample numbers and the shares of innovators.

Table 1. Proportion of innovative firms by size. Manufacturing sector in the Oslo-region and in Norway. Weighted proportions. (N=312, 1976). Source: ‘Norwegian Community Innovation Survey’

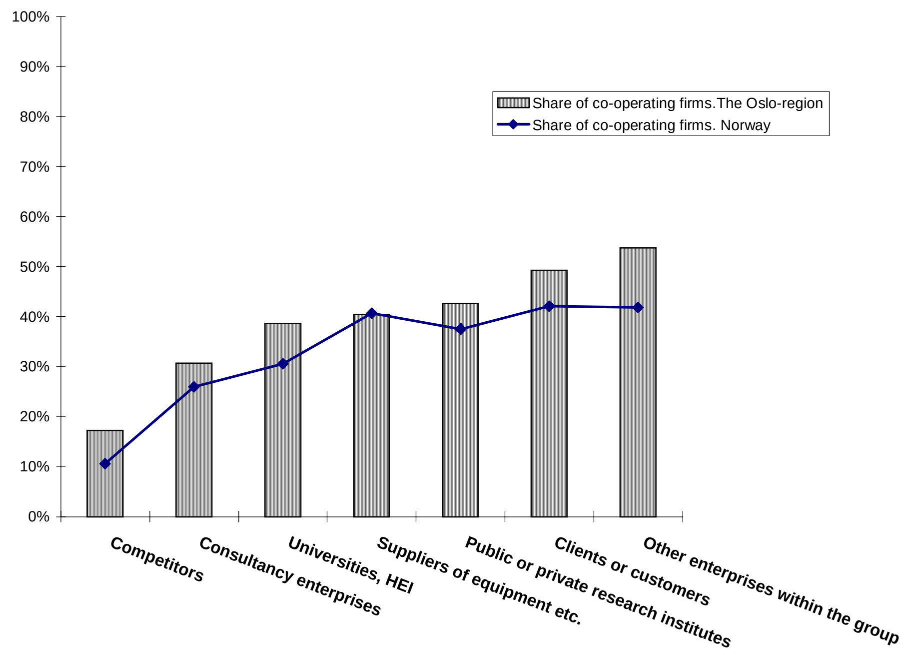
Size groups	Number of firms in the sample. Oslo-region	Share of innovative firms in the Oslo-region. Weighted	Number of firms in the sample. Norway	Share of innovative firms in Norway. Weighted
10-49	175	31%	1188	33%
50-99	41	47%	317	54%
100-249	52	69%	306	65%
250+	44	82%	165	79%
Total	312	40%	1976	40%

The table shows that there is a clear relationship between firm size and the number of firms 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%. The Oslo-region has a lower share of SMEs innovating (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 however, slightly higher for the Oslo-region than the average in Norway.

4.2 Innovation collaboration

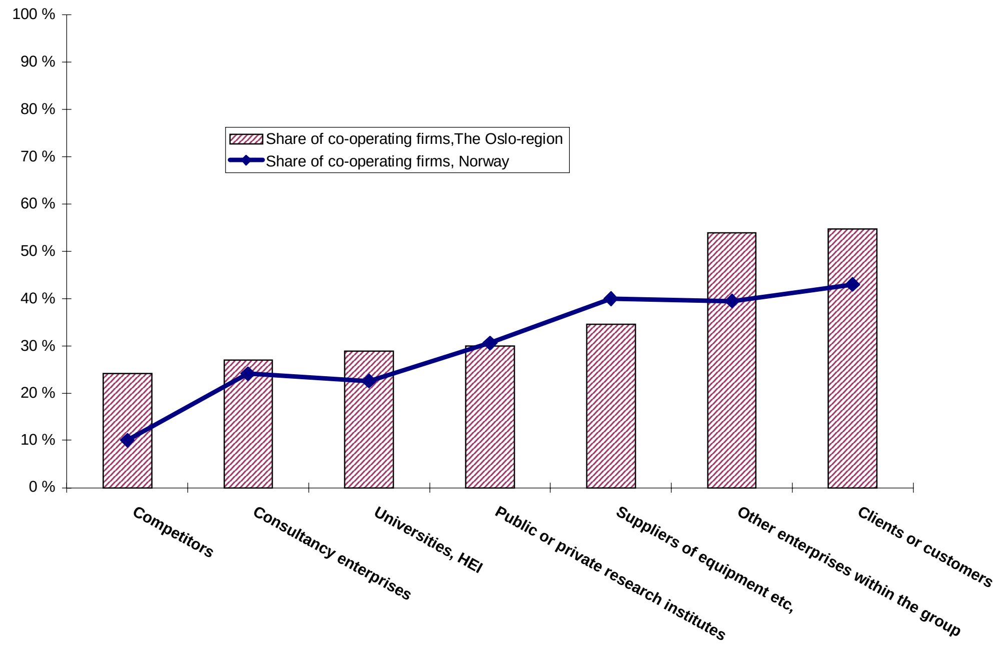
In this section we will look more closely at firms' collaboration with other partners in the innovation process. This will give us an insight into which actors in the innovation system firms have formal contact with.[10]

Figure 3. Share of firms with different domestic **collaboration partners in the Oslo-region and in Norway. Manufacturing industry. Weighted shares. (N=82, 473). Source: 'Norwegian Community Innovation Survey'**



Innovating firms in the Oslo-region have a higher share of firms collaborating with all types of partners when compared to the average for Norway. This might suggest that being located in a city-area, with the presence of other producers, extensive infrastructure and the concentration of knowledge providers, do have an effect on firms' networks. 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. What external partners do firms use in the innovation process? For the Oslo-region, 49% of innovative firms with innovation collaboration have 'Clients or customers' as partners, close to 40% collaborate with suppliers. Partners within the value chain are important in the innovation process. In addition, 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). The average shares of firms in the Oslo-region using these milieus are slightly higher than the average for Norway. This finding do support the hypothesis that proximity to such institutions do enhance linkages, suggesting that being located in a city-area do also have an effect on the interaction with the knowledge community.

Figure 4. Share of SMEs with different domestic **collaboration partners in the Oslo-region and in Norway. Manufacturing industry. Weighted shares. (N=33, 240). Source: 'Norwegian Community Innovation Survey'**



SMEs in general have a lower share of firms taking part in innovation collaboration with almost all categories of partners (compared to the average shown in Figure 3), except with 'Clients and customers' and 'Other enterprises within the enterprise group'. For SMEs, clients and customer linkages seems to be more prevalent than any other form of linkages. It is in the use of 'Clients and customers' and 'Other enterprises within the enterprise group' one finds the greatest difference between SMEs located in the Oslo-region and the average for SMEs in the country. This suggest that being located in an city area do have an effect on the share of SMEs collaborating with partners that go into their vertical network.

All other partner categories (besides clients and customers) are much less used by SMEs than by larger firms, suggesting that SMEs do not have such complex networks as larger firms. The proportion of *SMEs* having innovation collaboration with the scientific community is reduced with ca. 10 % points compared to the average for all firm sizes (shown in Figure 3). The Oslo-region has the same share of SMEs collaborating with research institutions as the average for Norway, suggesting that proximity to these institutions have little effect on enhancing linkages and that the innovation potential of the scientific infrastructure has not been fully utilised in the region. The figure also shows that Consultancy enterprises are relevant partners for only a low share of SMEs. We do find this surprising, seen in the context of the 'thick' institutional tissue of the region. This suggest that there is an innovation potential in linking SMEs to a larger part of the innovation system, and there are obviously elements of the innovation system that are missing for SMEs. SMEs often have few internal resources and therefore have a greater need for networking, but seem to have more barriers to networking.

4.3 Summing up findings on innovation and collaboration

Findings from the innovation survey have shown that firms in the Oslo-region have a lower share of firms taking part in innovation activity than the average for the country. Some of the explanation is to be found in the industry structure of the region. The largest share of manufacturing firms in the region belongs to industries that have low shares of innovators. The innovation survey also showed that SMEs in the Oslo-region have a lower share of innovators, than the average for SMEs in the country as a whole. However, being located in a city area is expected to have some effect on firms networking, and thereof learning and innovation. In terms of innovation collaboration, being located in a city area do have some effect on both the share of firms taking part in innovation collaboration and what kinds of linkages they engage in. Our findings suggest that larger firms are better to identify relevant partners (Kaufmann & Tödling, 1999), than SMEs. Larger firms, to a larger degree than SMEs, take part in systemic innovation, besides being located in a city area seems to have an effect of the share of firms taking part in the innovation system.

However, localisation does have an effect on SMEs networks too, but not on all types of networks. Clients and customer linkages (vertical linkages) seems to be more prevalent than any other form of linkages, a result that support the role of producer-customer relationships for innovation processes in SMEs (Sternberg, 1999). These kinds of collaboration are often related to more incremental innovations (step-by step) (Håkansson, 1994, 41), as opposed to radical innovations. Customer oriented networks is not sufficient for firms to be innovative, studies have found that less innovative firms are mainly engaged in intraregional customer oriented networks (Koschatzky, 1999). For SMEs, localisation have an effect on their vertical innovation linkages, but little effect on the horizontal innovation linkages (HEI, Research institutes, Consultancy firms etc). To make SMEs reach the innovation average as the rest of the country it seems like it is especially the horizontal linkage that needs to be strengthened. Innovation collaboration with partners in the horizontal dimension is more likely to lead to leap-wise changes (i.e. radical innovations), and it is also argued that "the upgrading of the partners increases the efficiency of the whole network" (Leborgne and Lipietz 1992, 399). Our findings show that the presence of certain actors in the region is not a sufficient condition for generating interactions between them, especially not for SMEs. In other words, spatial embeddedness is anything but automatic.

5. Barriers to the regional innovation system

The main focus in this chapter is on what seems to be the greatest barriers to the formation of an innovation system in the region, namely the barriers between SMEs and the scientific community. The chapter will look into the reasons for the insufficient spatial interaction between SMEs and the scientific community, and further look into SMEs barriers of networking and of being susceptible to external influences. It is based on findings from five industrial studies performed for the RITTS Oslo project.

5.1 Lack of long-term strategic thinking on innovation in SMEs

Relatively few SMEs use the scientific infrastructure when innovating. One of the explanations for this found in these industry studies was the lack of long-term strategic thinking on innovation activities. Innovation activities in SMEs often take place as immediate response to customer's demands, making the innovation process ad-hoc and unsystematic. There is an orientation towards "demand-pull" instead of "supply push". In many ways this seems to 'prevent' firms from the more long-term thinking on innovation, which might include horizontal partners into firms' networks. For example, the cultural and institutional environment of most printing and publishing companies in the Oslo-region is based on customer contact and “making a living on a day-to-day basis”. This is reflected by the fact that most of the companies interviewed could not see any obvious benefit in having contact with educational or research institutions.

Reasons for not being able to engage in long-term thinking on innovation are often linked to SMEs general lack of resources. For example, in the food industry (according to the company interviews), the small food companies are marked by problems as low levels of formal skills within the workforce, high work pressure (“few people get old in this industry”, said one interviewee), low technological capability compared with the large companies, and low capital resources. Accordingly, few of these companies will find it fruitful - or even find the time - to participate in long term strategic thinking on innovation. Also in the machinery and equipment industry, innovative firms have a need for ongoing R&D that is not market-led. One of the hampering factors is that firms have great problems with getting finance for this kind of activity. This is not helped by the heterogeneity of firms in the region. These independent actors have little power to ‘lobby’ for R&D schemes that are relevant to the industry.

Other factors preventing SMEs from strategic innovation projects might be linked to the structure of an industry. For example, family-owned companies with a high degree of embedded tradition and routine that constrains their capacity for change, can be a hampering factor. The graphics industry in the region is dominated by such a structure. The companies are also very small. The strategic development of new products is not on the agenda, and is certainly not pursued systematically. As one interviewee said: ” A company with 4-5 employees does not have time to develop an innovation. The companies that innovate are either large, or they have started up on a good idea”. This tends to make innovation an incremental process, this usually means finding new ways to co-ordinate and combine different skills in the production process.

5.2 The mismatch between ‘supply’ and ‘demand’

In our studies, we find that collaboration problems with the scientific infrastructure are significant, so does other studies (i.e. Koschatzky, 1998). The problems have their roots both in a lack of “cultural match”, and in a lack of “competence match”. As we saw from the survey, it does not seem that the competence and cultural mismatch can be compensated by proximity.

In firms, as well as in research milieus, many competent people are defensive with respect to outsiders, and displays what appears to be over-confidence with respect to the power of their own internal competence base. They find it hard to develop the mutual understanding, the communication and the commitment that is necessary for fruitful collaboration. Their problem context, their motivations and values are diverse, and they operate in institutions and organisations that work differently and are faced with diverging functional requirements. In many ways they live in entirely *"different worlds"*. Small firms find that the cultural divide between themselves and researchers in institutes and universities is an insurmountable barrier to constructive collaboration. One aspect of this is that researchers tend not to understand how important specific research objectives are for the future of the firm. For example in the machinery and equipment sector in the Oslo-region the knowledge-supplying institutions that provide R&D often specialise in the most sophisticated techniques. R&D institutions are often directed towards technologically sophisticated and financially strong firms, and this network of relationships seems to function well. Small firms appear to be somewhat left out of these innovation networks, and feel that their *R&D needs are not taken seriously*.

Many firms focus on the importance of keeping within the project budget and time-constraints in R&D collaborations. These are factors that are a sine-qua-non for the survival of firms. Among SMEs in the Oslo-region, the university is considered a very difficult partner for industrial firms, also large ones, because the university administratively functions as a slow moving, and at times incomprehensible, bureaucracy ("lack of professionalism"). SMEs need to relate to supply side actors who understand that *time is a scarce resource.*

The industry studies showed that firms apparently do not find that neither institutions in higher education nor non-profit research institutes are easy to access or easy to build profitable partnerships with. Small firms find it very *hard to orient themselves in what is going on* in public institutions, and in what way public institutions are doing efforts that are intended to be helpful for them. Further, many companies are *unable to formulate their technological needs.*

Business increasingly depends on specialised knowledge. It is often impossible to find the most advanced knowledge relevant for a specific business application in local research institutions. Also, the quality of existing competence varies. A firm requiring the absolute best competence on a specific field in order to be competitive, may find that the available Norwegian resources are inferior in quality to resources available abroad. This means that it is important to link SMEs onto national and international innovation systems. In graphics, one reason why regional institutions with knowledge in the area of IT often do not play a role in the knowledge infrastructure of individual companies is that the Norwegian institutions cannot compete in the supply of information in these areas. For electronics firms, leading competence may be found in the US, and the cultural divides do not appear to represent serious problems. In this case, the geographical distance, time differences and travel costs, however, do represent significant obstacles.

An analysis made of the R&D institutions in the Oslo-region[11] concludes that much of the research carried out in the Oslo-region is of high international standard. However, the *research institutes perceive themselves as national and not regional actors.* They see their role as at least national and with international linkages. The consequence of this is that their location is often of little significance, and the notion of developing local and regional linkages in not perceived as important. In the food industry the experience is that the food research environments in the Oslo-region are poorly adapted to local food industry's activities. Most research is centred on raw materials handling, while the bulk of the region's actual industrial activity is in beverages and pastry/miscellaneous products.

Competence building does not only happen through networking with external actors. A prerequisite for being able to network externally is that you have the *sufficient competence internally*. The fundamental competence base developed over time by firm is at the core of successful operations, and the ongoing learning and development inside firms can never be substituted with *infusions* from external competence centres. The matching of education and business needs for educated people appears to be a big problem in the Oslo-region. There are mismatches between what firms` need in terms of educated people and what the educational institutions actually are offering. This is seen as an important hampering factor for firms` competitiveness. The graphical industry, for example, is in a period of change where traditional and digital processes are merging, but it is hard to find people combining both these skills. IT is also increasingly important for producers of machinery, and the industry has problems in attracting skilled people. In the machinery and equipment industry they work to be able to attract young educated people, particularly students with a background in engineering.

6. Summing up and policy suggestions

This paper has showed that there are obstacles to the formation of a regional innovation system of SMEs in the region of Oslo. There is a potential for the average innovation activity in the region by integrating SMEs into the regional and national system of innovation. There is a need for both SMEs and the regional innovation system to be able to apply a more interactive approach. The knowledge infrastructure in the Oslo-region must be made more accessible and responsive to the individual collective needs of SMEs located there in order for SMEs to be able to acquire formally codified knowledge available from the regional or even the national innovation systems. Regional innovation strategies should aim at supporting and exploiting the knowledge capacity of innovative firms for regional development by a stronger integration of these companies into regional networking and value chains (Koschatzky, 1999). In this way these innovation systems, originally based according to the linear model, would become more accessible and responsive to individual and collective needs of international competitive SMEs.

It is clear that any integrated approach to knowledge infrastructure will require organisational innovation within the public sector itself (Smith 1997). In Norway it has developed a regional policy that support economic development of regions *outside* the Oslo-region. The policies of the Trade and Industry Ministry and the Research Council contain no special policies to exploit the knowledge bases of the region above others, and appear unwilling to build on areas of the regions comparative advantage. This seems to have resulted in a failure to capitalise on the full potential of the Oslo-region (Stage 1 report. RITTS Oslo).

In our analysis we found that SMEs in the Oslo-region need help to be fully integrated into the regional innovation system. The main findings are given in 5 points:

1) SMEs find that there is a lack of transparency in the scientific community in the region that makes it hard for them to approach the scientific communities with their needs. Efforts should be made so that one organisation in the region has the responsibility to generate and distribute full information on what the 'supply side' in the region actually can offer, 'a one stop shop'.

2) Technology transfer programmes between R&D milieus and firms should have *firms' needs* for problem solving in focus. It is important to improve the manner, and the extent to which, institutions work with companies. SMEs collaborating with regional, research institutions use the institutions in other ways than larger firms. SMEs tend to have low profile contacts; i.e. utilisation of apparatuses and laboratories as well as diploma theses (Sternberg, 1999) as opposed to formal R&D projects. For research institutes to take part in these kinds of collaborations, means must be given to researchers to make such collaboration feasible for the institutions.

3) Regional innovation policy should improve the information base for establishments in central regions about potential collaboration partners located in the vicinity of the own firm (Koschatzky, 1999). The explicit formation of networks or meeting places would be an important way of making firms aware *of other firms in the region*, and of establishing personal networks. Case studies from urban regions (e.g. Schmidt *et al.*, 1996) show that innovative firms also lack this kind of information and co-operation over longer distances although the same qualifications could be assessed just 'around the corner'. Linking together similar industries, could give industries power to 'lobby' for R&D schemes that are relevant to the industry. One of the greatest hampering factors for SMEs to engage in R&D activity is the lack of finance for this kind of activity.

4) Efforts should be made to make actors in the same sectors in the region come together and discuss their actual need for competence. Networks between the educational institutions in the region and manufacturing industry should be established. A competence building by relocating academically trained workers to SMEs is

important for the formation of networks with universities and other knowledge institutions.

5) A very important activity for firms to engage in is employees training. Firms are constantly required to relate to new information, new technology and enhanced quality requirements. This leads to strong training needs. Employees training courses that are offered in the region must have a reasonable price and need to be short. Institutions offering such courses should also have the ambition, autonomy and financial ability to quickly respond to firms' demands.

Endnotes

[1] In Norway small firms are defined to have from 0-19 employees, and medium sized firms have between 20 and 99 employees. Since the Norwegian Innovation Survey do not include firms with less than 10 employees, SMEs in this paper is defined as firms having between 10-99 employees.

[2] 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. The 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.

[3] The industry studies were all self contained and relatively independent analyses. The different studies were carried through in parallel, and the authors' ambition was to make studies that would be comparable in scope and which would be complementary with respect to choice of industry, but containing much common analytical substance. The industry analyses are based on three main sources: First, a range of in-depth interviews with people in the industries (managers, market directors, researchers and operators), in unions and other organisations working in the Oslo-region, and from institutions in research and higher education in the area. Second, information has been gathered through the screening of research publications, annual reports, web-sites, etc. Third, information on the industries, on employment, innovation patterns and technological collaboration, etc. has been obtained from a number of data-sets, some of which are maintained by STEP.

[4] The procedure used to identify potential regional clusters builds on the following three criteria: The identified regional clusters consist of labour-market regions, and Norway is divided into 103 such regions. The labour-market regions must be specialised in at least one of 39 industrial sectors, i.e. the location quotient for a sector is greater than 3.0. This means that an industry must have at least three times as many jobs in the region as 'expected', based on the industry's significance on a national scale[4].
The 'specialised' sector must include at least 200 jobs and 10 firms in a region; we set this limit so as not to include many very small clusters.

[5] The project was initiated by Oslo and Akershus Business Council in 1998, with financial support from the Commission of the European Union.

[6] The data is based on the Directorate of Taxes' VAT register, which registers and de-registers firms.

[7] International Standard Classification of Education (ISCED).

[8] Manufacturing firms were firstly asked if they had, during the period 1995-97, introduced technologically new or improved *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. <u>If the firms answered positively to any of these three cases, it was classified as innovative</u>.

[9] 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 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.

[10] 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.

[11] The 'supply side' analysis of the "RITTS Oslo-Stage 1 report". was carried out by three international consultants; Bruce Reed, Bob Hodgson and Michel Lacave.

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